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Harnessing dynamic capabilities for data-driven business model innovation in incumbents

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ABSTRACT

Data-driven business model innovation (DDBMI) leverages digital technologies to seize opportunities and address challenges, yet incumbents often struggle due to their reliance on existing capabilities. This study investigates the dynamic capabilities (DCs) incumbents need for DDBMI. It employs a multistage literature search, topic modeling to identify nine DDBMI global themes, thematic synthesis to generalize these themes, and qualitative content analysis to delineate the digital and strategic DCs necessary for their implementation. The study presents a structured approach to DDBMI through the development of the value-added concept, elaborated via four interrelated frameworks that (1) list DCs applied in DDBMI, (2) outline how to define, identify, and deploy DCs, (3) integrate DC implementation into the DDBMI process, and (4) map the value-added concept onto the four phases of the BMI process. Methodologically, the study advances data-driven literature reviews by adopting a multi-method approach. Theoretically, it contributes to DC theory by integrating it with DDBMI and identifying DCs as key enablers of the successful implementation of DDBMs. Practically, we provide guidance for practitioners on defining, identifying, and deploying DCs to drive value creation and sustainability in DDBMI through our proposed meta-level conceptual framework.

1. Introduction

Data-driven business model innovation (DDBMI) can be a strategy for incumbents to leverage digital technologies, seize opportunities, and address the challenges they cause. However, incumbents often struggle to implement data-driven business models (DDBMs) because they rely on existing capabilities and resources (Kim & Min, 2015; Lantano, Petruzzelli, & Panniello, 2022). Dynamic capabilities (DCs) enable incumbents to monitor the external environment, identify emerging opportunities, and integrate novel components into their business models (BMs) (Teece, 2018).

Current research highlights a theoretical challenge: Incumbents struggle with BMI, with a low success rate for BMI initiatives (Haftor & Climent Costa, 2023). However, a more nuanced theoretical understanding of incumbents' strategic transformation processes due to digital

disruption is needed (Fielt, Westerveld, Desouza, & Gable, 2018).

From a practical perspective, digitalization presents both challenges and prospects for incumbents to review their current strategies and pursue innovative business opportunities to enhance their ability to propose, deliver, capture, and create value. Incumbents face unique challenges during DDBMI, including acquiring and using relevant data (Sorescu, 2017), transforming physical products into smart products and services (Beverungen, Müller, Matzner, Mendling, & vom Brocke, 2017; Carsten, Monika, Jörg, & Benedikt, 2018), and shifting sales models toward pay-per-use or pay-per-outcome (Ettl, Harsha, Papush, & Perakis, 2020; Riesener, Kuhn, Blondrath, Tariq, & Schuh, 2023). With the rise of big data, advanced data analytics, and artificial intelligence (AI), the development of new DDBMs is driven (Fielt, Desouza, Gable, & Westerveld, 2019), and questions arise about how companies can capture data's potential to enhance existing BMs or develop new DDBMs

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(Hunke, Seebacher, Schüritz, & Illi, 2017). While many companies recognize the economic opportunities offered by using data, they underutilize the potential of DDBMs. This underutilization stems from the lack of data-driven technologies (e.g., machine learning (ML), AI) and capabilities (e.g., data analytics, data management) required for BMI (Breitfuss, Fruhwirth, Pammer-Schindler, Stern, & Dennerlein, 2019).

Social considerations provide additional motivation for research on DDBMI. Förster, Bansemir, and Roth (2022) identify a crucial social dimension: The unrealized value of DDBMs may stem from companies overlooking their employees' perspectives on value realization from data. Their research reveals significant differences in employees' perspectives, which can serve as a critical mechanism for innovation as they challenge potentially one-sided DDBM ideas for value realization (Förster et al., 2022).

Against this backdrop of theoretical, practical, and social motivations, this study addresses the following research questions: (1) *What DCs are required by incumbents for DDBMI?* (2) *How do incumbents define, identify, and deploy DCs to undergo DDBMI?* (3) *How should a framework be designed to support companies in implementing DDBMs?* We answer these questions by extending the work of Tripathi, Bachmann, Brunner, and Jodlbauer (2024) and adapting their topic classification—comprising value enablers, value makers, and value outcomes—to incorporate a DC perspective. The study presents a structured approach to DDBMI by developing the value-added concept. This framework (a) lists DCs applied in DDBMI, (b) outlines how to define, identify, and deploy the DCs necessary to establish value enablers and makers and ensure value outcomes, and (c) integrates DC implementation into the DDBMI process. Finally, the value-added concept is mapped onto the four phases of the BMI process—initiation, ideation, integration, and implementation—reinforcing an iterative approach to BMI and enhancing the understanding of how DCs facilitate DDBMI.

The paper is structured as follows: First, we present the theoretical background, covering incumbents' BMs and BMI, DDBMs and DDBMI, and DCs. Second, we outline our methodology, which comprises a multistage literature search, topic modeling to identify nine global themes, thematic synthesis to generalize these global themes, and qualitative content analysis to delineate the DCs required for their implementation. Third, we present our findings on the DCs required by incumbents for DDBMI. Fourth, the following section discusses the value-added concept, its accompanying frameworks, and the theoretical and managerial implications. Finally, the paper concludes by outlining its limitations and suggesting avenues for future research.

2. Theoretical background

2.1. Business models and business model innovation of incumbents

A BM is an abstract logic of the four dimensions of value proposition, delivery, creation, and capture (Teece, 2010). It explains how a firm operates and creates value for its customers while ensuring sustainable financial success (Magretta, 2002). First, the value proposition expresses the intended added value for the customer through products, services, and the job to be done (Latifi, Nikou, & Bouwman, 2021; Massa & Tucci, 2013), the latter being a concept that involves understanding customer needs and designing products and services to fulfill those needs effectively. Second, value delivery ensures efficient processes, personalized channels, and customer support through target segments, channels, and relationships. The interaction between BMs and digital technologies creates an ecosystem of suppliers, distributors, partners, and customers, enabling manufacturers to offer smart solution value propositions (Chen, Visnjic, Parida, & Zhang, 2021). Third, value creation maximizes customer-perceived value, meets customer needs, and minimizes associated risks through key activities, processes, resources, technologies, partnerships, and ecosystems. Fourth, the value capture maximizes revenues and minimizes costs through revenue models and cost structures (Johnson, Christensen, & Kagermann, 2008).

BMI is a multifaceted process that involves overcoming barriers and requires the application of effective methods and tools. Successfully implementing BMI initiatives necessitates organizational agility, experimentation, and effective change leadership (Chesbrough, 2010). BMI can involve adding new key activities, linking activities in novel ways, altering the parties performing activities, or modifying any of the four BM dimensions (Amit & Zott, 2012). For incumbents, BMI is an iterative process, requiring incremental changes to existing BMs while maintaining compatibility with established systems (Lantano et al., 2022; Sosna, Treviño-Rodríguez, & Velamuri, 2010). The novelty of BMI can be incremental, evolutionary, or radical, depending on the extent of changes to BM dimensions (Bachmann & Jodlbauer, 2023; Jodlbauer, 2020).

