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ORIGINAL PAPER

Riding on the wave of digitization: insights how and under what settings dynamic capabilities facilitate digital-driven business model change

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Abstract

Little is known what facilitates business model change in response to turbulent environments, particularly how firms can respond to digitization. This is noteworthy, since the emergence of digital technologies opens up the space for new business opportunities and at the same time creates numerous challenges. Motivated by the high practical relevance of the topic and following recent calls for investigating business model change from a dynamic capability lens, we show how and under what conditions firms successfully develop and implement digital business models. Our findings indicate, that firms need strong dynamic capabilities in order to respond to environmental dynamics. Further, we show first empirical insights about the role of organizational context as moderating variable on the relationship between dynamic capabilities and business model change. Dynamic capabilities are only effective, if there is an alignment between strategy, organizational design and appropriate leadership mindset. A further central outcome of the study is our contribution to an in-depth understanding related to the dynamic capability construct and their underlying mechanism. In doing so, we map overall 13 critical capabilities and various activities per case. We were also able to emphasize differences in the way of doing business in the digital age compared to the traditional view. First, we highlight the importance of relational capabilities. Internal networking, cross-divisional exchange and external partnerships increase the potential for a more efficient and effective implementation of digitization initiatives. Second, we distinguish between general and new digital capabilities. This specification allows managers to balance which capabilities to adapt, develop or build up in view of the given requirements on their road to successful digitization.

Keywords Business model change · Business model innovation · Business model adaptation · Dynamic capabilities · Response to digitization · Environmental turbulence · Organizational design · Strategy

JEL Classification M10 · M19

1 Introduction

There is broad consensus that digitization is fundamentally transforming the organizational and strategic context of firms. Oswald and Kleinemeier (2017) even go a step ahead and set up the provocative thesis "digitalize it or die". Following their argumentation, digitization is not seen as an option, but rather than an imperative. From a strategic perspective, digital technologies facilitate changes in the process of strategy-making and implementation (Dobusch and Kapeller 2017), change the content of strategy (McIntyre and Srinivasan 2017) and determine the context for strategic change in that way that firms need to change their business models in order to stay competitive in the digital economy (Khanagha et al. 2014). Thus, digitalize it or not, is not anymore the core question. It is much more about to what extent and how to cope with the new challenges. But, because of path dependencies, lack of sensitivity and experience, high uncertainty and a "knowledge-doing-gap" most companies struggle to respond to digital disruption. According to Bradley et al. (2015) only 25% of firms describe their response as proactive, while 43% have not addressed the risk of digital disruption sufficiently and nearly a third are taking the "wait and see" approach in order to emulate successful companies and replicate their business models. Due to the fact that business acting is not characterized by "endless reaction speed" (Voigt 2008), firms therefore have to adapt co-evolutionary to changing environment, otherwise it would create destabilizing changes in current business position or even lead to an erosion of the competitiveness. Not least, from strategic management we know that the timely perception and interpretation of business opportunities and threats as well as making appropriate decisions at the right time are the sine qua non of doing business.

Thus, understanding how and under what conditions firms in the digital-driven economy can create and capture value is of high priority and still unanswered question. In current research, dynamic capabilities (DCs) are discussed as an appropriate theory in explaining how firms can response, when they are confronted with uncertainty and turbulent environment. According to Teece (2007), DCs are "the ability of an organization and its management to integrate, build, and reconfigure internal and external competences to address rapidly changing environments". It is assumed that doing business in turbulent environments requires more than the traditional focusing on core competencies and the ownership of unique assets. To sustain long-term competitiveness it also requires difficult-to-replicate capabilities. Yet, while the relevance of DCs is well recognized, little is known about the mechanism of how to reconfigure and build resources and change routines towards innovation. As a consequence, several authors are calling for more in depth research, investigating the critical capabilities (CCs), activities and processes of DCs (Achtenhagen et al. 2013; Burisch and Wohlgemuth 2016; Fallon-Byrne and Harney 2017). Furthermore, since capabilities are becoming more significant for business model innovation as response to the current challenging landscape, some researcher (Mezger 2014; Fallon-Byrne and Harney 2017; Teece 2018; Foss and Saebi 2018) have already made efforts to conceptually link business model change and DCs. Further calls for research, particularly from prominent management journals (e.g. Long

Range Planning), underpin the thematic significance and claim for more theoretical and empirical insights linking DCs and business model research (Teece 2018; Foss and Saebi 2018).

Given the practical and scholarly relevance of this topic, this study investigates how firms develop and implement digital business models from a dynamic capability lens. Based on a multiple case study approach of eight leading German firms from different industries, we map (1) which (digital) capabilities and activities are essential for business model change, (2) how incumbents build capabilities in order to respond to digital disruption and what are the crucial steps and processes in doing so and (3) what are the fundamental determinants and challenges in building DCs.

The contribution of this study is threefold. First, we outline the relevance of DCs as a facilitator of business model change. Second, in contrast to previous work, we provide a more comprehensive view, considering not only the core microfoundations of DCs and related activities, but also the contingency between business model change, DCs and organizational context. Third, identifying core capabilities, correlated activities and processes we further contribute not only to a better understanding of the mechanism behind DCs, but also give useful managerial insights for firms on their road to digitization.

In order to shed new lights to the link between DCs, business model change, its microfoundations and the related determinants, our paper follows this structure: After the introducing section, we provide an overview related to the theoretical foundations of the two research fields DCs and business model change as well as their theoretical interconnection. Based on this, in Sect. 3 we present our conceptual framework including the underlying research questions. Section 4 illustrates our research design and fundamental methodological aspects, followed by a brief case description in Sect. 5. The sixth and seventh section is finally dedicated to the study results. More specifically in a first step we highlight the relevance of DCs as a facilitator of business model change, presenting the CCs and activities for each DC dimension (sensing, seizing and transforming). In a second step we investigate the underlying contextual factors, e.g. the role of strategy and organizational design as well as leadership. The paper closes with a discussion and summary of our contributions to theory and practice, along with limitations of the study and call for further research.

2 Theoretical background

2.1 Critical assessment of past and current research on business model research

When studying scientific output from different research fields, e.g. strategy (Casadesus-Masanell and Zhu 2013; Teece 2010), technology and innovation management (Massa and Tucci 2014; Tripsas and Gavetti 2000; Chesbrough and Rosenbloom 2002), entrepreneurship (Zott and Amit 2007; George and Bock 2017), environmental sustainability (London and Hart 2004; Schaltegger et al. 2012), one comes up immediately. The business model concept emerged as a prominent and influencing research stream in literature, but also one of the less understood with

several blind spots. As Teece (2010) stated, the concept is mentioned frequently, seldom analyzed and poorly understood. Nevertheless, the still ongoing discourse reflects the high significance of the concept as an interdisciplinary topic and important unit of research analysis in management literature. Massa and Tucci (2014) interpret the meaning and function of business models as an attribute of a firm, cognitive/linguistic schemas and formal conceptualization describing the activities and sets of a firm. Several scholars underpin the importance of business models as an antecedent for competitiveness (Markides and Charitou 2004; Giesen et al. 2007; Zott and Amit 2007), firm performance (Chesbrough and Rosenbloom 2002) and source of innovation (Zott et al. 2011; Casadesus-Masanell and Zhu 2013; Massa and Tucci 2014).

In addition to this rather static view of business models, an increasingly dynamic and transformational approach to business models has also taken place in recent years, which focuses on the changes in business models (Demil and Lecocq 2010). In general, business model change is defined "(…) as the process by which management actively alters the intra-organizational and/or extra-organizational systems of activities and relations of the business model in response to changing environmental conditions." (Foss and Saebi 2015, p. 148).

According to the common classification of Foss and Saebi (2017), literature on business model change can be classified into four main research streams. The first one includes studies offering concepts and definitions in order to identify the meanings, understandings and dimensions of business model dynamics (Foss and Saebi 2017). Whereas several authors generate frameworks or dynamic conceptualizations of business model changes (e.g. Cavalcante et al. 2011; Voelpel et al. 2004), others conduct literature reviews based on prior research (e.g., Foss and Saebi 2017). Secondly, some articles focus upon dynamic, organizational processes induced by changing business models (Foss and Saebi 2017). Thereby, several authors address factors referred to as drivers (e.g. Aspara et al. 2013; Giesen et al. 2010; Demil and Lecocq 2010; Winterhalter et al. 2017), facilitators (e.g. Andries and Debackere 2013; Hock et al. 2016; Mezger 2014; Velu 2017) or barriers (e.g. Markides 2013; Eichen et al. 2015; Koen et al. 2010) of business model changes. The third research stream emphasizes new or innovative business models as the outcome of changes in specific companies, industries, or markets (Foss and Saebi 2017). For example, certain studies concentrate on large corporations (Winterhalter et al. 2017) or alliances (Bouncken and Fredrich 2016), another paper focuses on business model adaptations for emerging markets (see Landau et al. 2016). The last stream contains publications regarding performance implications and consequences of business model dynamics (Foss and Saebi 2017). Here, positive impacts on firm performance (Cucculelli and Bettinelli 2015; Lambert and Davidson 2013), financial performance implications (Aspara et al. 2010) as well as consequences of business model innovation (Casadesus-Masanell and Zhu 2013) are considered.

Despite the growing body of literature in the last two decades, the publication rate referring to business model change is still at a very low level compared to the business model literature. Reviewing past and current literature it becomes clear that research is fragmented, rudimentary, and characterized by several shortcomings. First, due to inconsistencies in the definition and measurement of the business

model construct, research on business model change is consequently constrained by a lack of construct clarity in terms of nature and understanding of the business model change construct, which makes measurement and operationalization difficult. Similarly there is a lack of a clearly dimensioning in terms of the degree of novelty and scope of business model innovation (Foss and Saebi 2017). The second stream of criticism is related to the insufficient empirical work to antecedents, mechanism, outcomes as well contingency and moderating variables of business model change (Schneider and Spieth 2013; Wirtz et al. 2016; Foss and Saebi 2017).

Although changes in business models are recognized as an important driver of innovation and a key strategic response to environmental dynamism, engaging in this context represents still a complex and difficult managerial task due to a variety of cognitive and organizational barriers, inertia and path dependencies (Chesbrough 2010; Doz and Kosonen 2010). Despite the considerable progress of scholars emphasizing for example the role of different organizational capabilities and processes (Achtenhagen et al. 2013; Mezger 2014; Demil and Lecocq 2010), leadership (Doz and Kosonen 2010), experimentation and learning mechanism for enhancing business model innovation success (Euchner and Ganguly 2014; Sosna et al. 2010; Cavalcante 2014; Andries and Debackere 2013), current research is still missing deeper insights related to the question what motivates, facilitates or hinders firms in adapting or innovating business models (Schneider and Spieth 2013; Mezger 2014; Foss and Saebi 2017). Moreover, the authors indicate that research to date have not attend sufficient empirical attention in addressing internal factors influencing business model changes. Thereby, the limited knowledge about the question how firms can initiate, innovate and implement new business models is mainly affecting incumbent firms. Against the background that initial research was focused predominantly on new entrants and start-ups, literature still lacks knowledge how incumbents can systematically and successful engage in business model change (Schneider and Spieth 2013; Foss and Lyngsie 2014; Mezger 2014; Foss and Saebi 2017; Spieth et al. 2016)

Particularly, in the context of digitization, where a plethora of new business opportunities arise and established business models are threatened, little is known about how and under what conditions large and incumbent firms can cope with the emerging challenges triggered by environmental dynamism. Moreover, from practitioner view the question also arises whether there are differences compared to the traditional way of doing business and if so, to what extent? Anyway, research shows (Amit and Zott 2001; Voelpel et al. 2004; George and Bock 2017), that engaging in business model innovation, independently of scope, degree and context of change, requires organizations to adapt, renew, acquire or build new resources and competencies or even to re(combine) existing ones in different ways. Indeed, there is some empirical evidence, that core capabilities which are crucial for adapting and innovating business models are grounded in the theory of DCs. Reference is made to the specific capabilities such as (1) sensing opportunities and threats, (2) making timely and (3) market-oriented decisions as well as (4) reconfiguring organizational resource base, which are recognized as essential capabilities in response to environmental changes (Barreto 2010). Since this capabilities meets the "…core idea addressed in the concept of business model innovation" (Schneider and Spieth 2013

p.19), in recent years a young and promising research stream about the scholars e.g. Achtenhagen et al. (2013), Mezger (2014), Fallon-Byrne and Harney (2017), Foss and Saebi (2018), and Teece (2018) have emerged in order to conceptually and empirically link business model change and DCs.

2.2 Dynamic capabilities as an emerging explanatory approach for change

Research on DCs have emerged as a central research field within the strategic management literature (Gremme and Wohlgemuth 2017; Schilke et al. 2018), even faster than the related business model literature, which arose at the same period in the late 80es. The conceptual origins of the dynamic-capability view (DCV) lie in different theoretical approaches, such as the resource-based view (RBV) (Barney 1991), the core competency approach (Prahalad and Hamel 1990), the knowledge-based view (Grant 1996), evolutionary economics (Nelson and Winter 1982), behavioral decision theory (Cyert and March 1992) and transaction cost theory (Williamson 1985). Among these explanatory approaches, reference is made particularly to the RBV (Schilke et al. 2018; Wójcik 2015). From a RBV view, firms gain competitive advantage if they have valuable, rare, inimitable and non-substitutable resources (Barney 1991). However, the RBV is criticized for its static perspective as it does not take into account the dynamics of the business environment and neglects the necessary changes in the resource base and existing capabilities (Eisenhardt and Martin 2000; Priem and Butler 2001). Therefore, this static approach seems inappropriate to explain long-term differences between firms and sustainable success in dynamic environments (Sirmon et al. 2007, Barreto 2010), particularly triggered by digitization (Witt 2008). The DC approach breaks up this restrictive view and puts change in the focus.

Basically, the DC theory builds on the resourced-based perspective arguing that resources and capabilities are a fundamental factor of competitive success, but the earning power of a firm is seen as a function of ordinary capabilities and their adequacy to particular environment requirements. It is noted that firms with ordinary capabilities will achieve merely short-term returns, while without distinct capabilities the long-lasting competitive advantage will erode (Augier and Teece 2009). Only firms with distinct capabilities can adapt their resource base to constantly changing environmental conditions within a reasonable period of time and make sustainable use of the potential that results from these changes. Indeed, those capabilities are not available from factor markets, but rather the result of organizational learning processes and accumulation of experiences and routines (Teece et al. 1997; Eisenhardt and Martin 2000). This makes them distinct and difficult to replicate. Teece et al. (1997), p. 516 define DCs as a "firm's ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments. Dynamic capabilities thus reflect an organization's ability to achieve new and innovative forms of competitive advantage given path dependencies and market positions."

DCs can by conceptualized by different dimensions: processes (Teece 2007), degree of routines (Peteraf et al. 2013), function (Schilke 2014), hierarchy

(Heimeriks et al. 2012) and contextual level. The later one also includes individual capabilities, e.g. dynamic managerial capabilities (Adner and Helfat 2003). Nevertheless, according to Schilke et al. (2018) one of the most important dimensioning forms of DCs is the procedural typology by Teece (2007). Teece (2007) emphasize the three processes (1) sensing, (2) seizing, and (3) transformation as core elements of the DC construct, and describes the ability to (1) identify and (2) seize new business opportunities as well as (3) reconfiguring the resource base. Overall, DC are based on so called "microfundations", which are characterized by distinct skills, processes, procedures, organizational structure, decision-making rules and disciplines (Teece 2007). Basically, DCs are firm-specific, unique and non-imitable (Teece et al. 1997). Strong DCs enable effective orchestration of firm's resources and achieving long-term competitiveness (Teece 2007).

3 Relationship between business model change and dynamic capabilities

3.1 Relevance of the topic and need for deeper insights

Even DCV and business model change have become major and independent research streams in strategic management, both concepts are characterized with coherent research trends and overlapping research gaps, which is shown in more detail in the following section.

Despite the extensive research progress and still ongoing high attention in the academic world, the concept of DCs is still considered as a nascent research field with several blind spots (Schilke et al. 2018; Wilden et al. 2016; Wójcik 2015). Among others, criticism is related to the fact that there are still few empirical insights how DCs can be operationalized in practice and build by firms (Feiler and Teece 2014; Pavlou and El Sawy 2011; Schilke et al. 2018). Other authors are calling for more in depth research, investigating the CCs, activities and processes of DCs (Achtenhagen et al. 2013; Burisch and Wohlgemuth 2016; Fallon-Byrne and Harney 2017). This is a sobering observation, if considering that in current research, DCs are discussed as an appropriate and prominent theory in explaining how firms can respond, when they are confronted with uncertainty and turbulent environment.

Strongly linked with fast-changing environments is the growing interest to business model research. In literature, business model change is recognized as an essential response mechanism to environmental turbulence (Chesbrough 2010; Mitchell and Coles 2004, Schneider and Spieth 2013; Zott and Amit 2010). However, similarly to DCs, the research field of business model change remain as one of the most popular concept in current literature, but also one of the less understood (Foss and Saebi 2017). The expanding interest to the subject has led to an increasingly broad and confusing body of literature (Schneider and Spieth 2013), which finally resulted in a "theory jungle" with several unsolved research questions. Besides a plethora of definitions, conceptualizations and a lack of well-grounded theory (Bock et al. 2012; Foss and Saebi 2017), past and current

research is missing empirical studies, particularly quantitative studies (DaSilva and Turkman 2014; Hossain 2017).

Moreover, according to Hossain (2017) mainstream research focuses largely on few dominant topics, e.g. strategy, innovation, experimentation, governance, technology, flexibility, value creation and value capture, firm performance and sustainability. Studies that take into account the internal or external dynamics of the business model change are limited, especially with regard to specific or emerging contexts. Against the background of environmental turbulences in the digital age, it is crucial to understand how and to what extent contextual variables affect business models and what capabilities are required to adapt appropriately to these changes (Foss and Saebi 2018; Saebi et al. 2017; Schneider and Spieth 2013).

Current research also neglect contextual factors, e.g. the role of strategy or organizational design. Therefore a detailed understanding of the determinants influencing business model change is required (Cavalcante et al. 2011; Hock et al. 2016; Schneider and Spieth 2013). In particular, the organization's design in terms of structures, processes, personnel framework and culture as an influencing factor for business model development should be examined more intensively in the future (Foss and Saebi 2017; Spieth et al. 2014).