2.2. Data-driven business models and data-driven business model innovation of incumbents

DDBMs use data as a key resource, with data processing and analysis as key activities (Hartmann, Zaki, Feldmann, & Neely, 2016). DDBMs can be differentiated based on the data source they utilize (non-user or user data), the target audience they address (consumer or organization focus), and the technological effort they require (low or high) (Engelbrecht, Gerlach, & Widjaja, 2016). Through data collection and analysis, companies can assess market demand, identify opportunities, reduce operational costs, uncover new revenue streams, develop new BMs, or refine existing ones (Cheah & Wang, 2017). DDBMs integrate data analysis into their value propositions by deriving customer benefits through the analysis of customer data (top-down) and addressing customer needs based on usage data (bottom-up) (Benta, Wilberg, Hollauer, & Omer, 2017). By monetizing customer data, DDBMs redefine the value network, create new revenue streams, implement new cost models, and make customers value co-creators (Breidbach & Maglio, 2020; Elorza & Castellano, 2022). To support co-creation for the development of data products, Fruhwirth, Breitfuss, and Pammer-Schindler (2020), Fruhwirth, Ropposch, & Pammer-Schindler, 2020 developed the Data Product Canvas.

The need for BMI often arises during crises or in highly competitive markets (Saebi, Lien, & Foss, 2017). Mancuso, Messeni Petruzzelli, and Panniello (2023b) present a model for digital BMI in response to crises, which consists of three phases: (1) Enabling factors that support, trigger, and facilitate digital BMI activities; (2) modifications to fast-moving value mechanisms, which rely on technologies to respond to crises rapidly; and (3) unrivaled growth strategies that leverage technologies for long-term innovation actions. Beyond crises, technological innovations can drive DDBMI. By integrating physical and digital realities, Metaverse opportunities innovate BMs' value creation and capture mechanisms (Mancuso, Messeni Petruzzelli, & Panniello, 2023a). Incumbents adapt their BMs in response to digital innovation; successfully implementing DDBMI requires them to leverage digital technologies (Sabatini, Cucculelli, & Gregori, 2022) to optimize resource allocation (Paiola, Agostini, Grandinetti, & Nosella, 2022), adjust their approach based on the resources they must mobilize, and reconfigure their activity systems (D'Ippolito, Messeni Petruzzelli, & Panniello, 2019). DDBMI can be supported by different methods and tools, such as the Data Insight Generator, which combines DDBMs' key resources and value propositions (Kühne & Böhmman, 2020).

Data-driven technologies, such as Industry 4.0 (I4.0), the Internet of Things (IoT), AI, and big data, offer opportunities to transform traditional BMs into DDBMs (Fruhwirth, Ropposch, & Pammer-Schindler, 2020). However, their application poses several risks, such as unwanted knowledge leaks within the DDBMI process (Fruhwirth, Pammer-Schindler, & Thalmann, 2021, 2024) and ethical challenges (Breidbach & Maglio, 2020). I4.0 technologies drive DDBMI by optimizing processes, enhancing customer relationships, establishing new value networks, and developing smart products and services (Frank, Mendes, Ayala, & Ghezzi, 2019; Ibarra, Ganzarain, & Igartua, 2018;

Jodlbauer & Strasser, 2016; Müller, Buliga, & Voigt, 2018). The transformation of product-centric BMs into service-centric ones (i.e., servitization) (Frank et al., 2019) is supported by manufacturing companies leveraging IoT (Hasselblatt, Huikkola, Kohtamäki, & Nickell, 2018), while data-driven AI algorithms and analytics enable smart services under a pay-for-performance approach (Aranda, Tsitsanis, Georgopoulos, & Longares, 2023). Big data drives the transition from service-centric BMs to DDBMs (Marcinkowski & Gawin, 2021), as well as from one-sided BMs to two-sided DDBMs (Hmoud, Salim, & Yaakub, 2017). By optimizing current services and developing partnerships, digital multi-sided platforms can leverage data and data analytics to establish DDBMs (Isabelle, Westerlund, Mane, & Leminen, 2020).

2.3. Capabilities portfolio

Teece (2018) identifies three types of capabilities. At the foundational level, operational and ordinary capabilities manage routine activities, administration, and basic governance, such as in standard production programs. Building on these are 2nd-order DCs, which adjust and recombine ordinary capabilities to develop new ones, exemplified by new product development. At the top level, 1st-order DCs (sense, seize, and transform) enhance both ordinary and 2nd-order DCs. These are crucial for BMI: management senses future opportunities, develops new BMs to seize these opportunities, and transforms the organization to align with future plans. Hence, managerial competency in innovating BMs is a key DC.

Top management should prioritize 1st-order DCs for effective BMI, addressing company challenges and exploiting opportunities. Since DCs are context-dependent, a digital capability may be operational or ordinary for one firm and dynamic for another (Mele, Capaldo, Secundo, & Corvello, 2024). Incumbents often struggle with BMI because their established capabilities and resources, which have historically created and captured value, can become obstacles (Kim & Min, 2015; Lantano et al., 2022). Strategies involving DCs are crucial, enabling incumbents to monitor the external environment, identify opportunities, and integrate new elements into their BMs (Helfat & Raubitschek, 2018). Lange, Drews, and Höft (2021) identified four capabilities—data, technology, organization, and monetization capabilities—to characterize the DDBMI process of incumbents.

3. Method and research design

This study builds on the work of Tripathi et al. (2024) by employing the same methodological approach: a multistage literature search, topic modeling (automated text mining), and thematic synthesis (see Fig. 1). We extend their method by incorporating qualitative content analysis (Fingfeld-Connett, 2014) to gain deeper insights into the content of the included studies. Through this approach, we identify DCs as essential prerequisites of DDBMI, leading us to adapt the topic classification of Tripathi et al. (2024) to incorporate a DC perspective. Based on these findings, we present a structured approach to DDBMI by outlining a framework for defining, identifying, and deploying the DCs necessary to establish value enablers and makers.

3.1. Multistage literature search

We conducted a multistage literature search in the Scopus database,

focusing on titles, keywords, and abstracts. The search was unrestricted by time, scientific discipline, ranking, or publication medium, allowing for the inclusion of journal articles and conference papers. The only requirement was that the documents be in English. We used two search strings:

(incumbents) = “business model” AND (incumbent OR established OR mature) AND (“data driven” OR “big data” OR “artificial intelligence” OR “machine learning” OR IoT OR IIoT OR digitalization OR “machine learning” OR “deep learning” OR “process mining”)

s (incumbent manufacturers) = s (incumbents) AND (manufacture OR manufacturing OR production OR “industry 4.0”).

The first category includes only terms related to “incumbents,” while the second category also includes terms related to “manufacturing.” This yielded 275 publications on DDBMs of incumbents, excluding manufacturing-related terms (first sample), and 138 publications on DDBMs of incumbent manufacturers (second sample), with no overlap between the samples.

3.2. Topic modeling

The samples identified through the literature search were used for topic modeling (automated text mining) via Latent Dirichlet Allocation (LDA) (Blei, Ng, & Jordan, 2003; Jelodar et al., 2019) to identify topics in both samples and integrate them. Adaptive LDA model selection employed semantic coherence (Mimno, Wallach, Talley, Leenders, & McCallum, 2011) and exclusivity metrics (Airoldi & Bischof, 2016; Bischof & Airoldi, 2012).

The overall method is as follows: The data for the topic modeling includes the title, abstract, and keywords from each document, collectively known as the corpus. A document-term matrix (DTM) is then created from the corpus, where each row represents a document, each column represents a word (term), and each cell indicates the frequency of a word in the document.

LDA is a statistical model that estimates the distribution of a given number of topics (k) within each document and the distribution of words for each topic (k) based on the DTM. In LDA, a topic is defined as a probability distribution over an entire set of words, indicating how likely each word is to appear within a topic. Each document is considered a mixture of topics.

LDA operates on a likelihood maximization approach, inferring two matrices: the document-topic distribution matrix (which estimates the distribution of topics within each document) and the topic-word distribution matrix (which estimates the distribution of words within each topic) for a given number of topics ($k = 2, 3, \dots, n$), where k represents the number of topics, and p denotes the number of terms in the DTM. For practical and meaningful topic extraction, the number of topics should be smaller than the number of keywords, i.e., $n \ll p$. The topic-word distribution matrix for each topic identifies the most probable words that frequently co-occur, which are then defined as the representative keywords of the topic.

Two metrics are applied to optimize the number of topics (k): coherence and exclusivity. Coherence is measured from the topic-word distribution for a given k and assesses how often the top words of a topic co-occur in the corpus, reflecting their semantic relatedness. Exclusivity measures how distinct a topic is compared to others, ensuring minimal overlap between topics. To optimize k , both coherence (indicating topic interpretability) and exclusivity (indicating topic distinctness)

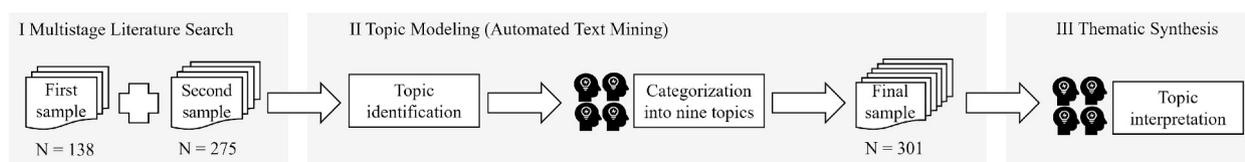


Fig. 1. Methodological Approach.

tiveness) should be high. From the LDA modeling of the corpus, we identified seven topics ($k = 7$) across both samples.

In the topic modeling, the identified topics reveal different interrelated themes (see Table A1 and A2 in the Appendix). For example, among the seven topics in the second sample, Topic 6 exhibits the highest mean proportion and includes the following top thirty keywords:

“business,” “digit,” “model,” “business model,” “innovate,” “transform,” “digital transformation,” “technological,” “incumbent,” “company,” “value,” “industrial,” “model innovation,” “digital technological,” “research,” “study,” “service,” “digital business,” “firm,” “energy,” “digital innovation,” “datum,” “manage,” “understand,” “case,” “disrupt,” “change,” “develop,” “strategic,” “base.”

The words within this topic can be categorized into various themes, such as BMs and strategy (“business model,” “company,” “firm,” “value,” “service,” “digital business,” “strategic,” “develop,” “change,” “manage,” “disrupt”), digital transformation (“digit,” “digital

Table 1
Thematic networks from basic themes to organizing themes to global themes.

Global themes	Organizing themes	Basic themes (selected from refined keywords)
Digitalization	Digital technology	Digital technology
	Digital business and economy	Digital business; digital economy; digital entrepreneurship; digital leadership
	Digital change and adaptation	Digital transformation; digital disruption; dynamic capability
	Digital innovation and development	Digital innovation; digital model
Sustainability	Digital manufacturing	Digital manufacture
	Digital connectivity	Online
	Circular economy business model	Circular economy; CE; circular business; circularity
Sustainability	Sustainable business model	Sustainable business; sustainable environment
	Sustainable energy systems	Energy market; energy transition; energy; renewable energy; local energy
	Sustainable innovation	Eco-design
Platformization	Resource orchestration	Resource orchestration
	Platform related	Platform; digital platform;
	technological components, functionality, architecture	multisided platform; integrated system
	Platform-driven business	Platform business; platform company
Platformization	Platform-based ecosystem	Ecosystem; business ecosystem; alliance
	Platform dynamics	Collaborate; cooperate; intercommunicate; interact
	Key IoT terms and concepts	Internet of things; IoT; industrial internet of things; IIoT; connect
Internet of Things	IoT-enabled intelligent system	Autonomous; automation
	IoT ecosystem	Software; cloud; virtual; sensors
	IoT-driven transformation in manufacturing	3D print; smart retrofit; retrofit
	IoT-enabled information system	Information system
Servitization	Key servitization concepts	Servitization; digital servitization
	Service-oriented architecture	Service orientation; service composition
	Product service system	Service system; product service
	Service enterprises	Service; professional service; service business; service firm
Artificial Intelligence	Artificial intelligence	Artificial intelligence; AI
Big Data Sharing Economy	Big data	Big data
	Sharing economy concept	Share; sharing economy
Mobile Network	Shared mobility business model	Shared mobility; mobility hubs
	Business transformation through mobile networks	Mobile networks; mobile; omni; omni channel

Table 2
Comparison of Prior Research with This Study on DCs in DDBMI.

Aspect	Existing Studies	Our Study
Scope	Focus on enabling firms to strategically adapt by sensing, seizing, and transforming processes or BMs (Brewis et al., 2023; Liao & Xie, 2024; Santa-Maria et al., 2022; Sjödin et al., 2023; Warner & Wäger, 2019).	Adopts a broader scope, covering the integration of nine global themes for DCs required for DDBMI.
	Focus on frameworks and process models for multi-domain DCs (Abebe et al., 2024; Albino et al., 2023; Sjödin et al., 2023).	Develops a framework for DCs, providing actionable insights for leveraging DCs in DDBMI.
	Address digitalization (Abebe et al., 2024; Albino et al., 2023; Wardhana et al., 2023; Warner & Wäger, 2019).	
	Address data-driven DCs (Brewis et al., 2023; Liao & Xie, 2024; Sjödin et al., 2023).	
Sensing, seizing, and transforming DCs	Address BMI (Pascucci et al., 2024; Santa-Maria et al., 2022; Sjödin et al., 2023).	
	Address sustainability integration, where DCs act as intermediaries by facilitating data-driven technologies to drive business outcomes.	Identifies key DCs under emerging global themes. Develops a framework for the definition, identification, and deployment of DCs. Tailors the framework to the DCs necessary for implementing value enablers, value makers, and value outcomes in DDBMI.
Methodology	Present sensing, seizing, and transforming as a foundational framework.	Uses topic modeling, thematic synthesis, and qualitative content analysis.
Theoretical Focus	Use mixed methods (qualitative analysis, case studies, surveys).	Positions DCs as enablers of iterative DDBMI processes.
Framework Development	Position DCs as mediators for outcomes.	Derives a structured framework for implementing DDBMIs.
	Derive general strategies, models, and frameworks addressing challenges and transformations in individual domains.	Provides insights into the BMI process and its three value levels across all four phases of BMI.
	Discuss how DCs enable firms to adapt and navigate challenges, improve competitiveness, and achieve sustainable performance through circular BMI.	

transformation,” “digital technological,” “digital innovation,” “technological,” “transform,” “develop,” “digital”), industrial context (“industrial,” “energy,” “incumbent,” “firm,” “company”), and value and change (“value,” “disrupt,” “strategic”).