Overall, the body of knowledge addressing business model change from a DC perspective is still in its infancy, evolving predominantly in conceptual contributions or limited empirical studies, mostly with qualitative nature. The most prominent scholars, Foss and Saebi (2015) as well as Teece (2018) link both literature areas and consider the interdependencies between the DCs, strategic and organizational conditions to be fundamental for business model development. They further call for a profound discussion of CCs in business model research. Although current research emphasizes the need to explore business model change from a capability based view, current research still lacks empirical evidence for this relationship. To date, only few scholars, e.g. Achtenhagen et al. (2013), Mezger (2014) and Inigo et al. (2017) contribute empirically to this research gap. Achtenhagen et al. (2013) question how firms change and develop business models in order to generate sustainable value. The result is a complementary construct based on mutually reinforcing strategic measures, CCs and supporting activities. In his study, Mezger (2014) confirms the fundamental role of sensing, seizing and transforming in business model innovation and conceptualizes these capabilities. Furthermore, he concludes that the business model development itself is a DC. In addition, Inigo et al. (2017) explore organizational processes in the development of sustainable business models with evolutionary or radical character. In a detailed analysis, they evaluate sensing, seizing and transforming as a suitable construct and operationalize the DCs depending on the business model type. Moreover, Bock et al. (2012), Müller and Vorbach (2015), and Hock et al. (2016) have provided first insights related to strategic and organizational prerequisites for business model development based on the DCV.

Related to the context of digitization, besides numerous managerial studies there is a growing body of empirical work addressing the context of digitization as a key driver of business model development (Bughin and Zeebroeck 2017; Petry 2016; Westerman et al. 2014). However, Schallmo et al. (2017) point out that there is still

a great need for further research linking digital transformation and business model research and therefore call for more in-depth practical insights.

Also with regard to digitization and DCs, there are only few studies linking the DCV with disruptive change (see Anyanwu 2016; Bärenfanger and Otto 2015; Day and Schoemaker 2016; Pavlou and El Sawy 2010). Therefore, additional research in this area is required (Bärenfanger and Otto 2015; Pavlou and El Sawy 2010). Nevertheless, the topic has attracted substantial attention at numerous conferences (Schmeiss 2017) as well as in several calls for special issues, e.g. in Journal of Business Economics (2018), Longe Range Planning (2018) or Journal of Business Research (2019).

Taken all together, a high level of theoretical and managerial relevance of the topic can be derived. It turns out that especially the relationship between DCs and business model research as well as the relationship to the strategic direction and the design of the organization are in need of research. Considering digitization as an essential external parameter in this work, another field can be addressed that is currently in high demand in this combination even in prestigious journals (Journal of Business Economics, 2018, Long Range Planning, 2018). So far, a comprehensive unification of the research fields of DC and business model development under the influence of digitization has not been undertaken. By applying case study analysis among various industries we meet the demand for further explorative studies identified in literature (Hock et al. 2016; Mezger 2014; Müller and Vorbach 2015; Saebi et al. 2017; Schilke et al. 2018).

3.2 Suitability of the dynamic capability approach for business model research

In general, business models are viewed as a static configuration of elements and characteristic activities (George and Bock 2017). However, in terms of sustainable value creation and due to changing market requirements business models have to be developed successfully. To take advantage of new business opportunities, on the one hand new skills are required, but also existing resources and organizational activities and structures must be adapted (George and Bock 2017; Zott and Amit 2010). In this context, DCs describe the set of required skills for business model change, since enabling resources and structural changes are the core elements of this scientific explanation approach (Achtenhagen et al. 2013; Foss and Saebi 2015; Teece 2018).

Particularly for the purpose of this study, it is crucial to clearly define and visualize the concept of DCs. In this context, Teece´s framework (Teece 2007) provides an ideal basis for structuring and delineating the concept of DCs, as it distinguishes between (1) sensing, (2) seizing and (3) transforming. It is therefore also applicable to the process of business model development, since this approach as well as Teece's construct are based on the same core capabilities: (1) identification, (2) exploitation of business model opportunities, and (3) transformation of the business model and the organization (Foss and Saebi 2015; Mezger 2014; Teece 2018).

Derived from this, sensing requires certain skills to identify changes in customer requirements, technologies, and market environments. This subsequently entails the need to recognize and profoundly evaluate novel business opportunities. Seizing

in turn, involves the ability to mobilize the required resources, as well as suitable innovation activities to realize business model development. Transforming capabilities aim to align the business model and the organization with future prospects and opportunities, while adjusting and renewing the resource base (Foss and Saebi 2015; Mezger 2014; Teece 2007; Teece 2018). In general, especially sensing and seizing are closely interrelated, which is characterized by reciprocal iterative learning and experimenting cycles (Mezger 2014). Transforming capabilities are also continuously needed to counteract resource rigidity (Foss and Saebi 2015). Figure 1 summarizes the key microfoundations of DCs.

In light of the technological change, driven by the digitization, this study examines high-volatility markets. In such dynamic times, in which disruptive technology leaps have become omnipresent, firms need distinct DCs to be able to effectively respond to changing market conditions with organizational and strategic measures. Referring to the concept of sustainable competitiveness, the DCV postulates that the existence of DCs has a decisive effect on how individual firms can successfully change in dynamic times (Teece 2007; Teece et al. 1997). From this point of view, the DCV provides a perspective for explaining the divergent success of firms in the digital (Anyanwu 2016; Day and Schoemaker 2016).

Furthermore, the DCV implies the development and coordination of not only internal resources but also that of external partners and the business context. Hence, the DCV considers not only the internal perspective of a firm, but also takes a boundary-spanning perspective (Teece 2007; Teece 2018). Against this background, it can be concluded, that the DCV represents a suitable theoretical basis for research in the context of digitization. Increasing consolidation of firm boundaries, a gradual shift towards close partnerships or entire business ecosystems require considering both perspectives (Amit and Han 2017).

To sum up, the DC approach proves to be a suitable construct for studying digital-driven business model change from a capability based perspective. In addition, previous studies have already examined the above mentioned construct operationalization (Inigo et al. 2017; Mezger 2014). Consequently, this form of DCs scaling is valid for strategic action recommendations and will be used in our study.

3.3 Conceptual framework and research questions

Drawing on the conducted literature review, DCs are discussed as a fundamental ability in explaining how firms can adapt or response, when they are confronted with uncertainty and turbulent environment. Moreover, a fundamental challenge of disruptive technologies is seen as “a business model problem, not a technology

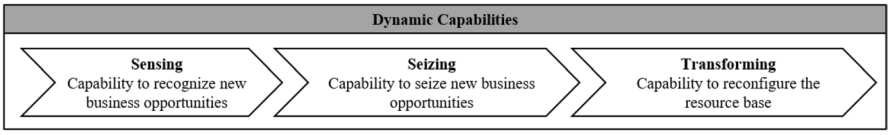

Fig. 1 The construct of dynamic capabilities

problem" (Christensen 2006, p. 48). Taken this arguments together, we propose in our framework that DCs are facilitating changes in business models. In contrast to several scholars e.g. Demil and Lecocq (2010), and Mezger (2014), who argue that business model is a distinct DC, we refer to the mainstream research (Leih et al. 2015; Teece 2018; Foss and Saebi 2015; Day and Schoemaker 2016; Fallon-Byrne and Harney 2017), assuming that business model change is an outcome of DCs as they "undergird how firms create and capture value" (Leih et al. 2015, p. 5). Teece argues in this context: "The design and operation of business models are dependent on a firm's capabilities. The crafting, refinement, implementation, and transformation of business models are outputs of high-order (dynamic) capabilities." (Teece 2018 , p. 40). Furthermore, in line with Saebi et al. (2017) in this work business model change is considered in the two forms of adaptation and innovation. Thereby, business model adaptation is defined as the evolution and incremental adaptation of a business model as response to changing environmental conditions. In contrast, business model innovation is a more radical form of change as it addresses the disruption of the market environment through the introduction of an innovative business model (Saebi et al. 2017). In addition, "a business model is digital if changes in digital technologies trigger fundamental changes in the way business is carried out and revenues are generated." (Veit et al. 2014), p. 48.

Considering the external context, namely digitization which triggers business model change and assuming that changes in business models are a result of DCs, we therefore ask:

RQ1: Which dynamic capabilities are essential for digital-driven business model change?

Next, we operationalize DCs as sub-capabilities (Day and Schoemaker 2016), which Achtenhagen et al. (2013) define as so-called CCs. They specify the process dimensions sensing, seizing and transforming and are therefore crucial for sustainable value generation in business model development (Achtenhagen et al. 2013; Day and Schoemaker 2016). For a practice-oriented conceptualization, the CCs can be further broken down into specific activities, which is illustrated in the following Fig. 2:

These strategic and organizational processes are micro-processes that represent concrete actions and can vary from firm to firm. This granularity of the activities

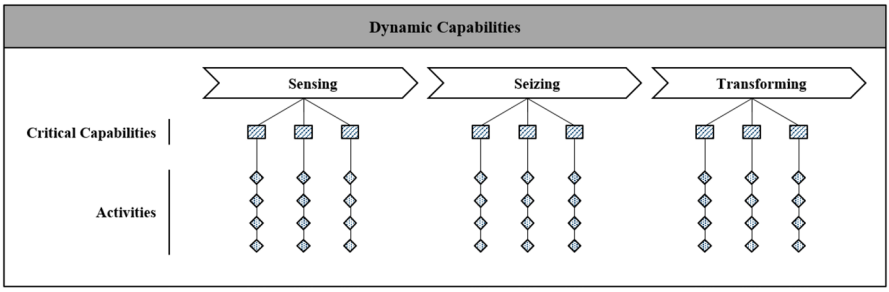

Fig. 2 Conceptualization of dynamic capabilities

makes CCs more tangible and allows more specific recommendations for action (Achtenhagen et al. 2013). Finally, this enables answering the second research question:

RQ2: How can incumbents build capabilities in order to respond to digital disruption and what are the crucial activities and processes in doing so?

The last part of the conceptual framework tries to explain why some firms can benefit more from developing and building DCs than others do. Thus it is crucial to analyze and understand the determinants having an effect on the relationship between DC and business model change. Following the propositions of Foss and Saebi (2015) and Teece (2018), both variables are influenced by external circumstances, e.g. environmental turbulence as well as the interdependencies with strategic orientation of a firm and its organizational design. Therefore, we expand our framework including the internal contextual variables strategy and organizational design. Since the goal of this study is to gain deeper insights to causalities and interdependencies we therefore ask:

RQ3: What are the fundamental determinants and challenges in building DCs? More precisely, what influence do strategic and organizational conditions have?

Motivated by several calls for research and the high practical relevance, our paper therefore provides a comprehensive framework explaining how and under what circumstances DCs facilitate business model change in fast-changing environmental context, such the digitization-driven economy. Figure 3 depicts our final conceptual framework, outlining the main derived assumptions.

4 Methodology and empirical setting

4.1 Research design and case selection

To open the black box of how firms identify, develop and implement digital business models and investigating the role of fundamental DCs and activities from a DC lens, an exploratory multiple case study was chosen. For this decision-making, several reasons were crucial: First, according to Edmonson and McManus (2007) an inductive qualitative research is an appropriate approach for "nascent theory" building. Second, multiple case studies allow what, how and why questions (Yin

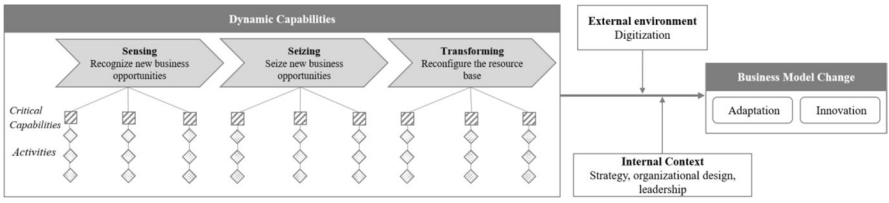

Fig. 3 Relationship between DCs, contextual factors and business model change

2003), assuring the examination of new knowledge about a specific phenomenon through in-depth understanding of the contextual factors and underlying processes with robust, generalizable, and better grounded results (Eisenhardt and Graebner 2007; Ellram 1996; Yin 2013). Third, in contrast to focusing on one unit of analysis, a larger number of case studies allows cross case analysis (Chiesa et al. 2007). Thus, a multiple and comparable case study approach is appropriate for exploring causal mechanisms as well as the derivation, testing and development of theoretical constructs (Eisenhardt 1989; Pickel et al. 2009).

By considering the replication approach and in line with the research goal, for sample selection we focused on (a) established firms from Germany, (b) from a cross-industry context and (c) successful adopting new digital business models, whereas a digital business model is defined as "a business model making use of digital technologies and data to create, deliver and capture value". Due to the subject novelty and thus the small underlying population, initially we identified 50 potential firms meeting the defined selection criteria. After prioritizing in terms of suitability of their implemented business model and reputation of the firm, 26 were identified as appropriate for this study and thereof 10 incumbents participate in the study. After collecting data from 15 interviews in eight case studies, it turned out, that we achieved the saturation point as no new themes emerged. Nevertheless, we did four more interviews in two case studies, but found that they did not add value to our analysis. Consequently, at this point we stopped the data collection and excluded the last four interviews from further in-depth analysis.

Thus, the final case study sample (see Table 1) for this research includes eight leading firms (mostly DAX listed) from various industries, e.g. mobility services, transport and logistics, real estate, manufacturing and energy. The number of eight conducted cases thereby meets the recommendations of various researchers from at least two (Yin 2013), four to ten (Eisenhardt 1989), and six to ten (Ellram 1996) carried out cases. All of chosen firms have successfully established new digital business models, partially rewarded with awards, and are due their market presence among the leading firms within their respective industry. Since all firms (or their parents firms) are founded more than 100 years ago, they have a long history with a high degree of stability as well as versatility and adaptability to new market requirements. However, they are also subject to path dependencies in their actions, what makes them particularly interesting as an object of investigation. For a valid, comprehensive analysis, the case studies are considered at the same company hierarchy level. Taking the explained aspects into account, the company sample proves to be a suitable starting point for a case study analysis.

Table 1 Sample and key business model characteristics

Case	Employees	Revenue (b €)	Industry	Industry dynamic	Type of BM change	Strategic intend	BM type and brief description
ALPHA	> 200.000	> 70	Mobility	High	Innovation	Development of a new business segment	SaaS*: Platform and applications for intermodal travelling, providing trip planning, booking for passengers and optimizing efficiency of mobility operators
BETA	> 400.000	> 100	Logistics	Low	Innovation	Development of a new business segment	Market-place: Platform and eco-system for innovative applications for logistics and fleet management, also connecting IoT**devices
GAMMA	> 200.000	> 70	Rail	Medium	Adaptation	Further development of core business	IoT Platform: Predictive data-based maintenance for trains, based on open IoT platform
DELTA	> 200.000	> 40	Trucks	Low	Adaptation	Further development of core business	IoT Platform: Open cloud-based platform across different truck manufacturers offering services such as monitoring of vehicles
EPSILON	> 30.000	1–10	Transport	Low	Adaptation	Further development of core business	SaaS: Digital services in the rail freight transport sector enable check-in of wagons and tracking of goods
ZETA	> 10.000	1–10	Real Estate	High	Innovation	Development of a new business segment	Market-place: IoT devices (smart locks) and connected application enable several service providers access to accommodations during the absence of end users
ETA	> 400.000	> 70	Sensors	High	Innovation	Development of a new business segment	IoT Platform: New sensor technology and related software-based services
THETA	> 40.000	> 40	Energy	Medium	Adaptation	Acquire new customers and retain existing ones	SaaS: Application to increase communication of energy providers with its end customers, offering incentives via gamification

SaaS Software as a Service, *IoT* Internet of Things

4.2 Data sources and process of data collection

As the primary data source we conducted 15 semi-structured interviews with executive and senior managers from all cases. In order to achieve credibility and gain different viewpoints (i.e. business and technical perspective), we talked with two managers per case (with exception of case Theta). Obtaining insights from experts with complementary roles and functions, avoid not only information bias, but also allowed distinct details from different perspectives and mapping the entire development process (Huber and Power 1985; Kumar et al. 1993). Decisive for expert selection were the criteria (a) task heterogeneity between the two experts in terms of managerial and technical background, (b) experience with digital business models and (c) high degree of decision-making power in business model development. Besides, all experts are familiar with firm´s history and culture, strategic orientation and further organizational issues. Therefore, all interviewees are qualified as experts for business model development in the context of digitization.

In order to achieve reliability of results, for all interviews we used the same guideline (Yin 2009). The interview guideline was developed analogously to the conceptual model and is based on the research questions. The introduction section covered background questions, e.g. work history of the expert, demographic details, and description of current job position and tasks. The second part deals with firm-specific characteristics, e.g. industry dynamism, organizational structure and culture, general perception of digitization and strategic orientation. In addition, we were interested in background information related to the starting point for business model change. This was helpful to understand motivational and behavioral perception with regard to digitization and business model change from a firm-level as well as individual-level. Finally, we posed questions related to the description of main characteristics and elements of the current business model. The main part of the questionnaire encompasses questions related to the process of business model change from a dynamic-capability-view. Based on Teece´s (2007) framework, the questions were structured about the dimensions sensing, seizing and transforming, by simultaneously addressing the business model development process. Specifically, the search and identification process is examined at sensing, the development process at seizing, and the transformation of the business model and renewal of organization is addressed at transforming. Discussion is centered mainly to the required critical capabilities and underlying activities and mechanism, as well as related influencing factors and challenges. In the concluding part, the experts had the opportunity to evaluate the entire development process and indicate further milestones for action. The final part included best practices, lessons learned and general managerial recommendations.

The interviews were conducted in the period between February and April 2018 and varied between 50–105 min. The duration of the first and second interviews was dependent on the information content of the first interview and therefore has

Table 2 Overview data sources

Case	Primary data used			Secondary data used
	Interview ID/Function	Job tenure/ BM expertise (years)	Interview length (min)	Public and internal documents
ALPHA	A1: Head of Sales and Business Development	18/8	63	Public: media report (1), journal (1), industry report (1), press releases (3)
	A2: Head of Project and Product Management	8/3	73	Internal: annual report (1), firm website (3), firm presentations (2), firm´s press release (1)
BETA	B1: Head of Digital Innovation Lab	11/2	100	Public: media report (1), journals (2), article (1)
	B2: Head of Operations, Support and Quality	8/2	50	Internal: annual report (1), firm website (4), firm presentations (2), firm´s press releases (3)
GAMMA	G1: Head of Sales and Business Development	18/3	90	Public: management journal (1), analyst report (1), press release (1)
	G2: Head of Business Administration	10/2	52	Internal documents: annual report (1), firm website (4), firm´s press releases (3)
DELTA	D1: Head of Marketing and Operations	14/5	105	Public: media reports (2), journal (1), press release (1)
	D2: Head of Business Intelligence for CRM and IT	13/3	55	Internal: annual report (1), firm website (1), firm´s press releases (4)
EPSILON	E1: Project Director	7/1	80	Public: media reports (2)
	E2: Head of IT Products and Operations	2/2	50	Internal: annual report (1), firm website (8), strategy presentation (1)
ZETA	Z1: Head of Venture Development	1/1	50	Public: media interviews (4), media reports (2)
	Z2: Venture Development Manager	2/1	60	Internal: firm website (6), Press releases (2)
ETA	ET1: Director Business Model	14/2	85	Public: media reports (3), management book (1)
	ET2: IoT Project- and Innovation Manager	2/2	65	Internal: firm website (6), firm presentations (2)
THETA	T1: Business Development and Innovation	7/3	80	Public: media reports (6), website article (1) Internal: annual report (1), firm website (4), press release (1)

a slightly greater variance. To maintain consistency, two authors conducted the interviews. All interviews were recorded (in total we collected data material with 1058 min) and transcribed in 256 pages, following the transcription rules according to Kuckartz (2016). For confidential reasons all data is anonymized, using indexing in form of the Greek Alphabet.