The topics identified through topic modeling highlight their interconnectedness and can be industry-specific. For instance, the aforementioned themes—BM and strategy, digital transformation, industrial context, and value and change—may be particularly relevant to specific industries. However, we sought to identify key themes that can be described independently from the identified topics and can be generalized in the context of BMI. For example, while BMs and digital transformation appear in the context of energy-related concepts or industries, these themes are broadly applicable across various industries. We applied a thematic synthesis approach to derive general topics that are particularly relevant for incumbents’ DDBMI. This generalization of

topics is crucial for identifying core concepts that serve as key drivers foundational to incumbents' DDBMI.

3.3. Thematic synthesis

Thematic synthesis, a qualitative analysis method (Thomas & Harden, 2008), follows a two-step approach. First, terms are selected from the topics to describe the most important concepts of BMI. Second, the most relevant and distinctive themes for incumbents' DDBMI are identified. Thematic synthesis encompasses all steps of manual topic analysis and consists of three layers: basic themes, organizing themes, and global themes.

We applied thematic synthesis for thematic categorization to generalize the topics identified by LDA. To enhance the interpretability of topic generalization, we used the topic word distribution matrix to select the top thirty keywords, along with FREX keywords (high frequency and unique to the topic) (Bischof & Airoidi, 2012), as codes for basic themes that frequently co-occur with other industry-specific terms.

These core theme keywords are analyzed within the network of thematic codes. The basic themes are categorized into 29 organizing themes, which are further grouped into nine global themes related to DDBMI (see Table 1). The process of thematic synthesis was iterative, refining the organizing themes to improve their explanatory power in relation to DDBMI and the global themes.

The nine global themes relevant to DDBMs of incumbents are digitalization, IoT, AI, big data, mobile networks, platformization, servitization, sharing economy, and sustainability. Phrases derived from the network of themes (see Table 1) are italicized in the descriptions (see Section 4, Findings).

3.4. Qualitative content analysis

We combined topic modeling and thematic synthesis with qualitative content analysis (Finfgeld-Connett, 2014) to gain deeper insights into the content of the included studies. The procedure of Finfgeld-Connett

(2014) consists of five steps: (1) reviewing articles to identify relevant data segments and codes, (2) recording data, (3) synthesizing coded findings across studies, (4) diagramming findings to illustrate relationships between codes, and (5) iteratively reflecting on ideas and their interconnections. Following this approach, DCs emerged as essential prerequisites of DDBMI, appearing in articles across all nine global themes. Four interrelated frameworks elaborating on the value-added concept were developed: (1) the value-added concept for DCs in DDBMI (see Fig. 2), (2) the value-added concept for the definition, identification, and deployment of DCs (see Fig. 3), (3) the value-added concept for integrating DC implementation into the DDBMI process (see Fig. 4), and (4) the value-added concept mapped to the BMI process (see Fig. 5).

4. Findings

4.1. Dynamic capabilities for data-driven business model innovation

We build on the work by Tripathi et al. (2024) on the preparedness of DDBMs and adapt their topic classification—comprising the three levels of value enablers, value makers, and value outcomes—by incorporating a DC perspective (see Fig. 2). Value enablers encompass foundational digitalization technologies such as IoT, AI, big data, and mobile networks. Value makers include platformization, servitization, and the sharing economy, enabling incumbents to propose, deliver, capture, and create value. Since both value enablers and value makers are essential for BM success, we summarize them as value drivers (Ammirato, Linzalone, & Felicetti, 2021). A value outcome of DDBMI is sustainability, which addresses all three dimensions: economic, environmental, and social. By combining value drivers with the value outcome level, we introduce a framework called the *value-added concept*.

The levels of the value-added concept influence one another, as indicated by the arrows in Fig. 2. First, the interaction between value enablers and value makers is exemplified by the implementation of digitalization and digital technologies (e.g., the IoT and big data) (i.e.,

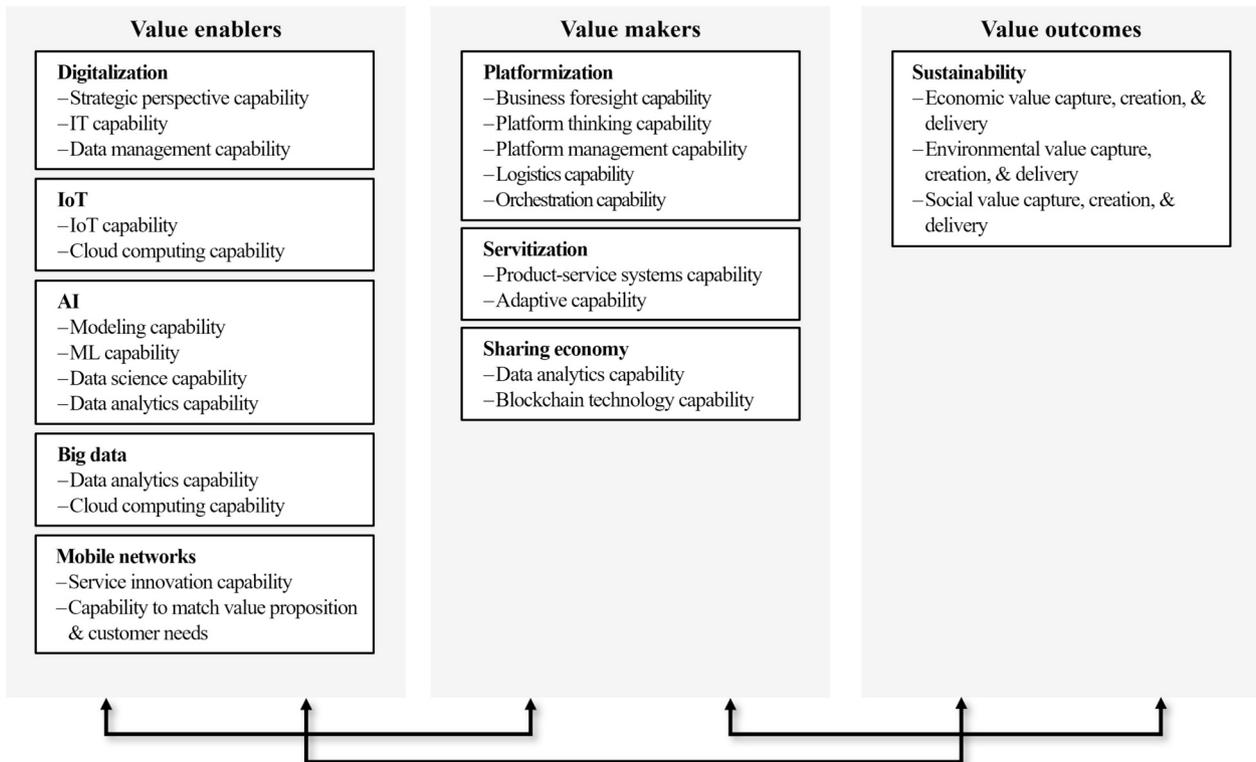


Fig. 2. The Value-Added Concept for DCs in DDBMI.