For a comprehensive and more detailed understanding of the firm-specific aspects, we additionally collected secondary data in form of internal archival data, e.g. annual reports, released press articles, websites, presentations. Finally, we triangulated our data with public data, e.g. media reports, press articles, websites and management literature, in order to understand firm's environment and industry-specific dynamism. Table 2 summarizes the sources and use of data.

In general, our data collection process relied on a systematic approach, consisting of five steps. Based on the initial research work conducted during the case study selection phase, at the beginning of our data collection process we searched on a large scale for further information related to firm and business model issues. Often, there were only isolated reports describing the business model, as they were recently introduced or contain sensitive information and thus intended only for internal use. Anyway, the intensive research has provided initial insights into business model development for each case study. Some details were integrated into the guideline as questions and consequently the discussion with the experts could be raised to a higher level. On the other hand, it was possible to enrich a sound knowledge base for the interviewer, which was very advantageous for conducting the interview. After the first interview, the data was transcribed and evaluated in preparation for the second interview. For this purpose, the entire guideline for the second interview was adapted with further questions resulting from the gained insights. Topics that were not discussed in the first interview were highlighted and asked again. Finally, both interviews were followed by an assessment of the findings in order to obtain further information on important interview content through further external research. Figure 4 summarizes our data collection process.

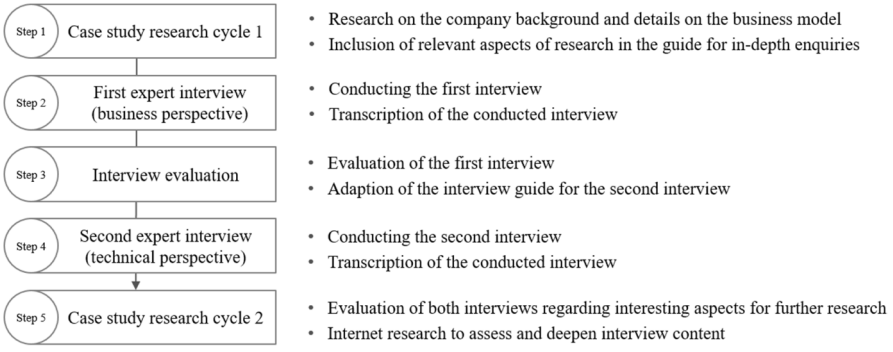

Fig. 4 Data collection process

4.3 Data analysis

As a method of data analysis, we applied the approach of qualitative content analysis according to Gläser and Laudel (2010), aiming to organize and structure the content of the transcribed data in order to finally form patterns or categories. According to Kohlbacher (2006), qualitative content analysis is a comprehensive and suitable approach for case study research, since it applies a methodologically controlled step-by-step procedure and theory-guided approach for text analysis, using a category system. It allows openness and the ability to deal with complexity, what fits the credo of case study research, namely understanding complex phenomena in a certain context. In line with Gläser and Laudel (2010) for category building, we applied the hybrid approach of deductive-inductive category building. This is a common process in research (Kuckartz 2016), and allows in contrast to Mayring's deductive approach, a supplementation and modification of the a priori determined code template. The main strength of this hybrid approach is that the category system is less rigid through the open-ended inductive principle and therefore allows the combination of data-driven insights with theory-driven knowledge. While the category system is based on prior (theoretical) knowledge and initially serves as a search grid for data extraction, the sub-categories usually emerge from the data. However, it is also conceivable to inductively supplement the top categories from data material (Schreier, 2014).

Thus, against the background of limited prior knowledge related to the field of business model research from the dynamic capability lens in general, and in search for new insights related to distinct capabilities activities and contingencies relevant in the digital age context, we found reasons to justify the application of Gläser and Laudel´s approach (2010) in our work. In doing so, we followed their four-step process of data analysis: (1) preparation, (2) extraction, (3) editing and (4) analysis of data material.

In the preparation phase we derived an initial category system based on our originally proposed conceptual framework and following the research questions. Accordingly, we transferred the main components of our framework (business model issues, DCs and contextual variables) into the category system. For example, following Teece´s conceptualization of DCs, we clustered the category system for the DCs construct around the dimensions sensing, seizing and transforming. Aiming to create an integrated database, in the next step we imported the transcribed interviews and secondary data into MAXQDA, a computer-aided software for qualitative data analysis.

In the extraction phase, two researcher started to independently analyze the data material of firstly two case studies, whereby all relevant text passages were raised to a certain level of abstraction by means of paraphrasing, generalizing and reduction, an then indexed with open codes and assigned to the category system (Pickel et al. 2009). Subsequent to this first coding-cycle, all researcher discussed the emerged themes. This joint reflection of findings and mutual exchange increased our understanding of data material and encouraged us to modify our initial coding rationale. Afterwards, we continued with the next coding-cycle of all case data with the same approach. As new insights or themes emerged and could not be integrated to the existing category system, we iteratively move back and forward between our data analysis and literature. Thereby we refined our coding scheme by inductively

forming new categories (Kuckartz 2016) and revising our preliminary second-order themes.

After the coding was completed, we conducted data editing. For this purpose, the codings were adapted for each case study, redundant categories were brought together and corrected for errors.

Based on the edited data material, we began with our last coding-cycle. We sorted codes which repeated again and show similarities to first-order categories. Then we used axial coding to search for relationships among the first-order codes in order to group them into second-order themes. In doing so, we identified for example main activities and processes required for digital-driven business model change and finally form the main patterns, which we called critical capabilities. After we reached a deeper understanding of the first-order categories ("key activities related to the critical capabilities") and second-order themes ("critical capabilities"), we used selective coding to assemble the second-order themes into aggregate dimensions, which reflected the "type of DCs". Using the same evaluation strategy, we also formed categories related to the overarching theoretical themes "business model" as well as "organizational factors determining the development and adaption of DCs". Here again, a close exchange between all researchers took place in order to enrich the results with further ideas and considerations from a different perspective. In addition, we obtained feedback from one expert from our pilot-interview and finally discussed our findings in an expert forum with a total of 30 managers. Thus, we were able to include an external perspective for the validation of our results (Baur and Blasius 2014). Once we incorporated the suggestions for improvement, we finalized our evaluation process and processed the data again until we reached our final data structure (see Fig. 5). As a result of the within-case and cross-case analysis, we were able to set up our final theoretical construct, showing the relationship between DCs, digital-driven business change and organizational factors.

4.4 Validity and reliability of the study

In order to ensure methodological rigor, we followed the suggestions of Gibbert and Ruigrok (2010), applying several measures to strengthen validity and reliability. To address construct validity, we followed two main strategies. First, we applied the principle of triangulation to data collection. By including two expert interviews per case study and further research on secondary sources, we significantly increased the validity of the results and lowered the information bias. The expert status was verifiable for each interviewee. Furthermore, we presented our findings and perceptions to other researcher familiar with the theoretical knowledge (Baur and Blasius 2014). Second, we established a chain of evidence (Eisenhardt 1989) through a clear documentation of how we went from research questions, through data collection and analysis, and finally to our conclusion. Furthermore, to strengthen internal validity, we applied a systematic approach with iterative loops between results and theory in the context of within and cross-case analysis. In addition, the use of MAXQDA was supportive within the scope of pattern matching. In order to achieve external validity, we followed the replication logic. Since our sample consists of eight case studies,

Fig. 5 Final data structure

it corresponds exactly to the required number of four to ten case studies, which are necessary to achieve analytical generalizability (Eisenhardt 1989). Further, we contributed to a better understanding of the sampling choice through explaining the rationale for the case study selection and provision of sufficient details to case study context. In addition, external experts with extensive field expertise, which confirmed the coherence and validity of the interpretation results, validated our findings (Baur and Blasius 2014). Finally, we addressed reliability by reporting how we conducted the case studies and by providing a complete documentation of the results, the interview protocols as well as the included documents from secondary sources. Particularly, making use of computer-assisted software for data evaluation increased the degree of transparency to a high level. The entire category system and all coded passages are well documented (Kuckartz 2007).

5 Case description

Alpha is one of a worldwide leading technology firm, operating in a variety of industries. Focus of our case study is related to the mobility sector, which is traditionally defined as very static due to its high market transparency and long-term running businesses. However, over the last three years and as digitization has become more and more widespread, it has become a very dynamic environment. The entry of new competitors with disruptive business models (e.g. Uber, FlixBus or DriveNow) are fundamentally changing the business environment. Therefore, Alpha is proactively looking for new, intelligent mobility solutions. In 2011 a new staff department was set up within the division in order to identify new business models for networked mobility and build a platform with services for intermodal travel. The strategic decision to position itself in a new market segment through this business model innovation is based in particular on identified market gaps with great potential and the opportunity to open up to new customer groups. After a three-year development period, the marketing of the new platform started in 2014 with international reference projects, such as in Dubai and Switzerland. In the meantime, this area has developed into a separate business segment with 30 internal employees. For its innovative solutions in the field of intermodal travel and ticketing, the business model was honored with the Transport Ticketing Global Award in the "Digital Champion" category in 2017.

Beta is operating in the automotive and logistic field. Focus of this case is the development of the "Logistics Platform and Services" business model. The logistic sector is characterized as very static, as the degree of automation is still low and, as a result, digitization does not yet have a major impact on this industry. Nevertheless, the new strategic direction of the firm is oriented towards digitization, whereas digital networking is defined as a core element in the corporate strategy. In order to push its role as a digital pioneer and to proactively search for new digital business, in 2014 an innovation lab was founded. As a result, the business idea for a logistics platform with digital services was realized as a completely new business model far away from the core business. With the business model innovation, the strategic goal was pursued to open up new customer segments. Furthermore, a considerable

market potential was recognized, as no company had positioned itself in this field before. In the course of business model development, the team was transformed into an independent and separate unit by founding an own brand name, which currently comprises around 170 employees. The platform services have been available on the market since the end of 2017.

Gamma is operating in the rail industry focusing on manufacturing of rail vehicles and solutions for rail automation and electrification. Traditionally, the rail industry is rather sluggish and not dynamic, as it is characterized by strict regulations and safety standards due to passenger transport. Nonetheless, Gamma´s management is strongly focused on digitization, providing the foundation for a proactive search for intelligent and efficient train solutions. Thus, the foundation for this business model was gained by collecting data for automated diagnostic messages from locomotives within internal research activities on maintenance projects. In 2015, the strategic decision was finally made to develop a new, platform-based business model based on the first findings and to set up an own staff department for this purpose. Decisive for this were ultimately two main aspects. First, it recognized the potential that Gamma can improve its competitive position by expanding its portfolio with digital services. On the other hand, the decision was also driven internally by the fact that its own maintenance processes can be made more efficient. Ultimately, a new area was set up that optimally complements the existing dual business model of train sales with maintenance contracts and thus represents a business model adaptation. The marketing of the platform and services started in 2017 and meanwhile the business model is being managed in a separate business unit with 130 employees.

Delta is one of established and worldwide leading suppliers in the automotive industry. In overall five divisions, Delta bundles a broad spectrum of intelligent and sustainable solutions for vehicles, machines and goods transport. In the context of our study, we focus on the tire industry, which is classified as static, as the market has developed only evolutionarily with little disruption in recent decades. Nevertheless, as digitization progresses, market dynamics gradually increase, while existing competitors aim to add a digital component to their business models. Consequently, digitization and networking are fundamental cornerstones of the R&D strategy and form the basis of corporates strategy. Main goal is to proactively search for new digital solutions complementing existing hardware offerings and to generate added value. As the initial development activities did not met the customer expectation and failed to generate revenue, in 2013 the management decided to stronger support this business field in a newly created division and radically improve the existing technical solutions. The motivation was mainly driven by the rationale that a data-driven service could improve the market position and differentiate the company from traditional manufacturers. The resulting business model expands and stimulates the existing tire business including maintenance with an additional digital service.

Epsilon is operating in the freight transport sector. Driven by digitization and the fear of new market player, the firm is pursuing an intensified digitization strategy. As a part of its digitization strategy, Epsilon intends to set the course for future mobility, including the increasing digitalization in freight transport through targeted advancement of digital innovations. The firm is facing major challenges, as competition between rail and road intensifies and new technologies and rising customer

expectations accelerate developments in the mobility market. In its history, the rail freight transport sector, one of the pioneers of industry 1.0, can be classified as very static. At present, however, in the context of digitization, there is an increased need for speed and agility while reducing costs at the same time. In particular, Epsilon aims to catch up with its largest competitor, the road freight transport, which is why the industry in general is still experiencing a low, but clearly increasing dynamism. Based on the current market assessment and future prospects, Epsilon carries out a comprehensive reassessment of its business model. The main strategic goals thereby are an increased "need for digital-driven flexibility while increasing supply chain visibility" (E2, 2018). Due to the change in the competitive environment, Epsilon's goal is to close the "digital gap to road" (E2, 2018) and thus become more competitive compared to freight transport by road.

Zeta is an owner-managed medium-sized family business, which is one of the leading international companies in the field of heating technology as well as industrial and cooling systems. According to the CEO, the firm is currently facing the challenge of reinventing itself and opening up new opportunities. Zeta's digitization strategy comprises three areas. First, the focus is on a future-oriented, entrepreneurial culture and the digitization of all essential internal processes. Second, digitization is to be driven forward by developing digital products and business models that are close to the core business. The third area is diversification through investments in new, digital-driven business areas. The business model of this case study is part of the third strategic component. By founding the digital unit in 2017, the 100-year-old family business aims to open up new business areas in the context of digitization that are not directly related to the existing core business. With the new business model, Zeta intends to enter the so-called Property Technology (Proptech) segment and thus diversify its own portfolio. The term "Proptech" stands for technological developments in the real estate sector that are mainly based on modern information and communication technologies. In the past, the real estate sector was characterized as a slightly digitized environment, but there has been a strong change in this respect. Currently, the market is classified as dynamic and "highly agile", as investment volumes and sales growth in the German real estate market are at record levels. The new business model and the entry into the B2C business represents an innovation for Zeta and is not linked to the core business.

Eta, one of the world´s largest sensor supplier, is operating primarily in automotive, industrial, consumer goods and building technology. Eta is a pioneer in the IoT market, offering solutions in the areas of connected mobility, Industry 4.0, smart city, and smart home. The competitive environment is described as very dynamic and characterized by short innovation cycles, as the company is confronted with the upheavals of digitization in various business sectors. Thereby, Eta sees itself not only as a company in transition, but also as one on the move. Consequently, as a part of the corporate strategy, Eta in general pursues the development of new business models with a focus on the IoT. The business model underlying this study, is driven by technology push whereby suitable applications are explored and developed for new sensor technologies. According to the experts the the new IoT-platform is a radical innovation in the IoT-environment that aims to address a new target group with a new product.

Theta is an energy supplier, operating in power production, network distribution and energy retail. The firm is also active in the smart home segment and in the electro mobility sector. Digitization is a key component of corporate strategy, as digital change is seen as an important "driver of change". Theta's self-perception is defined as a driving force in the digitization of the energy industry and sees digitization as an opportunity to support the complex control of the energy system and to produce new products and services. Theta's digitization strategy therefore encompasses both internal efficiency gains and the development of new business models. The firm intends to profit from the use of digital technologies, particularly in the area of end customer sales. On the one hand, Theta aims to proactively shape competition and on the other hand, the introduction of innovative business models is intended to counter the threat of customer migration. Theta is increasingly confronted with a change in the competitive environment. From a historical perspective, the energy sector can be classified as very static, as only a few large companies are dividing up the market. However, due to the energy turnaround and the associated political influencing factors, there has been an increase in competition dynamics. So far, there are few digital business models in the industry, but there is a strong trend towards the increasing digitalization of business models. In particular, the increased transparency for the end customer, which results from various online comparison portals, contributes to increased dynamics in the competitive environment, as tough price wars arise. As a result, Theta was forced to rethink and change its previous business model, especially in the end customer segment.

Based on the above description several similarities and differences can be derived. First, all presented business models are digital business models as they use digital technologies and data to create, deliver or capture value. Second, although a closer look at the cases reveals that the dynamics of the industry differ greatly (see Table 1), established companies are analyzed which are confronted with increasing or already pronounced environmental turbulence and consequently develop new business models in the context of digitization. Thirdly, the traditional companies are subject to extensive organizational change processes in the context of the digitization process, but also with regard to business model change. For example, the business models of Alpha, Beta, Zeta and Eta can be classified as innovation, while the cases Gamma, Delta, Epsilon and Theta are a business model adaptation (see Table 3). The key differences lie in the strategic goal and the associated motivation of the firms. When developing their business model, Alpha, Beta, Zeta and Eta focused on creating a new business segment. The finding that there is a market gap with great potential and that new customer segments can thus be addressed proved to be the main driver. In contrast, the business models of Gamma, Delta, Epsilon and Theta were introduced with the aim of adapting and further developing the existing core business to the new framework conditions of digitization. By using digital technologies, companies want to differentiate themselves more strongly from their competitors. At the same time, digital technologies also contribute to the optimization of internal processes for companies. Nevertheless, there are differences between the business models. Overall, different legal forms, industries, target customer groups and business model types are considered. In addition, the respective business models are based on different technologies. Furthermore, the results show

Table 3 Business model description by type of business model change

	Innovation			
	Alpha	Beta	Zeta	Eta
Target customer	Public and private mobility service provider (B2B)	Transport and logistics service provider with commercial vehicle fleet; Participants in supply chain; IT developer for logistics services (B2B)	Working people with a good income and living in large cities (B2C)	Addressing industrial customers from various sectors, e.g. pharmaceutical companies, food producers, supermarket chains (B2B)
Value proposition	Enabling efficient and comfortable travel incl. use of intermodal transport (public transport, taxis, car sharing, bike sharing) Optimization of the utilization, pricing and schedules of mobility services	Connection in transport and logistics processes via an open, manufacturer-independent ecosystem Improvement of capacity utilization, process and vehicle efficiency as well as transparency of transport and logistics services Marketplace or App Store for logistics services	Facilitation of everyday life for the end customer "No presence in the apartment or house required and yet everything around the household is done."	Recording and measuring parameters that cannot be recorded with previous sensor technology and human senses Replacement of previous measurement methods Increasing efficiency in production and simplifying processes
Value chain	Platform development and design of travel app Implementation of a payment function for contactless tickets and optional services Data integration from mobility service providers Visualization and analysis of traffic usage data	Development of the IoT platform and telematics box for vehicle networking Creation of data-based services for logistics, fleet and order management Provision of marketplace and developer tools for third parties	Provision of Smart Locks via partners Aggregation of different household services on one platform Takeover of access management App-based coordination of services for the household	Development, production and distribution of sensors Generation and utilization of data in the cloud Offering services based on the data collected by the sensor technology
Revenue model	Project business (platform and app) Licensing business (maintenance) Software as a Service Volume and transaction based commission business	Software as a Service Monthly subscription Provision (platform and marketplace usage for third-party services) Freemium for basic service and telematics box	Subscription fees with monthly basic fee Affiliate amounts of partners per booking of a service	Sale of sensors Offering pay-per-use, freemium or subscription models as possible options

Table 3 (continued)

	Adaptation			
	Gamma	Delta	Epsilon	Theta
Target customer	Operators and maintainers of trains and foreign fleets (B2B)	Maintenance and fleet managers of commercial vehicles (B2B)	Firms transporting goods by rail (B2B)	Change affine end consumer (B2C)
Value proposition	Increase the reliability, availability and cost-effectiveness of trains with digital services for predictive maintenance and optimized asset management	Transparency of the tire pressure of entire fleets and timely notification before problems occur Increased uptime and improved vehicle safety by reducing costly breakdowns	Increasing transparency in rail freight transport and increasing simplicity of rail towards customers Simplifying and increasing the effectiveness of existing processes	Independent reduction of the electricity price Potential procurement of electricity at zero cost
Value chain	Development of the IoT platform for networking trains and their infrastructure Data transfer, visualization and reporting of performance indicators Data analysis and coding of intelligent algorithms for predictive data services	Development of the IoT Platform and IoT Sensor Components for Networking Monitoring and analysis of tire pressure and temperature for entire fleets	Check-in of freight wagons by wagon number scanner and app Providing a platform to locate transport Offering an interface for integration of data into a logistics system	Generation, distribution and sale of electricity Development and regular updating the app Involvement of partners to offer incentives within the application
Revenue model	Project business (IoT sensors) Software as a Service (hosting, maintenance and upgrades of services): a) performance-based model; b) value based model; c) co-creation model Freemium (free basic service)	Purchase or pay-per-use (tires with sensor) Purchase or leasing (receiving unit) Software as a Service (hosting, maintenance and upgrades of services) Subscription (monthly cancelable services for customers)	Three different service packages Pay-per-use model Subscription fees	Customer contract fees under the electricity contract Contributions from participating partners, e.g. affiliate earnings

that the respective firm activities differ in terms of business model development in general and in terms to the underlying DCs in particular, which will be examined in more detail in the following section.

6 Analysis of the dynamic capabilities facilitating business model change

6.1 Critical capabilities and activities for sensing threats and opportunities

Before implementing and developing a new business model, it is necessary to identify and validate appropriate business model options. In our study, we identified four CCs that form significant sub-dimensions of sensing: (1) recognizing market dynamics and trends at an early stage, (2) integrating customers into the ideation phase, (3) modeling value proposition and value capturing mechanism, and (4) integration of external partners into the ideation process (see Table 4):

6.1.1 Early recognition of market dynamics and trends

> *"(…) you need to be able to find the market trends early enough (…), you need to have the skill to understand the pulse of the market (…), to get the feeling of the market what is really needed out there."(G2)*

Particularly in volatile environments, it is necessary to recognize market dynamics and trends at an early stage, otherwise significant opportunities for adapting or innovating the business model are not recognized. Due to the high speed of digital change and short innovation cycles, it is important to identify relevant trends in the market ahead of competitors and to fill white spots as quickly as possible. In this context, it is necessary to scan the market environment intensively and to recognize the business opportunities in good time. Anyanwu (2016) states that the identification of opportunities requires an understanding of latent client needs as well as the development of industries, markets and competition. Thus, in terms of sensing, it is crucial to explore markets, to recognize technological potential and to obtain relevant information about competitors (Achtenhagen et al. 2013; Feiler and Teece 2014; Pavlou and El Sawy 2011).

Indeed, in all conducted cases, proactively recognizing opportunities and threats at an early stage is an important critical capability. In doing so, companies use different activities supporting this capability, but also have some in common. First, all cases indicated that an in-depth market and customer understanding is essential for developing their business. *Traditional activities like intensive market and competitor screening* through carrying out studies, experimenting with new ideas, customer discussions and benchmarking are useful for anticipating relevant trends and technologies before they reach market maturity. Second, characteristic in terms of digitization is the broader search scope. *Trend monitoring and market screening* are not anymore restricted to current markets, competitors and customers. Recognizing new business opportunities is rather a question of looking beyond the horizon by

Table 4 Critical capabilities for the dimension sensing, related key activities and context examples across cases

Second-order categories (Critical capabilities for sensing)	First-order categories (Key activities related to the critical capability)	Context examples
Early recognition of market dynamics and trends (SEN_1)	Trend monitoring and market screening	Conducting studies, experiments, customer discussions and cross-industry benchmarking (Alpha)
		Market analysis of existing software solutions; Categorizing trends through customer conversations, surveys, internal and external studies; Create a roadmap from the analysis results (Delta)
		Consideration of predefined search fields; Creating a market overview for the identification of white spots in the market; Evolution of the market overview to the competition overview (Zeta)
		Identification of competitor solutions, identification of use cases with the potential for Blue Ocean strategies (Eta)
	Exchange with cross-divisional units	Dialogue and exchange of experiences with other internal departments for digital solutions; Cooperation with the central innovation department for experiences on new innovations (Alpha)
		Close coordination with central strategy department to assess market dynamics, cooperation with the central innovation department to exchange experiences on new innovations, participation in internal hackathons with other divisions to exchange about technology trends (Gamma)
	Industry benchmarking	Benchmarking competitors to identify market niches and unique selling points; Inclusion of internal experts from central product management
		Screening competitors and creating a competitor database; Special strategy team for Competitor Intelligence (Gamma)
		Cross-national comparison with other firms in industry; Drawing on example from cross-country as a model for your own business model (Theta)
	Participation in market surveys of customers	Customers get the opinion on new technologies of market participants before a tender; Opportunity for companies to better understand and shape the market (Alpha)
	Analysis of best practices	Evaluation of competitors within the industry; Cross-industry view of companies in the same technology area; Gathering information via trade fairs, portals and contacts to software manufacturers (Delta)
		Analysis of digital business models from leading competitors (Epsilon)
	Detailed evaluation of market potential	Use of a scorecard to evaluate use cases; Evaluation of cases based on the dimension market opportunity, strategic value creation and time to market (Zeta)
		Analysis of the market potential of use cases; Checking compatibility with business strategy (Eta)
Integration of customers into the ideation phase (SEN_2)	Co-creation workshops	Intensive workshops with customers in the context of research projects in various markets; Consideration of technologies, testing of business models, and definition of a concept of maturity; Interdisciplinary teams of IT, market experts, sales (Alpha)
		Intensive workshops with customers at the beginning of joint development activities; Consideration of customer problems and individual requirements for the definition of use cases; Interdisciplinary teams of IT, market experts, sales (Gamma)
		Organizing innovation workshops with customers (Eta)

Table 4 (continued)

Second-order categories (Critical capabilities for sensing)	First-order categories (Key activities related to the critical capability)	Context examples
	Feedback sessions with customers	Explanation of the latest technologies and presentation of market trends with subsequent customer feedback on various functions: technology, purchasing, law, etc.; Possibility to generate joint pilot projects (Alpha)
		Close involvement of seven pilot customers from different industries to obtain feedback; shared narrowing of the search space; Consideration of customer feedback for initial ideas; Using social media channels to gain feedback (Epsilon)
	Ideation phase with lead users	Special format for the development of new specific applications in short time; Implementation with different lead user groups and support by external consulting firm; Identification of customer problems without technology focus, creation of value streams, creation of transparency and determining willingness to pay (Beta)
		Organizing iterative workshops together with customers to bring in the benefit perspective; Presenting ideas in elevator pitches (Epsilon)
		Determination of problems and customer needs; Execution and structuring of qualitative user interviews are based on design thinking requirements; Quantitative survey with the Google Survey Tool (Zeta)
		Conducting interviews with potential customers in various industries; Involvement of customers to validate business model hypotheses (Eta)
	Voice of the customer program	Conducting interviews and workshops with clients in all regions worldwide; Involvement of regional sales, marketing, product management and business intelligence; Creating an idea list of customer requirements; Prioritization according to business benefits and customer needs (Delta)
Modelling value proposition and value capturing mechanism (SEN_3)	Specification of value proposition	Procedure with the Value Proposition Canvas for problem understanding and solution design (Alpha)
		Customer journey mapping to present the product idea with points of contact of the user; Understanding customer behavior and identification of potential for improvement (Beta)
		Value curve analysis to reconcile the value proposition of ideas with internal competences; Business Model Canvas to convey the value proposition to other parts of the business model (Delta)
		Definition of personas for understanding the needs of target customers; Create the customer journey to identify customer issues; Definition of the value proposition (Epsilon)
		Support through own design thinking team; Definition of personas for understanding the needs of target customers; Derivation of user stories (Zeta)
	Conception of revenue model options	Internal framework for presenting the revenue model, consideration of revenue and financing models of the applicants as an incentive for ideas (Alpha)
		Creation of flexible models based on a standardized basic model for Software as a Service; Inclusion of internal calculation tools for individual adjustments of the models (Gamma)

Table 4 (continued)

Second-order categories (Critical capabilities for sensing)	First-order categories (Key activities related to the critical capability)	Context examples
	Conception of the business model prototype	Early definition of individual business model elements; Determine the potential yield mechanisms (Zeta)
		Use of various methodologies for the modeling of the business concept; Definition of the benefit promise (Eta)
		Using the St. Gallen Business Model Navigator to model the business; Definition of the different business model elements (Theta)
	Cross-industry imitation and adaptation	Cross- industry analysis to identify alternative revenue models; Implementation of the yield mechanics for the own business model (Eta)
		Cross- industry analysis to identify suitable business model approaches; Implementation of an external value creation mechanism for the own business model (Theta)
Involvment of external partners into the ideation phase (SEN_4)	Research cooperation with external partners	Projects by industrial companies, universities and state ministries with expert support; Government subsidies are possible for projects (Alpha)
		Research activities with scientists and students from interdisciplinary programs; Open up new fields of research and prototyping of innovative technologies (Delta)
		Involvement of experts from universities (Zeta)
		Cooperation with universities; International involvement of experts from the lean start-up area (Eta)
	Building an ecosystem of strategic partners	Early development of long-term business relations with partners; Forming a heterogeneous ecosystem of partners with a shared vision (Beta)
	Hackathons with external	Derivation of innovations from worldwide Open Innovation events of the central innovation department; Implementation of hackathons with external industrial companies, experts, start-ups and students (Gamma)
	Cross-industry networking	Consortial benchmarking with other information exchange companies; Joint agreement on innovative revenue models (Epsilon)
	Industry networking	Networking within the industry through the formation of a strategic alliance; Exchange on digital business models (Epsilon)
		Conducting interviews with various service providers in the industry (Epsilon)
	Start-up involvement	Involving start-ups in the innovation process through start-up boot camps (Epsilon)
		Financial and methodical promotion of ideas via accelerator; Development of different venture capital strands for investing in start-ups with digitization reference; Derivation of new business fields (Zeta)
		Promotion of start-ups by incubators; Invest in start-ups through venture capital unit; Derivation of new business fields (Eta)
		International cooperation with start-ups; Financial and methodical promotion of ideas through the accelerator; Participation in start-ups through venture capital (Theta)

applying cross-industry and cross-country benchmarking, considering new potential customers and screening trends and developments from the start-up scene. A further supporting activity for identifying relevant technologies and trends is *internal or cross-departmental collaboration*. As shown for example by Alpha, Beta, Gamma, Epsilon and Theta central innovation or strategy units or even special strategy teams for competitor intelligence serve as a suitable partner. In addition, internal hackathons with cross-divisional units in the case of Gamma can contribute to a better market and technology knowledge. Another useful approach is the *participation in market surveys of customers*. In addition, greater market understanding can be achieved by participating in *customer market surveys*. This allows not only a greater understanding of the market and customer needs, at the same time it is useful as a tool to proactively influence and trigger the market before particular customers are aware of new technological opportunities or tenders are published.

Although all mentioned activities contribute to anticipating and shaping relevant trends and technologies before reaching market maturity, learning processes through best practices from other market player and identifying market gaps with potential unique selling points, it is important to note that this in not always an easy task. One of the main challenges is to identify and evaluate the right option among the broad range of opportunities.

6.1.2 Integration of customers into the ideation phase

One central aspect in the search process for new business models is the deep understanding of customer requirements (Teece 2018; Voigt et al. 2017). This applies in particular in the case of digital solutions, since experimenting interactively with customers is a vital capability to identify their latent needs (Day and Schoemaker 2016; El Sawy and Pereira 2013). Furthermore, our results show that integrating customers in an early stage is critical for business model development. As Beta´s head of digital innovation lab get to the point:

> *"To identify new business models, (…) the key is really (…), not internally discussing hypothetical customer issues (…), what has helped us, is to integrate the customer into an extremely early stage."(B1)*

Particularly in the context of digitization, customer integration is of high priority, since both new and existing customer needs have to be understood and fulfilled. The literature points out that close customer contact is an essential part of sensing (Feiler and Teece 2014; Teece 2007). These include, for example, the ability to identify and understand customer needs, recognize changing preferences, and interpret fluctuations in demand (Anyanwu 2016; Song et al. 2016; Žitkienė et al. 2015). Teece (2010) and Mezger (2014) confirm that involving customer feedback helps to develop business models that meet the needs of customers. One challenge thereby is to "approach the customer as problem-free as possible" (G1) and to determine if the business model actually creates value for the customer.

Notable in our study is that all companies have introduced new and innovative formats in order to involve customer directly in the ideation phase. In particular, short processes with *intensive co-creation workshops and innovation cells with lead*

users are in the foreground. For example, in order to get external knowledge, Beta follows the so-called innovation cell approach. Supported by extern consulting agencies, lead users with different needs were recognized and directly involved into the ideation phase. The concept is based on capturing customer issues without focusing too much on the technology. By creating value streams, a higher degree of transparency is achieved, so that finally specific use cases can be worked out. Besides an in-depth understanding of customer´s willingness to pay for digital solutions, another benefit from this approach is the establishment of a close customer relationship, which can also be helpful in later development phases. At Epsilon, lead user are closely involved in the brainstorming and selection process. These personal and frequent customer contacts, allow to meet the specific customer needs. In so-called iteration zero workshops the feedback from lead users is incorporated directly in the initial ides, whereas interaction with customers is useful to narrow down the search space. Further, pitches are used to suggest solutions to customers, for example with the so-called elevator pitch approach. Subsequently, selected ideas are prioritized and concretized in close consultation with the customers. In order to generate an understanding of the preferences and behavior of the target group, on which the benefit promise is also based, customer journey maps are also created. At Zeta, customers are interviewed to identify their problems and needs. The customer interviews are structured according to design thinking, user testing or usability testing specifications. To determine customer needs, both quantitative surveys, e.g. with the google survey tool, and qualitative user interviews are conducted. Zeta uses its own design thinking team to define personas and derive user stories that are essential for understanding customer requirements. Eta also uses customer interviews in order to identify customer's problems and creates a list of possible ideas. Finally, this list is rated using a scoring model in terms of user interest and technological feasibility. In addition, prioritized use cases are worked out in innovation workshops. In order to further narrow down the selection of potential business opportunities, both the market potential and the compatibility of the business model with strategy, the so-called "Eta-strategy-fit" are analyzed. Subsequently, customer interviews are conducted again to validate the business model hypothesis.

Another popular approach are *co-creation workshops*. At Gamma, small, interdisciplinary teams work on new solutions in direct dialogues with customers. After identifying customer problems and needs, use cases are defined, which are also developed jointly in an accelerator mode. In doing so, speed and a fast brainstorming phase are consciously emphasized. A similar approach can be found at Alpha. However, such workshops take place as part of research projects in various markets. In the meantime, there are projects in several countries where innovative business models are tested with customers in co-creation workshops under consideration of the latest technologies. The whole process takes place with interdisciplinary teams consisting of IT, marketing and sales in an accelerator mode, in order to be able to generate new solutions in a short time and avoid long project durations.

Furthermore, Alpha and Theta rely on *feedback sessions with customers.* In so-called educational sessions, technologies and market trends are presented to customers with limited market knowledge. An important part of these discussions is the feedback to possible innovations from an interdisciplinary team of the customer.

Based on the first feedback, this format offers the possibility to generate a joint pilot project in the future (A1; A2). Main focus in both approaches is to gain a better understanding of customer needs. In contrast to that, obtaining feedback at Theta takes place via social media channels.

A much more comprehensive and novel concept is pursued by Delta. In different regions, interviews and workshops with customers are organized, and thus so-called Fleet Councils initiated. Generally, this can be equated with a *voice of the customer program*. In doing so, various departments are integrated with direct customer contact and comprehensive market knowledge. Consequently, the customer requirements were collected in a list with all ideas and prioritized in a next step by business value and customer needs. The in-depth process of capturing customer's expectations, preferences and aversions is based on qualitative and quantitative research techniques, which allows a comprehensive view on customers' needs and business benefits.

With the help of these supporting activities, it is possible to generate customer-relevant use cases and to define the value proposition from the customer's point of view. The difficulty is to identify innovative lead users and to translate customer requirements into a universal solution.