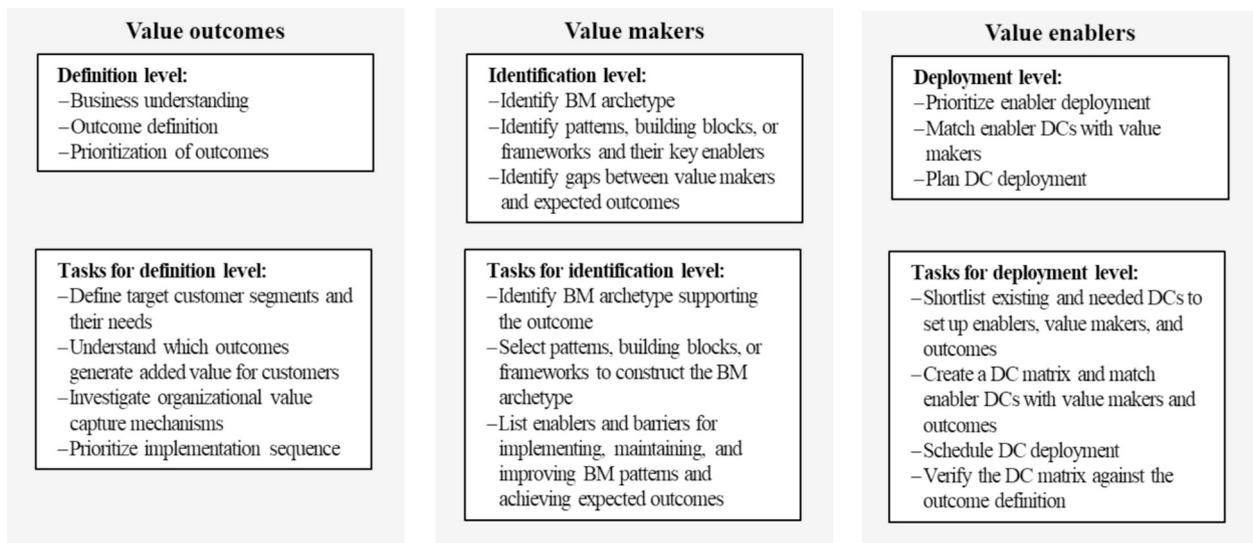


Fig. 3. The Value-Added Concept for DC Definition, Identification, and Deployment.

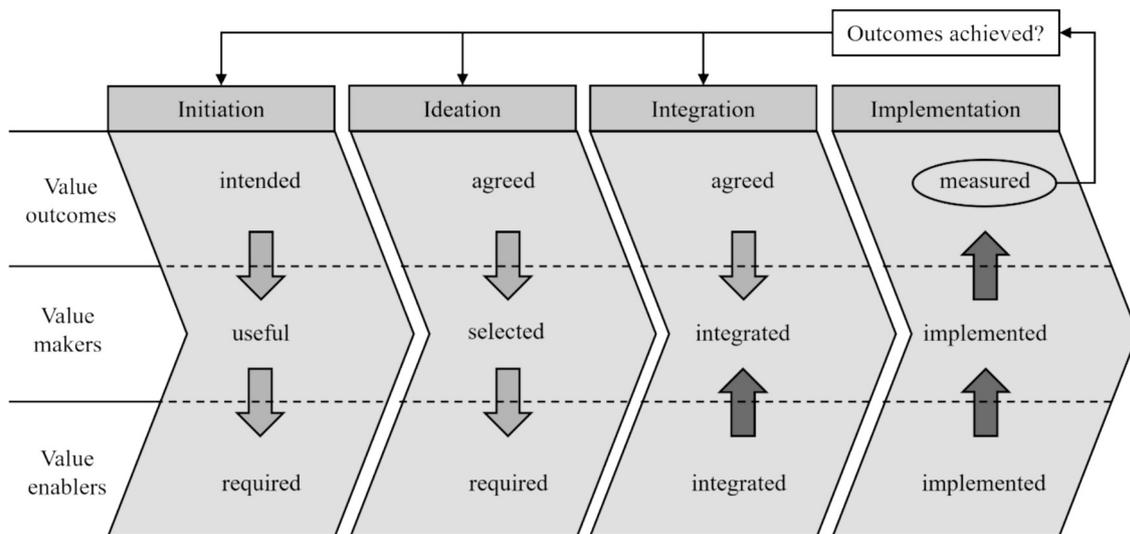


Fig. 4. The Value-Added Concept for Integrating DC Implementation in the BMI Process.

value enablers), which positively influences the development of servitization (i.e., a value maker) (Harrmann, Eggert, & Böhm, 2023; Koh-tamäki, Parida, Patel, & Gebauer, 2020). Second, the relationship between value enablers and value outcomes is illustrated by the positive impact of digitalization on companies' sustainability performance (Li et al., 2023). Third, the connection between value makers and value outcomes is demonstrated by the sharing economy and servitization (i.e., value makers), which contribute to sustainable value creation (Ciulli & Kolk, 2019; Laukkanen & Tura, 2020), generate positive environmental and social outcomes (Paschou, Rapaccini, Adrodegari, & Sac-cani, 2020), and enhance sustainable performance (Niu, Jiang, Geng, & Jiang, 2021).

The following sections provide a brief description of the nine global themes. As previously mentioned, phrases derived from the network of themes are italicized. For a more detailed overview of the references, excerpts, and basic codes on which the findings are based, readers are referred to Table A3 in the Appendix. This table comprises three columns: (1) references to the analyzed articles, (2) excerpts corresponding to each basic theme, and (3) the derived basic codes, which are emphasized through italicization in the narrative.

4.1.1. Value enablers of data-driven business model innovation

Value enablers, the first value driver in our value-added concept, comprise the foundational technologies of digitalization, such as IoT, AI, big data, and mobile networks. To implement these technologies, incumbents require digital capabilities (e.g., data management and data analytics) and strategic capabilities (e.g., strategic perspective and service innovation).

4.1.1.1. Digitalization. Digitalization leverages digital technologies such as mobile applications, AI, blockchain, IoT, and data analytics to enhance customer experiences, optimize operations, and create new DDBMs. Digitalization helps restructure value chains, supports the shift toward service-oriented BMs, and fosters sustainable practices. Successful digitalization requires companies to develop dynamic capabilities, including a strategic perspective capability. This involves adopting vertical and horizontal integration technologies, shop floor digitalization, IT capability, and data management capability. These digital capabilities enable firms to effectively utilize tools and digital technologies, ensuring the digital transformation of their BMs.