6.1.3 Modelling value proposition and value capturing mechanism

Since business models have become inherently customer-centered due to the progressing digitization, it is essential for businesses to be able to design their value proposition and revenue-models accordingly. Failing to do so renders the generation of sustainable revenues nearly impossible (Teece 2010, 2018). For an adequate conceptualization of the value proposition and revenue models, the ability to thoroughly understand the customer's problems and to address and transfer those to the value proposition and overall business model design, is crucial. On this notion, G2 states:

> *"(…) more and more imagination will have to come to play in terms (…), how do you actually charge the customers? What should the customer be willing to pay (…)? What kind of problem can you solve for the customer?" (G2)*

For modelling their value propositions, firms deploy several tools such as the *business model canvas* or *customer journey mapping* (A2; G1). Such tools place vital emphasize on customers' needs (Kreutzer and Land 2016) and are therefore fundamentally well suitable as means to grasp and visualize critical elements of one's own entire business model (E1; E2; G2). Scholars like Osterwalder and Pigneur (2010) and Gassmann et al. (2013) provide a theoretical basis for the conceptualization and practical application of innovative business models. Such business models invariably feature multiple revenue streams and to some extent offer pay-per use- and freemium concepts as part of their pricing strategy. This facilitates flexible pricing models and options for customers tailed to their specific needs, which is in general a criteria of business models in the digital age (Teece 2010).

More often than not it poses a significant challenge for established businesses to adapt their existing business model and redefine appropriate revenue models which harness and monetize the generated value in the most efficient way. To some extent, established businesses which have traditionally focused exclusively on sales, often

lack the expertise and knowledge on alternative revenue steam options possible in the digital context, such as freemium, subscription, affiliate-systems or pay-per-use-models (B1). This might in addition serve as an explanation why established businesses imitate alternative revenue-models implemented in different industries and transfer those to their own business models (G1; Mezger 2014). In order to incorporate novel external stimuli, the cases Alpha and Eta pursue benchmarking revenue stream models, too. Copying business models, denoted in literature as "*copycat*", is a widespread phenomenon in the digital age.

6.1.4 Involvement of external partner into the ideation process

Within the context of digitization the so-called "open innovation"approach becomes increasingly important for identifying new business opportunities (Hoffmeister 2013; Westerman et al. 2014). Actively seeking a dialogue with stakeholders outside the firm and integrating them in an appropriate form is an important capability in sensing (Inigo et al. 2017). The various cooperation attempts are justified by the argument that, particularly in the digital era, internal resources and one's own know-how are not sufficient to establish promising business models under high time pressure. In addition, aspects such as access to new markets and distribution of risk are the main stated arguments for open innovation. However, firms are facing various challenges while pursuing an open innovation approach. This includes: identification and selection of suitable partners, open communication when working with competitors and design of cooperation agreement.

The analyzed cases enter different forms of cooperation with external partners. These encompasses from *start-ups, strategic alliances, cross-industry networks, cooperation with universities and government institutions to co-opetition with competitors* (A1; A2; G2). In particular, cooperation with start-ups seems to be an effective means within the digitization context in order to develop new business models. In all cases, start-ups are involved in various forms. For example, accelerators, incubators, internal start-up programs and venture capital units are established (B1; G2; D1). In general, incumbents are currently highly engaged in cooperation with start-ups, which seems to be a cross-industry trend.

There are also some differences concerning the type of cooperation. While the majority of businesses, amongst others the two cases Alpha and Delta, conduct *long-term collaborative projects*, other cases like Gamma focus on day events like *hackathons*. Those seem to be most suitable for the purpose of fast problem solving. Furthermore, timely establishing a large network of strategic partners for marketplace business models is a critical success factor (Teece 2018). This applies to the case of Beta, in which this was successfully accomplished.

6.2 Critical capabilities and activities for seizing opportunities

After identifying appropriate digital business opportunities and threats arisen from environmental changes, firms need to focus how to address and actively exploit this. Our results confirm previous perceptions, that seizing business models is in fact a

Table 5 Critical capabilities for the dimension seizing, related key activities and context examples across cases

Second-order categories (Critical capabilities for seizing)	First-order categories (Key activities related to the capability)	Context examples
Appropriate organization of development competences (SEI_1)	Bundling cross-department competences	Bringing together market experts from other business units with specialized IT experts; Setup through internal transfers and recruiting of IT specialists of a strategic partner (Alpha)
		Bring together market experts and process specialists from other units with IT professionals (Gamma)
		Building a heterogeneous development team; Cross-departmental networking of competences; Access to IT competencies of the Group (Epsilon)
		Support by experts in marketing and design or lawyers; Access to the competencies of the Group (Zeta)
		Cross-divisional cooperation of different departments; Support by central unit for business model innovation (Eta)
	Joint development with external partners	Deep integration of a specialized development service on flexible framework contracts; Building heterogeneous development teams with all IT skills for digital product development; External consultancy takes over the stakeholder management and the scrum master role (Beta)
		Coordination of activities and selection of technologies by the internal IT unit; Program writing is mainly done by an external IT service provider (Delta)
		Support from external freelancers in web development (Zeta)
		Support in technical development by external agency (Theta)
	Offshoring of IT development activities	Software development by an offshore team with strong involvement in everyday business; Building through a bootcamp, where regional managerial staff study for two months at headquarter; Cultural workshops for new hires in the region (Alpha)
	Outsourcing of IT development activities	Outsourcing of uncomplicated development activities to partners in the nearshore environment (Gamma)
Agile working mode to develop business models (SEI_2)	Scrum-based agile development	Classic approach to Scrum with iterative development in two or three-week sprint cycle (Alpha, Beta, Gamma, Theta)
		Iterative method according to scrum; Defined role distribution; Conducting short daily meetings
		Successive introduction of the agile working mode after the development in the waterfall model at the beginning; The procedure is similar to Scrum with similar voting meetings and two to four weeks of sprinting (Delta)
		Iterative procedure according to Scrum; Compilation of a team with an agile mindset; Use of agile project management tool for planning sprints (Zeta)
		Iterative method according Scrum; Access to a wide range of development methods throughout the group (Eta)

Table 5 (continued)

Second-order categories (Critical capabilities for seizing)	First-order categories (Key activities related to the capability)	Context examples
	Lean-start-up methodology	Introduction of a lean start-up program; Establishment of internal start-up units within the group for business model development (Eta)
		Lean start-up methodology as a model for development; Fast and regular testing and iterative customization of the business model (Theta)
	End-to-end development	Autarky teams are responsible for developing, testing and maintaining the services (Beta)
	Communities of practices	Overarching small teams for specific IT fields; Promotes uniform exercise of functions in different teams, quality and speed (Beta)
Continuous customer integration into the development process (SEI_3)	Feedback systems for the design of services	Interviewing selected customers about the initial app design and usability during a test phase of several months (Alpha)
		Customers are presented with two alternative solutions in the form of A/B Testing and give a recommendation (Beta)
	Customer feedback after every iteration cycle	Customers participate in the Sprint Review; Developers present the latest developments and get feedback from customer;
		Coordination with customers on the development status at the end of each sprint; Joint learning with customers;
		Development of the business model as minimum viable product; Iterative development of the prototype based on customer feedback (Theta)
	Piloting and testing services with lead user	Long test phase with a heterogeneous customer group; Personal Account Managers conduct surveys and workshops in the regions; Customer experiences and feedback are integrated directly into the parallel running platform development (Delta)
		Several months of testing with a selected clientele from different regions; Customers receive beta software for testing functionality and usability (Delta)
		Cross-industry group of pilot customers; Close and personal cooperation with customers (Epsilon)
		Setting up a landing page to test the utility and prototype with customers; Six-month proof-of-concept phase; Validation of the business model (Zeta)
		Testing prototypes with pilot boats from various industries; Validate revenue mechanics with customers (Eta)
		Setting up a landing page to quickly test the customer's value proposition; Regular testing of the business model with fixed pilot customer group (Theta)

Table 5 (continued)

Second-order categories (Critical capabilities for seizing)	First-order categories (Key activities related to the capability)	Context examples
Effective implementation of key IT-activities (SEI_4)	Special IT security measures	Privacy by design, which respects privacy very early in the definition of the subject; Internal privacy experts work with the developers; Experts from customers and regions are directly involved in the discussions (Alpha)
		Conducting penetration tests with all critical systems for simulating hacker attacks; End-to-end encryption in data transmission from IoT sensors to the platform; Own team is responsible for IT security (Beta)
		IT security control with internal audits; Consideration of the group-wide safety standards; Defined authentication procedure with the customers (Epsilon)
		Ensuring end-to-end encryption; Testing and internal screening the security concept; Verification and testing of the hardware
		Carrying out criticality assessment with data protection officer; Regular control of the IT landscape (Delta, Theta)
	Building a sustainable platform architecture	Hosting the platform via cloud infrastructure and observing the scalability in the initial setup; Flexible platform setup through modular design of components and tools (Alpha, Beta, Delta)
		Selection and construction of a scalable platform architecture; Ensuring the extensibility of the platform (Epsilon)
	Consistent data protection regulation	Individual check for each use case when accessing customer data; Introduction of a data security officer for the administration of data rights (Beta)
		Consideration of extinguishing concepts and regulations for data economy; Greater consideration of the EU General Data Protection Regulation; Close cooperation with data protection officer (Theta)
	Customized design of the user interface	Development of a comprehensible and easy-to-use front-end; Orientation to claims from the user experience design (Epsilon)
		Orientation on UX and UI design; Prerequisite of a basic understanding of UX and UI design in the development team (Zeta)
	Synchronization of development processes	Coordination and coordination of hardware and software development cycles; Synchronization of different sprints (Eta)
	Data models and data analysis	Development of sustainable data models and database structures for continuous access of the services to the data;
		Standardization of data in the back-end as a basis for data analysis; Combining the understanding of technological interactions with artificial intelligence (Eta)

distinct DC. What critical skills they include, and what measures are necessary for building new resources or adopting existing ones, is illustrated in the following section. For a brief overview please refer to Table 5.

6.2.1 Appropriate organization of development competences

The organization of the development team is a key capability for the implementation of the business models, since *interdisciplinary knowledge has to be brought together and bundled*, especially in the digitization context (Mezger 2014; Schallmo et al. 2017). Mostly market experts and IT specialists are needed, but legal, audit, contract management and controlling staff are also needed to successfully implement new digital solutions (A1; A2; B1; G2; D1). In particular, the existing internal IT skills of established companies are often inadequate, as it has not been the core competence of IT to create solutions for the customer and build an IoT platform (B1; D1). Besides staff recruiting, several cases, e.g. Beta, Delta, Zeta und Theta indicate a *close cooperation with external IT development partners* as an additional effective tool (Inigo et al. 2017; Westerman et al. 2014). This led to high learning affects and fast knowledge building (B1; D1). Expert G1 comments this as follows:

> *"(…) the interaction of our data services competence, our maintenance people, (…) our engineers (…), this intensive cooperation in this industry is the key to success (…)." (G1)*

In contrast to this, *offshoring and outsourcing of simple software development processes* are appropriate means at Alpha and Gamma for cost-effective outsourcing activities and effective use of internal resources (Granig et al. 2016; Teece 2018).

6.2.2 Agile working mode for business model development

As an alternative to waterfall models, iterative approaches are becoming increasingly important for business model development (Abolhassan 2016; Gadatsch and Landrock 2017; Petry 2016). This is also evident in all eight case studies. The central goal of *agile methods like Scrum* is to increase the speed and agility of business model development. A further goal is the promotion of a new culture with a clear focus on customer-centered actions and continuous improvement (Abolhassan 2016). This agile development approach allows incremental product improvements in short cycles. As a result, firms are able to respond flexibly and quickly to changing customer needs as well as to minimize error and documentation costs (A2; B2; G1; D1). Key components of this methodology are daily communication and sprint reviews for enhancing transparency, as well as retrospectives to improve team performance (A1, A2; B1). Further, Alpha and Beta show, that *end-to-end development of services* and *communities of practices* can serve as supporting activities. Another suitable approach is the *lean start-up methodology*. At Eta and Theta, this methodology is used for fast and flexible testing and adjusting of business models by obtaining customer feedback (Ries 2011; Schallmo et al. 2017). Central aspect of the method is to shorten the development time in an entrepreneurial matter by applying a combination of experimenting, learning and iterative principles. In particular,

this approach is suitable for the development of software-intensive business models since changes can be implemented quickly (Foss and Saebi 2015; Teece 2018). Mezger (2014) also emphasizes the importance of agile and iterative approaches as essential activities of seizing. In line with Teece (2010), he also underpin the iterative conjunction between sensing and seizing, which lead to learning-oriented development processes.

However, for established firms, applying agile methods is not always an easy task, as they suffer from inertia and deadlocked routines (ET1). The director of business models adds that iterative approaches are often inaccurate, what is contradictory to the previous quality standards (ET1). In addition, the introduction of agile methods encounters some resistance among the workforce (E2). Therefore, several trainings are useful in order to promote agile thinking within the firm (ET1). Overall, it is important that among the various approaches, a development methodology is selected which is appropriate for the specific project and its problem (ET1). Experts also see challenges in scaling agile multi-team work, parallel hardware development in waterfall mode, and establishing a suitable communication mode in the team (A2; B1; G1; D2).

6.2.3 Continuous customer integration into the development process

To ensure that a new digital solution optimally meets the needs of customers, activities like *continuous testing of products and services with end users* and the *direct inclusion of this feedback* proves to be critical to the success of the development process (Amit and Han 2017; Kreutzer et al. 2017). As Gamma stated, this allows agile customer requests and suggestions for improvement before the solution is fully developed. Overall, customers appreciate their active role in product design and show understanding in cases when prototypes does not work perfectly. Beta´s expert comments as follows:

> *"This live customer feedback is extremely important to adjust the direction. The team showed customers what they developed and there was a lot of enthusiasm too!" (B1)*

Primarily, tests are conducted with customers to provide direct feedback on the business model. In line with the lean start-up idea, solutions are initially offered as MVPs, so that the minimally functional iteration of the business model is cyclically improved and extended based on customer feedback. Fundamental goals are the early identification of problems and the development of business models that fully meets customer needs. Main focus thereby are joint learning process with the customer (Kreutzer et al., 2017; Ries, 2011; Teece et al., 2016). Other helpful tools that could be identified were intensive discussions at sprint reviews, workshops and surveys with a heterogeneous group of lead users. Despite high organizational cost and efforts, this approach is essential in order to meet customer need in terms of service usability and to increase user acceptance (A1; B1; D1). A close exchange between firms and the pilot customer group during the test phase is also of high relevance.

However, the selection and composition of the pilot customer group can be difficult. Alpha therefore advice to select pilot customers based on predefined criteria,

e.g. innovation ability or willingness. In addition, Beta criticized that too close involvement of customers can slow down the speed of the development process, because the integration is also associated with a high expenditure.

6.2.4 Effective implementation of key IT-activities

The development of business models based on digital technologies places high demands on the technical capabilities of the firm. Since the development of digital business models requires special and for most companies new knowledge regarding digital technologies and IT-abilities, established firms are forced to build abilities, reconfigure existing abilities and to implement them effectively (Bärenfanger and Otto 2015; Oswald and Kleinemeier 2017; Porter and Heppelmann 2015). Depending on the business model typology and underlying technologies the necessary skills can vary greatly. For example, different skills are needed for an all-data-driven business model compared to an IoT-based business model that links physical assets to data. The case studies show various best practices on how companies can respond with appropriate measures. Thereby selected technical activities are of particular relevance. It is thus important to *ensure IT security*, *compliance with data protection* and the *design of a user-friendly interface*. In addition, it is important to *design platform-based business models* in order to ensure high expandability and scalability.

With regard to data protection and cyber security, on the one hand security concepts are demanded by customers, but politically a stricter framework is enforced by European data protection guidelines (A1; B1). For example, Alpha follows the principle privacy by design, observing data protection guidelines when defining prototypes. For this reason, internal data protection are involved at an early stage. Due to the globally varying data protection requirements, additional experts are involved on the customer side and in the regions. A similar procedure can be found at Theta. In close cooperation with the data protection officer, technical and organizational measures are implemented at an early stage to ensure compliance with data protection standards. The data security of the IT landscape is checked in collaboration with a data security expert as part of so-called criticality assessments. At Beta, a dedicated cyber security team is responsible for the IT security of the platform and its vulnerable systems. In addition to that, attention must also be paid to compliance with data protection regulations if there is an internal request for the use of customer data. For this purpose, a data security officer was introduced to perform validity checks of use cases and grants access (T1). As a provider of IoT solutions, Gamma also takes extensive protective measures for cyber security. Penetration tests simulate hacker attacks and recommend action for system vulnerabilities. A high degree of encryption during data transmission leads to secure communication between IoT sensors and the platform. In addition, Gamma has the competence to train, certify and advise its customers on topics related to smart security. These new capabilities have been built by acquiring a specialized company and working closely with external partners. Delta also conducts continuous penetration tests and encryption in order to guarantee a high level of security. Since Eta is a high-tech business model, specific technical competencies are required. On the one hand, it is important to synchronize and harmonize the parallel hardware and software development steps.

Besides, it is necessary to standardize the data generated by the sensors in the backend so that they can be subsequently evaluated. The peculiarity of IoT platforms is that it requires both, an understanding of the cause-effect relationships in the field of hardware technology, and expertise in artificial intelligence. The successful combination of these disciplines offers the greatest potential for data analysis.

The results clearly demonstrate that a robust and flexibly scalable architecture as well as consistent data models are essential for platform building. The experts also endorse that the interfaces to internal systems and partners should be considered and defined uniformly at an early stage of the development process (A1; B1; D2). Further, the use of cloud services enables the flexible scalability of data-based business models. As stated by Bharadwaj et al. (2013), the ability to scale quickly represents a DC to adapt to the market needs. The key technical activities of Alpha, Beta, Gamma and Delta include the development of a scalable platform architecture through cloud hosting and the flexible and modular design of the platform tools. Likewise, the design of consistent data models is crucial so that services can access them reliably without major changes. As mentioned by Gamma, this requires a lot of time and human resources at an early stage of development. The expert from Delta also confirms that the creation of data models and database structures was a critical success factor in the development process.

6.3 Critical capabilities and activities for transforming firm´s assets

Furthermore, firms need to have special transforming capabilities, which is reflected by firm's ability to adapt, extend and renew the resource base as well as to implement organizational renewal. In doing so, firms have the option to build capabilities internally or to acquire them from external sources. Overall, we identify five CCs within the transforming dimension, which we discuss in the following section. For an overview about the CCs, selected activities as well as further practical insight for transforming, please refer to Table 6.