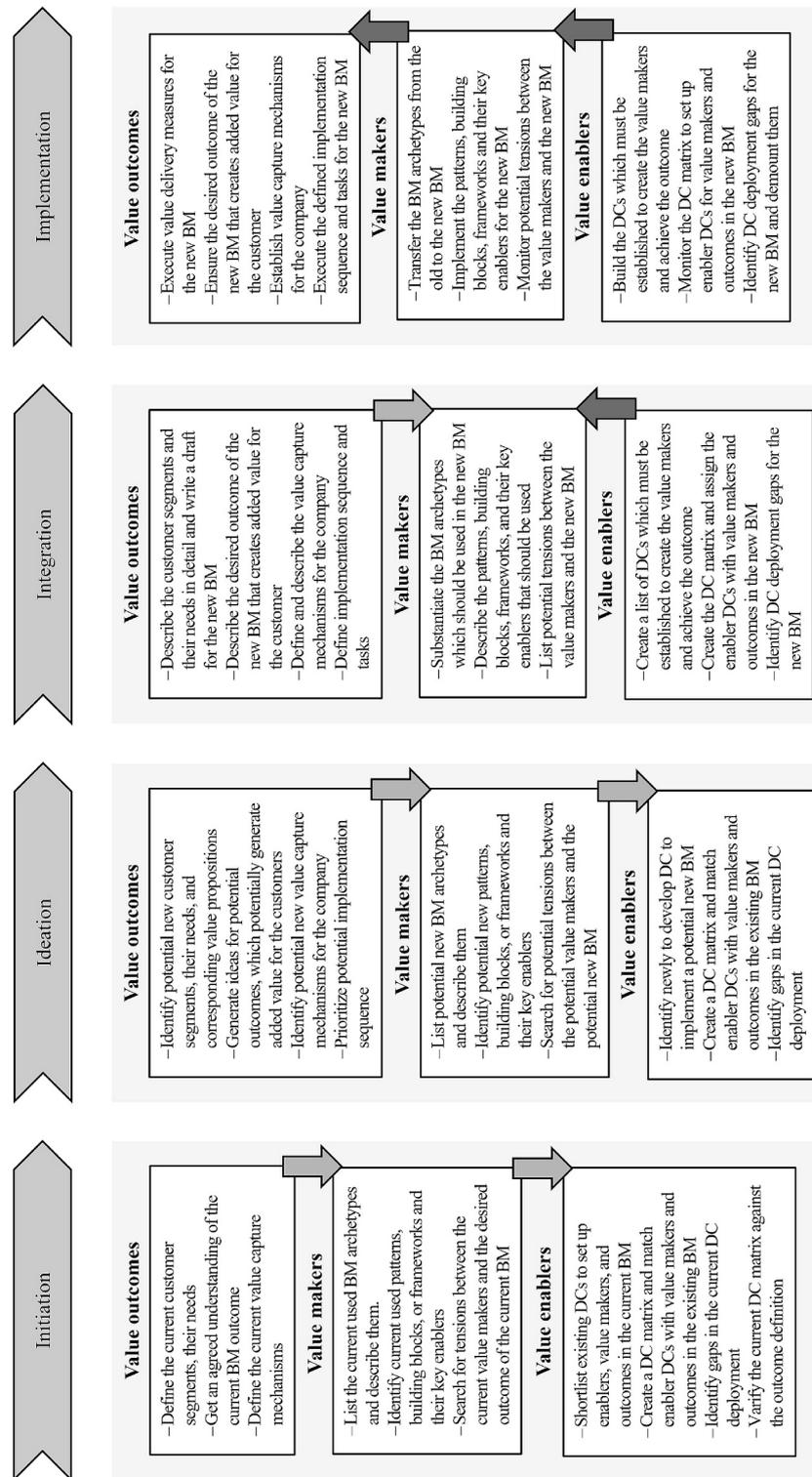


Fig. 5. Mapping the Value-Added Concept to the BMI Process.

4.1.1.2. *Internet of things.* The *IoT* enables new approaches to value creation and BMI, improves resource efficiency in material usage, energy consumption, and human labor, and enhances physical products. While *IoT ecosystems* connect the *virtual* and physical worlds, it is essential to ensure interoperability and collaboration between companies and individuals to coordinate objectives and tasks. Challenges in interoperability and scalable collaboration across production networks arise from heterogeneous devices, network types, and communication

protocols. Incumbents need *IoT* and cloud computing capabilities to integrate ecosystems into value-based *IoT* platforms, leverage *IoT* technologies, and develop service-oriented BMs.

4.1.1.3. *Artificial intelligence.* *AI* encompasses functions in which machines are programmed to replicate human-like cognitive processes, including environmental perception, information processing, and decision-making. These functions facilitate intelligent behavior,

Table 3
Comparison of Practical Implications Between Prior Research and This Study.

Aspect	Other Studies – Further Research	Our Study's Contribution
DCs in BMI	Present the impact of different types of DCs on BMI in various industries and contexts. Investigate the role of digital transformation (Lin, Zhang, Yan, & Jiang, 2020).	Provides deep insight into the BMI process and the impact of DCs on different value levels. Conceptualizes sustainability as a value outcome and platformization as a value maker. Integrates digital transformation through the inclusion of various value enablers.
DCs as sustainable BMI drivers	Analyze the connection between DCs and sustainable BMI. Propose a framework to connect DCs with BMI processes (Oliveira-Dias, Kneipp, Bichueti, & Gomes, 2022).	Identifies sustainability as a global theme and the primary value outcome across all three dimensions, making it the goal of DDBMI. Proposes a framework to map DCs across the three value levels in the BMI process, offering a deeper understanding of DDBMI.
Sensing, seizing, and transforming DCs	Focus on organizational and managerial DCs to enhance sustainability. Present a framework supporting sensing, seizing, and transforming, but it is not mapped to the BMI process (Inigo, Albareda, & Ritala, 2017).	Focuses on DCs for DDBMI to enhance sustainability. Supports sensing, seizing, and transforming while linking DCs to the three value levels and the BMI process.
DCs for circular BMI	Find that DCs can facilitate digital circular BMI and increase sustainability. State the need for further research to examine the long-term impacts of digital circular BMI on organizational performance (van Eechoud & Ganzaroli, 2023).	Suggests that combining our approach for DDBMI using DCs could support the framework of van Eechoud and Ganzaroli (2023). Proposes that mapping DCs to the BMI process, measuring the outcomes, and the possibility of reworking and improving value enablers, makers, and outcomes are beneficial.

enabling machines to autonomously analyze the environment and execute actions. Scalable AI capabilities through BMI are achieved by developing interdependent AI capabilities, applying DDBMI principles to ensure scalability, and leveraging scaling mechanisms. To fully utilize AI, incumbents must possess capabilities in modeling, ML, data science, and data analytics.