6.3.1 Future-oriented organizational design and transformation

> *"I think this is the big organizational challenge, (…) how do you manage this transformation from being earlier a start-up and then become a driving organization (…)." (G2)*

Critical to success for ensuring long-term performance are organizational measures and capabilities (Day and Schoemaker 2016; Inigo et al. 2017). However, particularly for established companies that have built up certain structures and processes over decades, the integration of digital business models seems to be a major challenge. Our results show, that all cases conduct activities in form of restructuring measures or competence development. An example of this is the *reintegration of the business model into the existing organizational structures*. Thereby, other areas can benefit from synergies and experiences from business model development (E1; E2). For example, the development of "Epsilon Digital" promotes agility and an

Table 6 Critical capabilities for the dimension transforming, related key activities and context examples across cases

Second-order categories (Critical capabilities for transforming)	First-order categories (Key activities related to the capability)	Context examples
Future-oriented organizational design and transformation (TRA_1)	Acquisitions and strategic investments	Acquisitions of complementary companies to build an internal ecosystem; Integration teams and intensive, open exchange for synergies as companies remain independent; Corporate Venture Fund contributes funds (Alpha)
		Acquisitions and participations in companies as a means of market access; Companies remain independent and independent; Start-up screening for the identification of innovative IoT companies in the niche area (Gamma)
	Building data analytics competences	Successive build-up of internal teams for data analytics by working together with external experts and recruiting specialists (Alpha)
		Successive development of the internal team with the staff of the original development team for the platform (Beta)
		Bundling of existing competencies with regard to data analytics with cross-departmental specialists
		Establishment of regional data centers for improved market access (Gamma)
	Implementation of an internal restructuring	Branding for a new image of the platform; Part of the department becomes the digital predevelopment and testing ground of digital technologies in the group; Moving to a modern building with high-quality equipment separate from the group site (Beta)
		Involved staff from central units will be integrated into the business unit (Delta)
		Introduction of a central unit for digitization; Establishment of an organization for the initialization and targeted pursuit of strategic and global topics for digital solutions (Delta)
	Scaling in separate unit	Platform service is transformed into an own start-up for greater flexibility and increased product focus (Beta)
		Spin-off as an option to scale the business model in a standalone company (Zeta)
		Scaling by internal accelerator program; Further development outside the existing structures (Eta)
	(Re)integration in existing structures	Linking the new business model with another, already existing project; Building up know-how as the basis for new business models (Epsilon)
		Linking the new business model with existing products and services of the core business (Zeta)
		Reintegration of the business model (after initial spin-off) into existing structures after the expiry of the extensive test phase (Theta)
	Fundamental renewal of the IT organization	Fundamentally renewal of the IT landscape; Agile transformation in the IT sector; Business model development as an internal model for agility; Change in the project portfolio management structure (Epsilon)

Table 6 (continued)

Second-order categories (Critical capabilities for transforming)	First-order categories (Key activities related to the capability)	Context examples
Sustainable provision and development of key competencies (TRA_2)	Internal competence development	Internal further education academy incl. certifications; Training on business models, product management and communication; Continuing education of specialized knowledge about e-learning courses on external platforms (Alpha)
		Special trainings and webinars for regional sales and adjacent business units; Continuing education programs for digitization via a company- wide training unit; Offer of e-learning workshops and trainings (Gamma)
		Conducting retraining and further education measures; Special program for the promotion of competences in the field of digitization (Epsilon)
		E-learning program promoting digital competencies; Organizing workshops for the development of the digitization strategy (Zeta)
		Digitalization training as part of corporate strategy; Internal training through the central business model innovation unit; Promotion of technical and cultural competences; Further training measures in the field of software development (Eta)
		Offering internal training with digitization- specific content; Enable internal certifications and training (Theta)
	Promotion of interdisciplinary IT teams	Rotation of the developers to familiarize themselves in several areas and gain experience (Alpha)
		Joint programming and mutual learning in pair programming sessions; Employees can flexibly participate in daily work of other IT teams and gain new experience (Beta)
	Trainee program for digital solutions	Implementation of the program during development for sufficient staff from the start of marketing; Recruiting in various functional areas exclusively for digital topics; Activities in later function, group task and training as program content (Delta)
	Realignment of recruiting	Targeted site selection in the start-up ecosystem; Using start-up-related job portals and social networks to attract start-up professionals; Recruiting technology specialists with an understanding of business model development; Introduction of a program for promoting digital competencies (Zeta)

Table 6 (continued)

Second-order categories (Critical capabilities for transforming)	First-order categories (Key activities related to the capability)	Context examples
Enchancing know-how exchange and internal communiation (TRA_3)	Platforms and channels for information bundling	Several platforms and wikis for IT and business; Holistic documentation is especially useful for newly hired staff (Alpha)
		Platform for portfolio information and digital solutions with regular updates (Gamma)
		Introduction of external tools and a separate app to extend the communication possibilities (Zeta)
		Build a database of best practice examples of business model innovation (Eta)
		Changes in internal communication; Providing digital channels and platforms for sharing new business model ideas (Theta)
		Internal newspaper and video on the intranet as an information source for employees
	Special formats for regular exchange	Lunch & Learn as a two-week exchange format for news, technical advances and best practices; Townhalls for business management announcements; Volunteer to interesting topics after work in the form of meet-up (Beta)
		Regular lectures on digital topics in pizza lunch format; Annual meetings of regional marketing and strategy department for exchange (Delta)
	Cross-sectoral events, communities and initiatives	Agile community and start-up community for exchange within the group
		Internal social media for the exchange of experience on innovations, technologies and projects within the Group
		Presentation of the business model at an internal, cross-divisional digitization conference; Communicating progress to create an internal understanding of business model development (Epsilon)
		Arranging events for exchange with the CDO via livestream on topics related to digitalization; Exchange of key experiences between business model developers in the context of events (Zeta)
		Intensive personal exchanges with colleagues in other areas of the company; Promotion of internal exchanges on business model development
		Building cross-sectoral networks; Promotion of know-how exchange between the business units (Zeta)

Table 6 (continued)

Second-order categories (Critical capabilities for transforming)	First-order categories (Key activities related to the capability)	Context examples
Intensive customer support and interaction (TRA_4)	Conference with customers	International events to introduce new ideas; Direct customer feedback on potential solutions (Alpha)
	Customer interaction via key accounts	Lead customer contact directly with product manager; Feedback through key account manager, who forward it to product manager (Beta)
		Start of a regional sales force for close customer contact; Coordination of sales and product development with customer feedback (Gamma)
	Customer Support Concept for problem cases	Expert support via a support center; Deployment of mobile service technicians in case of failure (Gamma)
		Contact for customers in case of problems and service team for on-site support; Administration of the support via a ticketing system; Updates- over-the-air allow problem solving remotely through the head office (Delta)
		Creating customer-oriented forms of communication through use of the business model (Theta)
	Integration of customers in portfolio planning	Workshop in each region once every six months to shape the future portfolio; Gathering new ideas from customer visits, trend monitoring and management requirements; Creating a roadmap for the future portfolio (Delta)
		Construction of a new department for customer information; Active involvement of customers in the expansion of the service offering (Epsilon)
Scaling the business model through partnerships (TRA_5)	Cooperation with cross-industry partners	Collaborative development of new services; Development of new potential target customers (Alpha)
		Cooperation with a strong partner for important value added processes (Delta)
		Joining an European alliance of industrial companies, public authorities and research institutions; Promoting technical, legal and commercial standards through joint programs; Enables the exchange between different stakeholder groups (Alpha)
	Integration of partners into the platform	No restrictions on partner selection; Providing software development kits to facilitate integration on the platform; Fast integration through a standardized process and a separate team for partner management (Beta)
		Screening process for partners who complement portfolio and have mutually beneficial synergies; Depending on model, partners contribute competences: a) new apps for partners, partner becomes reseller, b) data analytics for application of the partner, c) access to existing apps (Beta)
	Introduction of an accelerator for start-ups	New program with a pitch event to select a start-up, which remains independent; Mentoring and intensive collaboration to develop new services (Beta)
	Data exchange with partner	Mutual exchange of data for greater customer benefit and service improvement; Ensuring data compatibility via suitable interfaces (Delta)

agile mindset (E2), which is why the classic project portfolio management structure across the firm is increasingly being replaced by a more agile way of working.

As an alternative to reintegration, the business model is *scaled separately in an independent unit* (Beta, Zeta, Eta). For example, this is the case when no suitable reference to existing structures can be made. (ET2). Overall, the ability for continuous reorganization is an indication of pronounced DCs (Feiler and Teece 2014). However, it can be difficult for established firms to integrate the new business model into existing structures. For example, Eta's large-scale production is designed for very high volumes and efficient processes. Implementing small series production of the new sensors in this value chain is problematic, which is why external partners are used for production (ET1; ET2).

Besides our findings reveal, that firms conduct *acquisitions (start-ups)*, and various restructuring measures to bundle resources. *Strategic investments* are mainly important in areas where the competition has a great advantage in terms of experience and, at the same time, access to new markets (A1; G1). In addition, some firms place a strong *focus on data analytics* and therefore build their own teams or even *centers of excellence*. To this end, new structures are proactively created in order to anchor the multitude of required competences in the context of data management deep within the organization (Bärenfanger and Otto 2015). Challenging for firms is the establishment of digitization initiatives throughout the group (G1). In order to advance digital topics even more effectively, it is therefore advisable to introduce central units, as in the case study Delta.

6.3.2 Sustainable provision and development of key competences

The age of digitization requires many new skills from employees regarding the use and application of digital technologies in new business models. Expert from Beta states:

> *"On the way (…) we have learned a lot that we (…) need many skills, (…) a front-end designer, a UX/UI designer, all those things that such a steel and iron corporation actually up to date did not need it at all." (B1)*

Therefore, companies must be able to build and develop them over the time (Mezger 2014; Oswald and Kleinemeier 2017). For this purpose, an assessment of the required skills is crucial (Westerman et al. 2014), which can be done, for example, by mapping competency profiles (G1). The experts point out that for developing digital solutions, especially technical, sale and consulting expertise is required. However, the demand for those people is high (B2; G1; G2; D1). Traditional training and recruiting measures remain relevant, but implementation should take a different form (Petry 2016). Accordingly, the case studies respond with a *combination of internal training programs and realigned recruitment measures*. The internal training sessions include specific digital related professional and educational programs in form of certificates, workshops or e-learning courses. In terms of recruiting programs like special trainee positions focusing on digital issues are very popular. However, especially B2B-oriented, medium-sized firms like Zeta face the challenge of recruiting digital talents. Therefore, founding the digital unit located close to a start-up dominated ecosystem (e.g. Berlin), should facilitate the recruiting of

start-up-experienced and digitization-savvy specialists (Z1; Z2). An additional activity is the use of start-up related job portals or social networks.

Furthermore, case studies Alpha and Beta focus on the *promotion of interdisciplinary IT skills* through rotations among various areas. This means that employees successively build up a broad and at the same time deep knowledge base in different disciplines. As a result, a so-called T-shape in the team can be created, so that a variety of tasks or user stories can be processed holistically in the agile working mode.

6.3.3 Enhancing knowledge exchange and internal communication

Particularly in fast-changing times, the internal exchange of information and knowledge plays an important role and requires special transforming skills to create transparency and a sense for change among employees (Kreutzer et al. 2017; Song et al. 2016). Expert D1 points out:

> *"So in principle it is important to establish transparency and (…) to show colleagues what is going on here and to try to be present at all ends (…)." (D1)*

Our results also confirm that business model development benefits sustainably from fostering internal communication and knowledge exchange. Departments like the central unit for business model innovation at Eta support the *cross-divisional exchange of knowledge*. In this context, the central unit has the function to „bring lessons learned together" (ET1). In addition, by building databases of best practices, all departments can benefit from the expertise and experience of other areas. This is particularly relevant for building digital business models, as "*traditional business areas do not have all the necessary skills and resources."* (G1). For ensuring effective communication, firms are *introducing new formats and integrating these into the daily business*. One goal thereby is to make success stories more visible. Another goal is to create space for employees to be self-initiative and to present interesting topics (B1). In order to bundle information and counteract the threat of information overload and silo mentality, firms are establishing *cross-divisional platforms and share points* (Kreutzer and Land 2016). In addition, newly established initiatives and communities can create enterprise-wide synergies, whereas digital formats, such as internal social media channels at Delta or apps and livestreams such as social media create a direct connection between communication and digitization (Klewes et al. 2017). Kleinbaum and Stewart (2014) note, that the building of those intra-organizational social networks increase the adaptive capacity. Furthermore, the establishment of internal events such as digitization conferences promote a better understanding for the development of digital business models. For this reason, it is important to communicate success activities in order to create cross-divisional transparency as well as to remove resistance and skepticism towards development activities. As part of these events, the direct exchange with the management on digital topics is also possible. This open communication on the part of top management strengthens the commitment and motivation of employees (Achtenhagen et al. 2013; Teece 2007). However, due to differences in interests between departments and internal corporate conflicts knowledge sharing is often a difficult task (E1; Z1; ET2). Therefore, despite the new communication channels, *direct discussions and*

personal contacts are still essential to exchange experiences and resolve conflicts of interest within the workforce (Z2).

6.3.4 Intensive customer support and interaction

Our results further indicate that the ability to continuously adapt and change the business model in digital-driven business environments is critical to success. Particularly the ability to interact with established customers is of high priority. On the one hand, this is crucial for customer loyalty and, on the other hand, customer feedback is crucial for product optimization. (Kreutzer et al. 2017; Schallmo et al. 2017). This finding is also reflected in our study, as one expert indicate:

> *"The user experience has to be awesome. It is also part of the user experience if the customer has a problem that this is resolved quickly (…) this will be a key success criterion, as well as I can support my customers." (D1)*

Except for Zeta and Eta all cases show that, the key factor for the long-term success is the continuous development of the offered solutions under considering the specific customer requirements. Important activities in this context include *customer interaction* via *key accounts*, *customer support*, and *conferences with established customers* and *customer integration in portfolio planning*.

With the introduction of support concepts and key accounts the cases Beta, Gamma, Delta, Epsilon and Theta have appropriate mechanisms to ensure close customer interaction. The main benefits thereby are the ability for fast response and personal customer contact (B1; D1). Within the framework of two-day conferences, the so-called User Days, Alpha is positioning new topics and specifically seeking customer feedback on the various ideas (A1). Beta, on the other hand, puts lead users in direct contact with product managers, while the remaining customers are reached via special key account managers. Nevertheless, the feedback loop is ensured by regular coordination of the key accounts with the product management. (B1). For Gamma, the introduction of a regional specialist company is an important step in intensifying customer exchange (G1). Through regular phone conferences between the sales units and the product management customer requests and suggestions can be directly integrated in the development process. (G2). Equally important is to provide optimal support for customers in case of incidents. For this, established customers can contact specialists around the clock via a support center. A similar approach for customer support can be found at Delta. In addition to that, Delta and Epsilon have taken measures to integrate customers into portfolio planning. For this purpose, Delta conducts a workshop with each regional unit every six months and brings together the ideas from customer visits, trend observations and management requirements. From this, in turn, a new roadmap can be derived (D1.)

In summary, the outlined activities represent not only targeted measures for ensuring long-term customer satisfaction and commitment, but also ensure a well-founded basis for continuous business model development through a close customer integration.

6.3.5 Scaling the business model through partnerships

Another important capability for a sustainable and frequent improvement of business models is the ability to acquire new knowledge and skills externally and to integrate them effectively into the organization. In this context, *collaboration with external partners (e.g. start-up accelerator, alliances and cross-industry partnerships)* and the *development of ecosystems* are becoming increasingly important in the context of digitization (Day and Schoemaker 2016). Kagermann et al. (2011) and Mezger (2014) argue that building long-term business relationships with partners who have complementary resources and competencies is critical to success. This is also evident in our cases. From the very beginning the cases Alpha and Beta place great value on an *open platform*, whereas Gamma has open the platform after a while and Delta is planning the same (A1; B1; G1; D1). Thus, there is a trend towards opening the platform, what is also confirmed by expert from Gamma:

> *"And with the recognition that we are not alone in the world, you actually quickly have to open your platform (…), the more partners I have (…), the stronger the platform becomes." (G1)*

The Zeta example also demonstrates the importance of ensuring extensibility for platform-based business models, integrating new partners into the digital ecosystem and expanding the business model portfolio with further services or offerings. Together with partners and customers, the business model should be continuously updated and improved. Especially with regard to changing customer needs, shorter lifecycles and the high speed of innovation in the competitive environment, adjustments of the business model are necessary (Mezger 2014). A successful partner integration thus can provide new customer value, marketing image and expertise enhancements to platform operators (B1; G1; G2; D1; Z1). One challenge thereby is often to give partners the opportunity to generate revenue (B1; G1). Intensive discussions and transparency with regard to the commercial, legal and technical aspects are therefore recommended (A1; A2).

6.4 Cross-case analysis and patterns of dynamic capabilities

Our results confirm that DCs are a multidimensional construct of interrelated and complementary dimensions (Barreto 2010; Pavlou and El Sawy 2011; Teece 2007). As illustrated in the Appendix, in sum we identified 13 CCs and overall 56 different activities. The total number of activities per case study ranges between 17 and 23 activities and is therefore very homogeneous. Due to the high number of identified activities per case study, it is assumed that the DCs are relatively strong in all investigated cases. Although we were not able to evaluate the significance and effectiveness of individual activities on the business model outcome, the high degree of homogeneity of the CCs and high number of activities may be considered as the first indication for the degree of expression of the DCs. In addition, our results show that all three dimensions of DCs are equally important, while certain CCs are significantly more distinct. Within the dimension sensing, for example, the CC

"early recognition of market dynamics and trends" (n = 16 activities) seems to be highly relevant. It also reveals that firms not only rely on early and proactive search behavior, but also on the broad search scope. Here, exceptionally all firms pursue the strategy "looking beyond the horizon" by greatly expanding their existing search field through integrating new insights from the cross-industry or cross-country perspective, strengthening cross-sectional exchange and involving particularly start-ups as external partners. Further distinct capabilities are also evident in the other two dimensions. Within seizing, the CC "effective implementation of key IT-activities (n = 20 activities) is particularly significant. Within transforming the CC "future-oriented organizational design and transformation" (n = 18 activities) is highly relevant, too. Here, the focus is on organizational and technical restructuring measures (building data analytics competencies and renewal of IT landscape).

Furthermore, the cross-case analysis shows an overall low level of overlaps in terms of nature and form of the activities along each dimension. There are also no significant findings regarding the type of business model change: whether it is an adaptation or innovation does not seem to affect the manifestation of activities. Perhaps this can be explained by the fact that a comprehensive business model adaptation requires comparable capabilities as a business model innovation. Nevertheless, in some cases a high degree of overlap can be deduced. Within sensing, the degree of activities "trend monitoring and market screening", "industry benchmarking", "specification of value proposition" and "startup involvement" are relatively high. Also noteworthy is the large overlap degree within the dimension seizing. To be mentioned here are the activities „bundling cross-department competences, "special IT security measure, and particularly the activity "scrum-based agile development", which was identified in each case. Consequently, the high importance of these activities in the context of digitization can be emphasized. Within transforming, "implementation of an internal restructuring" and "internal competence development" play an important role. However, the overlap degree appears overall relatively low and there is only a small number of activities with overlaps in more than half of the case studies. This in turn speaks for the individual character of DCs in each business model and for a possible dependence on the internal and external firm's conditions. A high overlap degree would also be very inconsistent with Teece's basic view (1997) that DCs are company-specific, unique and not imitable.

Another peculiarity becomes evident when analyzing CCs within the sub-dimensions of DCs. Numerous examples show that the CCs within one dimension are high interdependent. Exemplary in the context of sensing, Alpha is involving their customers into the ideation phase (SEN_2) and integrating them into the value proposition modelling process (SEN_3). Insights from the seizing context show, that Beta and Gamma closely connect the activities for customer feedback related to development progresses (SEI_3) with the exercising of agile development processes based on scrum (SEI_2). In terms of transforming, Delta organizes trainee programs for digital issues (TRA_2), which are focused on staff training for the new established business units (TRA_1). Similar to the fact that individual ordinary skills, such as recruiting, are not sufficient to create value (Feiler and Teece 2014), this idea can also be applied to the CCs. Consequently, the presence of independent CCs cannot contribute to value creation, and thus not lead to successful business model development. In order to create sustainable value, the combination of single CCs within

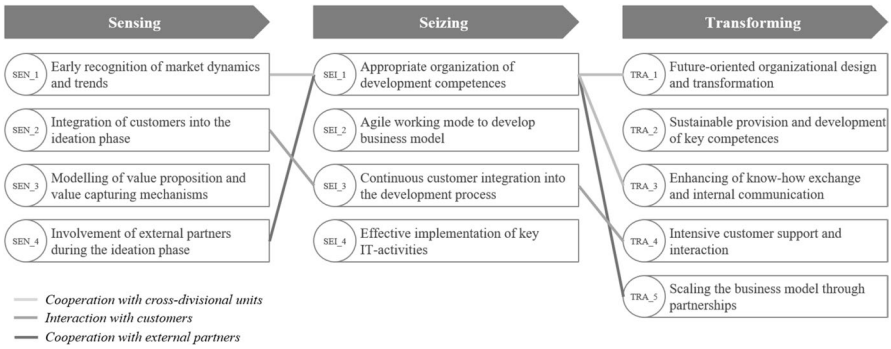

Fig. 6 Relational capabilities within the construct of dynamic capabilities

a dimension is required. Likewise a multitude of deeply embedded and interlinked activities must be carried out (Day and Schoemaker 2016).

Besides interdependencies within the dimensions, the result reveal also overarching relationships. For example, when looking at the interaction activities with customers, Gamma runs in the first step a common idea generation process (SEN_2), directly followed by integrating customers in the development process in so-called accelerator projects (SEI_3). Furthermore, through close customer support and interaction in the transformational stage (TRA_4), the generated feedback can either be incorporated into the agile implementation of key IT-activities (SEI_4) or even in a new idea generation phase (SEN_2). This shows that the identification and implementation of new business opportunities and the adaptation of the resource base in the context of digitization is a repetitive process that must take place continuously (Oswald and Kleinemeier 2017). Expert A1 notes: "So these cycles (…) are continuous. We always have new topics (…), they are going through the whole process now and it will stay that way." The experts from other cases describe the process as a cycle that repeatedly requires sensing and seizing of new business options. Beyond this, transforming capabilities are also permanent required, such as communication, acquisition or recruiting activities. These insights thus illustrate the causality between each dimension as well as the need for iterative and continuous development of DCs.

Our results show further peculiarities. Relational activities with cross-divisional units, customers, and partners play an important role in each DC dimension and are required in a variety of CCs (see Fig. 6). The growing importance of internal and external collaboration is often related to environmental dynamics (Helfat et al. 2007), and obviously in the context of digitization, as our findings show. In general, internal networking and cross-sectoral exchange increase synergy potential for a more efficient and effective implementation of digitization initiatives. In order to optimally satisfy customer needs, customers must be placed at the center of activities and integrated into the innovation process as early as possible. Finally, external partnerships offer the opportunity to benefit from great networking and learning effects (Kreutzer et al. 2017; Westerman et al. 2014). Thus, in the context of digitization, business model change focuses on creating a common value in the sense of co-creation, which

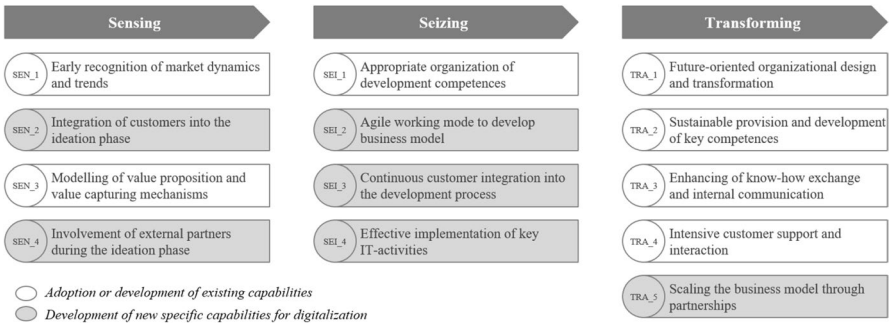

Fig. 7 Classification framework of general and specific critical capabilities

in particular requires relational abilities in firms (Day and Schoemaker 2016; El Sawy and Pereira 2013). According to Helfat et al. (2007) relational skills are considered as a type of DCs and are defined as capabilities to adapt the resource base by incorporating the resources of partners or resources in the network. By embedding these resources and effectively managing such relationships, competitive advantages can be achieved (Dyer and Singh 1998). In this context knowledge management is fundamental. Learning processes such as "inter-firm knowledge-sharing routines" as well as "absorptive capacities" have to be developed in order to benefit from the acquired knowledge and to learn from them (Dyer and Singh 1998; Helfat et al. 2007). However, there are certain difficulties in establishing and managing this internal and external relationships. For example, it is important to minimize the coordination effort and dependencies on stakeholders (Hoffmeister 2013; Westerman et al. 2014).

Furthermore, the CCs can be specified in two categories: on the one hand in general, and on the other hand in new specific capabilities (see Fig. 5). The first one encompasses capabilities, which already exist in established firms, but have to be adopted or developed in terms of digital issues. For example, best practice analyzes now occur more frequently in order to recognize trends. Equally useful tools in the digital age are new tools for modelling business models, acquisitions or investments in small firms, e.g. start-ups (Kreutzer et al. 2017; Schallmo et al. 2017). The second category encompasses new specific digital capabilities which have gained gradually importance with the progress in digitization. Meanwhile, they are acknowledged as irreplaceable for the development of digital business models. Common idea generation processes with customers through co-creation workshops and also with external partners through hackathons, scrum-based agile processing of scalable platforms and data models under constant customer involvement as well as accelerator programs for start-ups are a short list of activities, which become popular with the arise of the digital age (Petry 2016; Westerman et al. 2014). The classification of the two CC types has mainly practical relevance, as it can thus be differentiated, how and where to make adjustments. Figure 7 depicts an overview regarding the CCs among the each dimension sensing, seizing and transforming, showing general and new specific capabilities essential for developing and implementing digital business models.

In summary, it can be concluded that DCs are an enabler for business model change, since "DCs undergird how firms create and capture value" (Leih et al. 2015). Our findings clearly demonstrate that identifying, developing and implementing digital business models requires various CCs and activities which come along with the need for an effective orchestration of the underlying micro processes and hence with comprehensive strategic and organizational changes.

7 Analysis of contextual factors

7.1 The role of strategy and organizational design

Inspired by Leih et al. (2015), Foss and Saebi (2017) and Teece (2018) we propose that the relationship between DCs and business model change is influenced by strategic and organizational issues. Thus, we analyzed the role of strategy and organizational design, comprising structure, culture, processes and people.

In all cases, digitization issues are an integral part of the strategy, whereas business model change is chosen as a strategic response to digital disruption. Although the concrete objectives and contents of the strategies are company-specific, the development of new, innovative business models is integrated in the respective corporate strategy across all case studies. The high strategic relevance of digital business models becomes evident when studying the secondary data sources, e.g. business reports, internal or public documents. The strategic goals and contents are not only communicated inside-out, but also inwards. Expert D1 comments on this: *"(…) it stuck in the strategy (…), so you get a priority, so if it was just another project, then people would not have worked so hard, everyone knew that everyone was looking at us (…)."* Of particular note in this context is Zeta, which digital business model is anchored in the newly founded digital unit, which is initially not directly related to the core business and existing customers. The strategy therefore pursues a dual business model strategy (Markides and Charitou 2004). In the case of the planned splitting of Theta, it becomes clear that strategic decisions at the highest level could significantly influence the development process. This example also demonstrates that the success of business model development is driven by strategic drivers. According to this, even pronounced DCs without the necessary strategic framework conditions do not necessarily lead to successful business models. Or in the word of Foss and Saebi (2015), p.37: "Dynamic capabilities must be used in a good strategy in order to be effective".

Furthermore, the structural framework conditions are also important. One expert from Gamma notes: *"(…) you need an entire organization of itself which can make this entire thing work"* (G1). In each of the considered cases, the necessary structures for the development of digital business models were created. In the case of Epsilon, the various competences are bundled in a separate unit, the so-called Epsilon-Terminal. Zeta develops digital business models separate from the core business and headquarters in the newly founded digital unit. In cooperation with lean start-up experts Eta implements a program to develop business models in internal start-up units. In addition, they are supported by a newly-formed cross-divisional business model innovation central unit. Theta takes a radical approach to reducing legal risks

and develops the new unit in a spin-off that has no external connection to the parent company. Case studies Alpha, Gamma and Delta have created a new staff department, whereas Beta a new innovation lab. As a result, it was possible to work on new topics separately from the core business with dedicated people and competencies. During the development process, the organization was transferred to its own business unit to better scale the business model. According to Hess et al. (2016) and Kreutzer et al. (2017) this approach is very important in overcoming organizational resistance and increasing flexibility and decision-making speed. In general, innovation labs as well as accelerator and incubator programs are becoming increasingly popular among established companies in the context of digitization (Kreutzer et al. 2017; Schallmo et al. 2017). All cases show that companies have made structural changes in order to implement their digital business model. These are always associated with a distancing from the core business (Christensen et al. 2015). As a consequence, business model change should take place in a separate unit besides the core business. This is closely related to the findings of Teece (2018), who notes that the introduction of a new business model is difficult and requires a separate organizational unit. In addition, it is stated that even the adaptation of an existing business model, such as at Theta, can benefit from a separate unit. The structure is closely linked to the DCs, as DCs favor organizational changes and thus business model development can benefit from the structural conditions (Foss and Saebi 2015; Müller and Vorbach 2015; Teece 2018). Therefore, there may be a kind of mutual causal relationship between DCs and structural framework conditions: DCs could both enable the creation of suitable framework conditions and, in turn, profit from the results of the change processes.

Cultural factors also play an important role in business model change in the context of digitization. The literature shows that culture moderates the business model development (Hock et al. 2016). This was confirmed by all cases. On the one hand, there is a strong focus on innovation, as there is a constant search for new opportunities to drive the development of innovative business models. At Epsilon and Theta, this innovation focus seems to be largely driven by technological opportunities offered by digitization, since rail freight transport and energy supply are historically regarded as less innovation-oriented. In general, business model development represent extensive changes in the company, which is why the willingness to change is expected to have a positive impact. The willingness to change describes the fundamental ability of companies to deal with change situations. This is mainly influenced by the corporate culture and includes aspects such as openness to change (Müller and Vorbach 2015). Development activities benefit from the attitude that digital transformation is seen as an opportunity. The openness to new ideas is a basic prerequisite for dealing with digital technology trends, especially in the identification phase (A1). As a result, there may be a particularly strong influence from culture on sensing. Furthermore, the willingness to take risks is a cultural prerequisite because changes of business models entails various risks. These risks can be both financial in nature and effect the reputation of established companies (G2; D 2). In this context G 2 point out: *"(…) there are multiple factors which helped to reach this status today, but the risk-taking factor is pretty important, to try out something new, to give the freedom to people who can*

try out different business models, different solutions." Closely related to risk willingness are also the error culture and willingness to experiment. The iterative approach is "always error-prone" (ET1) and therefore designed for experimentation and learning from the errors. Likewise, breaking up established thought patterns and creativity are recognized as important settings for successful business model development (B1; G2, D2). Thus, there are parallels to the results of Bock et al. (2012), which consider that creative corporate culture seems to be conducive to business model development. Overall, several common characteristics can be highlighted across the cases. Great freedom for experimenting, openness as well as flexible and agile ways of thinking and acting prove to be central cultural characteristics. In addition, in comparison to traditional business, the case studies show courageous financial investments. Interesting, the cases compared the culture with a start-up mentality, which is characterized by a special spirit. This is not initially suspected by incumbents. This is justified by the fact that the cultural characteristics differ significantly from the rest of the company, are very innovative and place a high value on flat hierarchies.

Furthermore, the results reveal, that business model change is favored by iterative approaches. In this approach, the development project is divided into iterations, gradually adapted and continuously improved. The iterative approach allows to conclude customer feedback into the definition of goals of the next development cycles. Teece (2010) confirms that iterative processes favor business model development. In addition, business model development benefits from standardized process models, which are the focus of the development team. For example, "Zeta Digital" has a special "venture development process". According to Z2 this innovation process gives employees the opportunity to develop digital business models "from an idea to an innovation". Likewise, Eta has a newly introduced, defined process for business model development. Essential aspects of these new processes are the experimentation and mutual learning with the customer. In research, these experimental processes are recognized to contribute to the success of business model development (Chesbrough 2010; McGrath 2010; Sosna et al. 2010).

Within the processes people from a wide range of disciplines are involved. The development teams are very versatile and characterized by "many different abilities in each person" (EP1). The literature points out that particularly in large established firms DCs are less dependent on individuals (Foss and Saebi 2015). Therefore, when considering the staff conditions, the totality of the workforce is decisive. The development of digital business models increasingly requires IT-skills and interdisciplinary professionals. For example, E2, ET1 and T1 underpin the involvement of mobile app developers, data scientists, back-end developers and data security experts in the development process. However, in developing digital business models, established functions such as marketing, sales, legal or accounting are also essential. In addition, the business model development benefits from newly created, special functions. At Eta, for example, the in-house consultants of the central unit for business model innovation support cross-divisional development projects. This result is in line with the findings of Foss and Saebi (2015), who recommend the building of dedicated functions to support and manage business model development.

To sum up, the results show that the organizational context have a very strong influence on business model change in the context of digitization. Overall, they can be seen as a prerequisite for successful business model development in these turbulent times. In their study on organizational design in the digital age, Kane et al. (2016) also identify very similar framework conditions. Only processes are defined as tasks, but the differences in meaning are minor. In their findings, the authors outline the role of the "digital congruence", defining it as the congruent behavior of structure, culture, processes and personnel among themselves as well as in relation to the strategic orientation of a firm. In their view, this is the key to success in complex digital business. The idea can also be transferred to this work, which is confirmed by the research results. All cases have created new structures with an agile and innovative culture that best fit the iterative learning and experimentation processes for product owners and IT-developers. Thus, there is an alignment between structure, culture, processes and people. On the other hand, there is a clear strategic orientation towards digitization and the development of digital business models. Thus, a high coherence of strategy and organization design can be observed in the case studies. As proposed by Foss and Saebi (2017) and Teece (2018), internal contextual factors have a moderating effect on DCs. The case study results illustrate the significant influence of the strategy and the organization's design on the manifestation of DCs. The cases Beta, Gamma and Delta also note, that strategy was given direction for sensing, while the vision was a crucial orientation point for seizing and transforming capabilities. In line with this, Teece (2014) underpin the high interrelation between strategy and DCs and considers "diagnosis" for sensing, and "guiding policy" and "coherent action" for seizing and transforming as the strategic core elements of the respective dimensions. Just as important are the structural conditions, as they create the organizational conditions for sensing, seizing and transforming. Concerning this matter, Wilden et al. (2013) and Foss und Saebi (2015) consider decentralized decision-making processes as conducive to DCs. These is particularly pointed out by both experts from Delta. In addition, Beta and Gamma state that cultural characteristics are generally very conducive to DCs. This view is also taken in the literature (Anyanwu 2016; O'Connor 2008). In part, culture is even a prerequisite for the effective execution of activities. Thus, E 2 suggest that a feedback culture has to be created for the retrospective when developing the business model in an agile working mode. Since DCs are needed continuously, iterative learning and experimentation processes are very relevant, especially for sensing and seizing (Mezger 2014). As stated by Beta and Gamma these are closely related to the entire agile approach and therefore also to a multitude of activities. In addition, people are considered to be significant to DC in order to effectively carry out the activities (B1; G1).

7.2 Leadership mindset

In addition to the strategy and organizational design, the function of the management is integrated into the overarching view. Business model development represents

strategic matters for which the necessary framework conditions have to be created at management level (Foss and Saebi 2015).

According to all experts, the management occupies a crucial position in the development of business models, as it not only fulfills the requirements of commitment and agile mindset, but also has to create the necessary strategic and organizational framework conditions. Consequently, leadership significantly influences the DCs. The great influence of leadership on the strength of corporate DCs is also emphasized by Helfat ann Martin (2015) and Teece et al. (2016). In this regard, Anyanwu (2016) claims that the development of business models in a market environment which is characterized by uncertainty and rapid change requires special skills from management. Here, the author differentiates between dynamic entrepreneurial and dynamic managerial capabilities. In addition, she assumes that the first-mentioned capabilities are needed primarily for sensing, while dynamic managerial capabilities are necessary for seizing and transforming (Anyanwu 2016). Teece also argues that within the dimension sensing dynamic entrepreneurial capabilities are fundamental for anticipating market changes and proactively acting in a volatile environment (Teece 2012; Teece et al. 2016). This can be illustrated by two examples of the study. First, at Gamma some managers with very visionary skills in the search and identification process for new business options were involved: *"(…) people who started at two years back where the real visionaries, who said: I think this data can be useful for companies! And now everyone is catching up."* (G2). In a similar way, in case Beta, many entrepreneurs within the company dealt intensively with new topics, worked out a vision, and then implemented them step by step. Second, dynamic managerial capabilities are described as managers' abilities to build, integrate or reconfigure the resources and competencies of an organization (Adner and Helfat 2003). They are seen to be more relevant in seizing and transforming, whereby the leadership plays a notable role (Day and Schoemaker 2016; Teece 2007; Feiler and Teece 2014). This perception is evident in several cases. Alpha indicates that business model growth must be healthy. The expert from Beta extends this statement by adding that the management is strongly challenged in this context in order not to lose the focus, the vision and the agile mindset. Furthermore, expert A2 emphasizes that new leadership qualities are needed, especially when implementing the solution in agile working mode. Autonomy, purpose and appreciation are considered as the three central criteria, so that the IT developers have certain freedoms, have a specification regarding the purpose of their work and at the same time receive recognition. The expert underlines in this respect: "(…) you also have to protect such IT groups from traditional management methods, so this classic top-down, as in the military, that just does not work." (A2). Gamma and Delta also address the issue of possible resistance within the organization to growth and cooperation. Expert G2 sees the management as responsible for this: *"(…) the guy who is the CEO of the business, needs to have this bigger picture and see how different pieces within his pieces fit in there."* In addition, the planning and investment decisions are subjected to "a sound management decision" (A1). Therefore, Anyanwu's propositions (2016) can be accepted.