4.1.1.4. Big data. *Big data* enhances manufacturing applications and transforms incumbents by optimizing internal and external processes, improving customer interfaces, creating new ecosystems and value networks, and facilitating BMI. The potential for DDBMI is further amplified by integrating *big data* and the IoT with smart data—i.e., small multidimensional organizational data. For incumbents to effectively leverage *big data*, they must possess digital capabilities. These include data analytics for processing and analyzing large volumes of data and cloud computing for designing, developing, and maintaining *big data* systems. A broad range of manufacturing technologies can profit from *big data*, like additive manufacturing or robotics and automation.

4.1.1.5. Mobile network. Online channels have become the primary mode of customer interaction as digitalization permeates consumer businesses. Consequently, technology providers in the *mobile network* are adopting new BMs. Companies transitioning to online *omnichannel* retailing must ensure seamless customer experiences, integrated analytics systems, and efficient supply chains. To navigate this transition

successfully, companies require strategic capabilities for service innovation and aligning value propositions with customer needs.

4.1.2. Value makers of data-driven business model innovation

Value makers, the second value driver in our value-added concept, enable incumbents to propose, deliver, capture, and create value. They include the concepts of platformization, servitization, and the sharing economy. Businesses must possess or develop digital capabilities (e.g., platform management and product-service systems) and strategic capabilities (e.g., business foresight and orchestration) to adapt and evolve their operations.

4.1.2.1. Platformization. *Digital platforms* enable companies to create *ecosystems*, facilitate *interactions* among market actors, and gather knowledge. By providing the *technological infrastructure* for *multi-sided* markets, *platformization* supports new BMs, enabling incumbents to both compete and *collaborate* with new entrants while capitalizing on network effects and new revenue streams. To navigate this transformation, incumbents must develop strategic capabilities, such as business foresight, as well as digital capabilities, including *digital platform* thinking and management. Modular *technological architectures* are crucial for integrating *platforms* within *ecosystems* and supply chains, requiring logistics capability and orchestration capability to optimize operations and manage customer relationships.

4.1.2.2. Servitization. *Servitization* aligns *product-service systems* with new value propositions, thereby transforming traditional product-centric BMs into *service-centric* ones. *Service-centric* BMI enables incumbents to enter new markets by offering *digital services*, ultimately creating *digital servitized* ecosystems that support digital technology utilization and value management. The maturity of *digital servitized* ecosystems influences the adoption of *product-service systems*. Digital capabilities for leveraging digital technology and enhancing digital maturity include *product-service systems* capability and adaptive capability.

4.1.2.3. Sharing economy. The *sharing economy* relies on digital technologies, such as platforms, to connect diverse users, foster collaborative societal systems, and facilitate collaborative consumption while reducing resource usage. Successful value creation involves new marketing strategies and engaging customers as co-producers. To leverage the *sharing economy*, incumbents need digital capabilities in data analytics and blockchain technology.

4.1.3. Value outcomes of data-driven business model innovation

The global theme of *sustainability*, addressing its environmental, social, and economic dimensions, is identified as a value outcome of DDBMI. Digital technologies facilitate the advancement of *sustainability*, ensuring environmental benefits, social well-being, and a strong economic foundation for companies. These technologies support *environmental sustainability* by helping companies track CO₂ emissions, supply chain emissions, and *energy* consumption while also reducing waste, incorporating *circularity* into product lifecycles, and enhancing social procurement. Regarding *social sustainability*, digital technologies improve customer support through digital services, promote a better work-life balance through remote work, and enhance the accessibility and comprehension of training programs. For *economic sustainability*, digital technologies enhance customer satisfaction, reduce churn rates, and foster repeat business, ultimately delivering value outcomes for companies.

Sustainable business practices are supported by companies' capabilities to capture, create, and deliver value. Achieving *sustainability* requires changes in BMs, such as adopting *circular economy* principles. The *circular economy* has become a key value proposition in the pursuit of *sustainability*. Strategic capabilities are essential for facilitating the

transition from linear BMs to *circular economy BMs*, as *circular economy BMs* maximize *resource utilization* and ensure the economically, environmentally, and socially *sustainable* value delivery.

5. Discussion

5.1. Dynamic capability definition, identification, and deployment

We developed a framework for defining, identifying, and deploying DCs based on the digital and strategic DCs required for implementing the value-added concept (see Fig. 3). This framework is extended to integrate DC implementation into the BMI process (see Fig. 4) and is mapped onto the four phases of the BMI process (see Fig. 5).

To define, identify, and deploy DCs, the value-added concept outlines value outcomes at the definition level, value makers at the identification level, and value enablers at the deployment level. Unlike the representation in Fig. 2, the process begins with value outcomes in this context. Companies seeking to implement DDBMs must specify the value outcomes they aim to achieve before aligning them with their selection of relevant value makers and required value enablers.

First, value outcomes are specified at the definition level: Defining the intended value outcome involves a comprehensive understanding of the business context, the ecosystem, and the company's position within it. The outcome definition involves defining the goal of the DDBMI, providing a clear description of the company's value proposition, outlining the value added for customers to meet their needs (Das & Nayak, 2022), and offering a comprehensive understanding of the jobs to be done for the customers (Christensen, Hall, Dillon, & Duncan, 2016). As customers face challenges across all three levels of sustainability—economic, environmental, and social—companies must define their outcomes accordingly (Brunner, Bachmann, Tripathi, Pöchtrager, & Jodlbauer, 2024; Pepin, Tremblay, Audebrand, & Chassé, 2024). A company's value outcome must define a value proposition that addresses its customers' needs and supports them in achieving their jobs to be done across all three sustainability levels. In addition to fulfilling customer needs at all three levels of sustainability, it is equally essential to create value for the company at these levels. A comprehensive business understanding has an ambiguous effect; it supports the customers in achieving their goals and ensures value co-creation for the company (Fawcett, Fawcett, Knemeyer, Brockhaus, & Webb, 2021). Through DDBMI, the value outcome can be achieved to address these customer needs. However, in addition to the customer-centric perspective and the added value delivery to the customer, value capture for the company itself must also be clearly defined. As value delivery and value capture are interrelated, the offered added value in all three sustainability dimensions must lead to value capture in those same dimensions for the company. To ensure purposeful implementation, it is necessary to clearly define and prioritize the desired value outcome.

Tasks at the definition level include understanding, defining, and describing the target customer segments and their needs, which is the first step in developing the DCs needed later. Next, knowledge about which value outcomes generate added value for the customer or consumer must be acquired. Then, the company's value capture mechanisms are investigated. Finally, the sequence of implementation should be prioritized to ensure the effective and efficient achievement of the desired value outcome.

Second, value makers are selected at the identification level: The identification of an appropriate BM archetype and the associated relevant patterns, building blocks, or frameworks, as well as the linked key value enablers for each identified BM archetype (Bocken, Short, Rana, & Evans, 2014), are necessary to achieve the intended value outcome. These identified value enablers will later serve as the cornerstone for the future BM archetype and, consequently, for DDBMI. It is also necessary to identify corresponding shortcomings in the value enablers. Shortcomings, in this sense, prevent the intended value outcomes from being achieved.