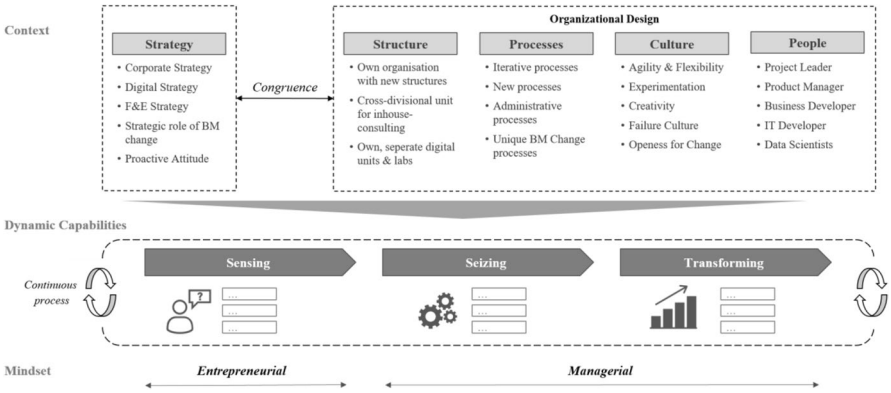

Fig. 8 Comprehensive view on the relationship between dynamic capabilities and organizational factors

8 Discussion and implications

The results reveal that all cases have strong DCs in adapting or innovating business models in the age of digitization. Overall 13 CCs were identified, which can be build up by a broad range of activities. It has been shown that DCs are generally unique, company-specific, non-imitable and differ among the three dimensions. Nevertheless we identified that some CCs are comparatively more relevant in the context of digitization. We found, that a proactively and broad search behavior is characteristic for all cases. As well the increased focus on IT-activities and organizational or technical restructuring measures. In addition, we identified several distinct activities (e.g. scrum-based agile and iterative process development, search activities, collaboration activities as well as activities related to bundling and developing competencies), which are also crucial for adopting to new environmental conditions triggered by the digital age. In this context, an effective and context-appropriate orchestration of the individual activities is necessary for successful business model change, since they are interrelated and complementary. Furthermore, in developing new business models, DCs are continually required and need to be continuously developed or adopted. Finally, our results reveal, that relational capabilities are highlighted as a dominant type of DC. With regard to contextual factors, all cases reveal a strong alignment of the organization´s strategy and design to new challenges of digitization. The congruence of structure, culture, processes and people as well as the strategy was recognized as a prerequisite for success in business model change. In this regard, interdependencies between the DCs and the strategy as well as the design of the organization could be found. Moreover, our results highlight the key role of leadership in the considered context. In order to counteract the challenges of digitization, management must have dynamic entrepreneurial capabilities for sensing and dynamic managerial capabilities for seizing and transforming.

Overall it can be concluded, that DCs are only effective, if there is an alignment between strategy, organizational design and appropriate leadership mindset. Figure 8

summarizes the relationship between organizational factors, DCs and leadership mindset.

8.1 Theoretical implications

This explorative study unifies for the first time the research areas of DCV and business model change in the specific context of digitization. In doing so, a profound construct of the DCs with the sub dimensions of the CCs and activities as micro processes and options for building DCs was derived. Thus, our work can be considered as a theoretical and empirical extension of the studies by Achtenhagen et al. (2013), Mezger (2014) and Inigo et al. (2017). The operationalization of the construct using the dimensions sensing, seizing and transforming in terms of business model change proved to be very suitable. In contrast to Demil and Lecocq (2010) and Mezger (2014), which stated DC as a business model change, we ascertain that DC facilitates business model change. Our results show, that in rapidly changing environments such as the digital era, established firms need strong DCs to overcome challenges in business model development. Corresponding to Feiler and Teece (2014), we argue that these processes require a composite of CCs and along with this, an effective orchestration of activities. DCs are particularly advantageous in a turbulent and dynamic environment, as they are firm specific, unique and not imitable (Pezeshkan et al. 2016; Teece et al. 1997). This was also apparent in the cross-case analysis. We further found evidence that the manifestations of sensing, seizing and transforming vary in dependence of business model type and firm´s organizational context. This correlates with Teece´s (2018) proposition, who assumes a variation of the individual dimensions.

Further, recent literature (Foss and Saebi 2015; Teece 2018) points out that DCs are continuously required in the business model development process, in order to proactively take advantage of new business opportunities and respond to threats. This is even more relevant in highly dynamic market environments (Teece 2012). Indeed, our results confirm the strategic relevance of DCs, showing that successful adopting to environmental turbulences constantly requires DCs and consequently also sensing, seizing and transforming capabilities.

Another key finding is that in the age of digitization, firms must increasingly have relational capabilities in order to successfully build new resources and develop new business models. We provide first evidence for the central role of orchestrating internal and external cooperation activities (Foss and Saebi 2015; Teece 2014). In particular, against the background of digitization as external influence factor, we further were able to classify the DC construct in a more detailed way, by specifying the 13 identified CCs into two new categories, namely in general and distinct digital capabilities.

In terms of the role of internal framework conditions, we significantly contribute to close existing research gap as postulated by Schneider and Spieth (2013) as well as Foss and Saebi (2017). Thus, strategic and organizational prerequisites required for digital transformational processes were in-depth analyzed and their coherence

illustrated. This also supports Kane´s et al. (2016) proposed digital congruence, defined as the alignment between culture, people, structure, and processes with firm´s strategic orientation and challenges arising from an ongoing changing digital landscape. Our results expands Kane´s view, by transferring his argument to the DC construct. Accordingly, we empirically confirm the assumed independencies between DCs with the strategic and organizational orientation of a firm (Foss and Saebi 2015; Teece 2018).

In addition, the study also refers to contextual variables at the individual level. We confirm Anyanwu´s (2016) proposition related to the crucial role of dynamic entrepreneurial and managerial capabilities in driving DC processes. While dynamic entrepreneurial capabilities are particularly required for sensing, managerial capabilities are more important for seizing and transforming processes. Consequently, in order to be able to explore new business opportunities, managers should be encouraged to change their mindset towards an entrepreneurial leadership style characterized by proactivity, flexibility, risk aversion and openness in decision-making and creating new pathways. Besides, in order to exploit these new opportunities and implement transformational processes, dynamic managerial capabilities are required. Our results indicate that close involvement of management in development activities as well as management commitment to organizational and strategic change are essential for business model change.

To sum up, our findings not only highlight the positive relationship between DCs and business model change, but also illustrate the context in which it is favorable.

8.2 Managerial implications

The results of our research imply numerous action-based recommendations for firms and practitioners, which are confronted with challenges caused by the digital disruption. The results of the study show that the proactive search for new business opportunities and the decision to develop business models are an effective response to the high industry dynamism. The considered firms are all best practice examples in their industries and illustrate the importance of these development processes for long-term sustainability. The case studies illustrate the feasible design of digital business model elements and demonstrate how digital technologies can be used in practice in a targeted manner.

Furthermore, our findings reveal that ordinary capabilities are not sufficient for a successful development of digital business models. There is a need for strong DCs, which are deeply embedded in strategy and organizational structure.

In general, the insights can serve as a kind of checklist for required DCs. Further, the set of illustrated activities offer a guideline for building and implementing DCs. Important to note is the significance of orchestrating activities for the effectiveness of capability building. It has to be pointed out, that these activities describe a multitude of action options, which have to be applied contextually and in different time. The choice of suitable measures varies in dependence of the business model type and underlying contextual factors. Moreover

the specification of DCs in general and digital capabilities, allows manager to balance which capabilities to adapt, develop or build up in view of the given requirement. The described relational capabilities are intended to raise awareness of their immense significance in terms of business model change. External and internal cooperation as well as customer centric relations have been identified as the crucial key elements for enhancing firm´s DCs and in turn the success of business model change. In contrast to other identified CCs, the three mentioned capabilities are embedded along all dimensions sensing, seizing and transforming.

Networking effects are not only crucial in terms of building digital platforms, but also along the whole development process. In general, the customer has to be in the middle of all activities, whereby partnerships should not only be maintained, but new cooperation should be consciously entered and digital ecosystems built up in the long term. On the other hand, internal networking and information exchange should be promoted through effective communication and sharing of best practices.

The development of cooperation with different partner types requires not only a strong openness and new mindset. In general, the whole digital transformation process requires the creation of a new contextual setting. In particular established firms encounter difficulties and hurdles due to path dependencies. Therefore, it is crucial to create necessary conditions with a suitable strategic orientation to digitization and a congruent design of the organization. The focus should be on building a new unit separate from the core business, an innovation culture characterized by openness, flexibility and risk-taking and a mix of highly motivated, IT-savvy employees. In addition, it is advisable to focus more on an agile and iterative approach, whereby administrative processes throughout the company must be adapted to the new conditions of digitization. Thereby the management plays a special role as the driver of change. The findings show that business model development in the digital business is not comparable with traditional routines from the business development process. The speed and complexity require high requirements in terms of commitment and deeper engagement and an agile mindset for digitization initiatives in the management. Consequently, entrepreneurial capabilities and high leadership skills seem to play an important role for managers in the digital age.

9 Limitations and future research directions

Although this study provides significant contributions to theory building and practice, our work is constrained by content-related and methodological limitations. Despite the strong focus on a high quality case study analysis and a robust research sample, we cannot ensure generalizability of results to all types of industries and firms. For this reason, further case studies covering different firm-, industry- or geographical-specific contexts are required to investigate additional CCs and activities.

Furthermore, we call for additional quantitative-research to specify the significance of the CCs framework and the identified activities. For this purpose, the presented DC construct offer a valid basis for evaluating DC dimensions and underlying CCs. In addition, the significance and effectiveness of the identified activities should be empirically tested and prioritized for practice-relevant recommendations. Another interesting starting point for future research could be focused on empirically validating the presented contextual factors, e.g. the role of strategy and organizational design as well as leadership mindset in a more detailed way. In this context, reference should also be made to the importance of dynamic entrepreneurial and dynamic managerial capabilities. In addition, they might be other variables that affect the relationship between DC and business model change.

Besides, the selected cases were restricted to established large firms from Germany, therefore it would be interesting to analyze how SME cope with challenges caused by digitization progress and how they build and develop DCs. In particular, the transmission of our results to SME and start-ups, emerged during the digital age, might provide exciting insights. Alongside identifying further activities, DC characteristics and framework conditions could be compared with the findings from established firms.

Although the study highlights the strategic relevance of DCs for business model change and provides a comprehensive view to underlying micro-foundations and contingencies, we were not able to show which DCs are essential in supporting different business model dynamics and to which extent in turbulent environments. Therefore, we encourage further studies to evaluate if antecedents and effects of DCs vary among different scope and degree of business model change. This could significantly improve the understanding of the effectiveness and degree of influence of DC in terms of business model change and thus close another research gap.

Another interesting research domain would be to illuminate the types of DCs required for business model change. We made an initial attempt to map different types of distinct DCs relevant in the digital context, by providing a classification framework of general and new specific CCs. Further research should specify in a more differentiated way to what extent the required capabilities in the digital age differ from those needed in the past and how such (digital) capabilities can be build.

A further restriction is related to our findings in terms of deeper process analysis. As our study reveals numerous results concerning CCs, related activities and (sub-) processes, we were not able to illuminate all findings in a reasonable depth. This therefore requires further empirical efforts to investigate specific factors, processes and causal mechanisms in more detail and thus deepen our understanding of DCs, in particular how companies can build and orchestrate DCs necessary for the business model change in the digital context. For example, we provide evidence, that internal and external cooperation activities play a crucial role in building capabilities along all three DC dimensions. We show that firms interact with various external partners such as customers, competitors,

suppliers and start-ups or put on cross-industry partnerships in building digital ecosystems and platforms. Cooperation per se and the related knowledge, integration and coordination processes are nothing new, but the network patterns and quality of partnerships in the digital age are changing. Thus, we have to rethink our prevailing knowledge about cooperative behavior and relational capabilities and call for more research contributing to understand the underlying processes and required DCs for partnerships. Particularly, as digital platforms and ecosystems may become the next competitive factors which determine the success or failure of a business model, we need to investigate what distinct DCs and CCs are required for building and managing digital platforms. Moreover, managing such multilateral relationships is not an easy task. For instance, incorporating new knowledge in routinized processes and orchestrating the variety of existing and new resources is a complex mechanism and poses several organizational challenges to most firms. Thus, further in-depth studies are required to contribute to the understanding of the underlying processes and how firms overcome related challenges. Beyond that, tracking the development and implementation of a digital business model over time, could provide more detailed process-related insights regarding the question how DCs are initiated, build and orchestrated. A longitudinal case study approach could help to understand how DCs contribute to undertake strategic and organizational change processes and how firms manage emerging challenges.

Generally speaking, for riding on the wave of digitization it is vital for firms to know the required capabilities and understand the underlying mechanism behind that. To say it in the word of *H. Jackson Brown, Jr. "When you can not change the direction of the wind, adjust your sails"*. This is why we call for more empirical work exploring business model change from a capability based view.

Appendix

See Table 7.

Table 7 Critical capabilities and activities per case

Critical capabilities	Activities	Alpha	Beta	Gamma	Delta	Epsilon	Zeta	Eta	Theta	Σ
SENSING										
Early recognition of market dynamics and trends (SEN_1)	Industry benchmarking		x	x		x			x	4
	Analysis of best practices				x	x				2
	Trend monitoring and market screening	x		x	x		x	x		5
	Detailed evaluation of market potential						x	x		2
	Participation in market surveys of customers	x								1
	Exchange with cross-divisional units	x		x						2
Number of activities within SEN_1										**16**
Integration of customers into the ideation phase (SEN_2)	Feedback sessions with customers	x				x			x	3
	Ideation phase with lead users		x			x	x	x		4
	Co-creation workshops	x		x				x		3
	Voice of the customer program				x					1
Number of activities within SEN_2										**11**
Modelling value proposition and value capturing mechanism (SEN_3)	Specification of the benefit promise	x	x		x	x	x			5
	Cross-industry imitation and adaptation							x	x	2
	Conception of the business model prototype						x	x	x	3
	Conception of revenue model options	x		x						2
Number of activities within SEN_3										**12**
Involvement of external partners into the ideation phase (SEN_4)	Cross-industry networking					x				1
	Industry networking		x			x				2
	Start-up involvment		x	x		x	x	x	x	6
	Research cooperation with external partners	x			x		x	x		4
	Building an ecosystem of strategic partners		x							1
	Hackathons with externals			x						1
Number of activities within SEN_4										**15**
Number of sensing activities		***8***	***6***	***7***	***5***	***8***	***8***	***8***	***5***	***54***

Table 7 (continued)

Critical capabilities	Activities	Alpha	Beta	Gamma	Delta	Epsilon	Zeta	Eta	Theta	Σ
SEIZING										
Appropriate organization of development competences (SEI_1)	Joint development with external partners		x		x		x		x	4
	Bundling cross-department competences	x		x		x	x	x	x	6
	Offshoring/outsourcing of IT develop. activities	x		x						2
Number of activities within SEI_1										**12**
Agile working mode to develop business models (SEI_2)	Scrum-based agile development	x	x	x	x	x	x	x	x	8
	Lean-start-up methodology							x	x	2
	End-to-end development	x	x							2
	Communities of practices		x							1
Number of activities within SEI_2										**13**
Continuous customer integration into the development process (SEI_3)	Feedback systems for the design of services	x	x							2
	Customer feedback after every iteration cycle		x	x		x		x	x	5
	Piloting and testing services with lead user				x	x	x	x	x	5
Number of activities within SEI_3										**12**
Effective implementation of key IT-activities (SEI_4)	Special IT security measure		x	x	x	x	x		x	6
	Building a sustainable platform architecture	x	x	x	x	x				5
	Customized design of the user interface					x	x			2
	Synchronization of development processes							x		1
	Data models and data analysis			x	x			x		3
	Consistent data protection regulation			x	x				x	3
Number of activities within SEI_4										**20**
Number of seizing activities		***6***	***8***	***8***	***7***	***7***	***6***	***7***	***8***	***57***

Table 7 (continued)

Critical capabilities	Activities	Alpha	Beta	Gamma	Delta	Epsilon	Zeta	Eta	Theta	Σ
TRANSFORMING										
Future-oriented organizational design and transformation (TRA_1)	Implementation of an internal restructuring		x		x	x		x	x	5
	Fundamental renewal of the IT organization					x				1
	Scaling in separate unit		x				x	x		2
	Acquisitions and strategic investments	x		x						2
	Building data analytics competences	x	x	x	x					4
	(Re)integration in existing structures					x	x	x	x	4
Number of activities within TRA_1										**18**
Sustainable provision and development of key competences (TRA_2)	Internal competence development	x		x		x	x	x	x	6
	Realignment of recruiting				x		x		x	3
	Promotion of interdisciplinary IT teams	x	x					x		3
Number of activites within TRA_2										**12**
Enhancing know-how exchange and internal communication (TRA_3)	Platforms and channels for information bundling	x		x	x		x	x	x	3
	Special formats for regular exchange		x		x	x	x			4
	Cross-sectoral events, communities and initiatives		x		x	x		x		4
Number of activities within TRA_3										**11**
Intensive customer support and interaction (TRA_4)	Conference with customers	x								1
	Customer interaction via key accounts		x	x		x	x			4
	Customer Support Concept for problem cases			x	x				x	3
	Integration of customers in portfolio planning				x	x				2

Table 7 (continued)

Critical capabilities	Activities	Alpha	Beta	Gamma	Delta	Epsilon	Zeta	Eta	Theta	Σ
Number of activities within TRA_4										**10**
Scaling the business model through partnerships (TRA_5)	Cooperation with cross-industry partners	x			x		x			3
	Integration of partners into the platform		x	x			x			3
	Introduction of an accelerator for start-ups		x							1
	Data exchange with partner				x					1
Number of activities within TRA_5										**9**
Number of transforming activities		***8***	***9***	***7***	***11***	***8***	***9***	***7***	***4***	***63***
Total number of activities per case		***22***	***23***	***22***	***23***	***23***	***23***	***22***	***17***	***175***

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