Tasks at the identification level include identifying a BM archetype that supports attaining the desired value outcome. Relevant patterns, building blocks, or frameworks are then selected to construct the BM archetype using creative methods and synergy, confrontation, or combination approaches (Gassmann, Frankenberger, & Choudury, 2021). Next, all necessary value enablers for implementing, maintaining, and improving the BM pattern are listed. Finally, all the required value enablers are reviewed, and any potential barriers to implementing, maintaining, and improving the BM pattern and achieving the expected value outcome are identified (Bocken & Geradts, 2020) using failure modes and effects analysis (FMEA).

Third, value enablers are selected at the deployment level: Listing and prioritizing value enablers is collaborative and crucial. It not only aids in effectively deploying them but also values the user's input. Therefore, value enabler DCs must be matched with the value makers to fully align with them, and DC deployment needs to be planned and scheduled.

Tasks at the deployment level include creating a shortlist of necessary and existing DCs required to establish the value-added concept. Subsequently, a DC matrix that matches the relevant value enabler DCs to support the value makers and, subsequently, value outcomes must be developed. This is followed by planning and scheduling the deployment of the identified DCs (Cavusgil & Deligonul, 2025). Finally, the DC matrix must be reviewed and verified against the defined value outcomes to identify and address any blind spots, a process that values the user's insights and expertise.

5.1.1. Integrating dynamic capability implementation in the BMI process

To fully leverage the potential of DCs for supporting DDBMI, it is essential to closely examine the innovation process. Therefore, we refer to the four phases of the innovation process as outlined by Frankenberger, Weiblen, Csik, and Gassmann (2013). We present the conceptual framework at a meta-level (see Fig. 4) and then extend our previously defined framework by mapping the definition, identification, and deployment levels onto the innovation process phases (see Fig. 5). In recent years, scholars have developed extensions, revisions, details, or adaptations of the framework by Frankenberger et al. (2013) (Bachmann & Jodlbauer, 2023). Our conceptual framework outlines value outcomes at the definition level, value makers at the identification level, and value enablers at the deployment level. These three levels occur during each step of the BMI process, but with a different processing sequence.

In the initiation phase, it is essential to clarify the intended value outcomes (e.g., business understanding, outcome definition, or prioritization of outcomes) before proceeding to the value makers level. Following this, it is crucial to identify potential useful value makers (e.g., BM archetypes, BM building blocks, or BM patterns). Identifying the required value enablers follows the identification of the value makers, and these value drivers are essential for building the DCs necessary for DDBMI. This first process step is characterized by exploration, creativity, testing, and searching in all directions.

In the ideation phase, the value outcomes are agreed upon and confirmed. Once this task is completed, selecting the appropriate value makers from the suggestions made in the prior process step is necessary. Any remaining potential value makers not selected can be stored in an idea repository. After the selected value makers are confirmed, the required DCs must be identified and shortlisted for further consideration.

In the integration phase, the processing sequence is modified. The value outcome determined in the ideation phase serves as the input for the value makers. These value makers must support achieving the value outcomes intended to meet the customer's needs. Another input for the value makers is the set of integrated value enablers, which are essential for connecting the value makers with the later BM.

In the implementation phase, the processing sequence changes again, beginning with the now-implemented value enablers necessary to

implement the value makers. These value makers ensure the value outcome of the DDBMI. The value outcomes must be measured to identify variations from the intended value outcomes. If the key performance indicators (KPIs) used to measure the intended value outcomes do not meet expectations, all phases of the BMI process must be iterated. Possible reasons for a discrepancy between the measured and intended value outcomes could include missing DCs that have not yet been implemented, BM building blocks that do not support customer needs, or new customer needs that have emerged over time.

5.1.2. Mapping the value-added concept to the BMI process

Having introduced the conceptual framework, we now assign specific tasks for our value-added concept to the specific BMI process phases. The innovation process must examine each level (value outcomes, value makers, and value enablers) in every process phase. This continuous examination will redefine the value outcomes, value makers, and the necessary DCs throughout the BMI process. We follow the approaches outlined in the framework for implementing the value-added concept (see Fig. 3) and the meta-level framework for integrating DC implementation into the BMI process (see Fig. 4). This process begins with defining the value outcomes, then identifying the value makers, and ultimately focusing on the deployment level. This sequence is visualized with the light grey arrows. An exception occurs in the integration and implementation phases, where the order is (partly) reversed. This sequence is indicated with dark grey arrows to highlight the change, as illustrated in the meta-level framework (see Fig. 4).

The initiation phase involves investigating the current BM by analyzing its value outcomes, value makers, and value enablers. It is crucial to define the current customer segments, the BM outcome, and the existing value capture mechanisms (Batocchio, Ghezzi, & Rangone, 2016). Once the value outcome is determined, all relevant BM archetypes, patterns, and key enablers that should support achieving the BM outcome must be listed. The initiation phase should also identify potential tensions between the current BM and its value makers. Subsequently, it is important to shortlist all existing DCs required to establish the value enablers, value makers, and value outcomes by the end of the initiation phase (Karlsson, Hoveskog, Halila, & Mattsson, 2018). A DC matrix should be created to gain an overview of the existing DCs and their alignment with the value makers and value outcomes. This matrix helps identify potential gaps in the existing DCs, which must then be verified against the defined and desired value outcomes.

The ideation phase focuses on idea generation and creativity, aiming to develop potential new value outcomes, BMs, and DCs. In contrast, the initiation phase assesses the current status across all three levels. The first task in the ideation phase is identifying potential new customer segments, their needs, and corresponding value propositions (Chesbrough, Lettl, & Ritter, 2018). In addition to identifying these new segments, needs, and value propositions, it is essential to generate ideas for future added value for customers. Equally important is considering the internal value added by identifying potential new value capture mechanisms for the company (Sjodin, Parida, Jovanovic, & Visnjic, 2020). The second task in this phase, similar to the second task in the initiation phase, involves identifying new BM archetypes, patterns, building blocks, and so on, without referencing the current ones (Gassmann et al., 2021). Potential tensions between the new BM and value makers must also be anticipated. The final task of this process phase is to identify all necessary new DCs, visualize them in a matrix, and highlight gaps between existing and missing DCs.

The integration phase shifts from idea generation to integration. This phase requires a detailed description of the new BM, including the needs of customer segments and the desired value outcomes that will create added value for customers. Also, defining and describing the value capture mechanisms for the company from an internal perspective is crucial (Lager, Simms, & Frishammar, 2023). Furthermore, the implementation sequence and subsequent necessary tasks must be determined. As with the value outcomes, the value makers should be

substantiated, and the BM archetypes, patterns, building blocks, and their key enablers should be described. This task should conclude with identifying potential tensions to be aware of (Andriopoulos & Lewis, 2009). The final task in this process phase is to list the DCs necessary for creating the value makers and achieving the value outcomes. The existing DC matrix must be refined, and any deployment gaps must be identified.

The implementation phase changes the sequence logic. The first task is to build the DCs necessary for implementing the new value makers, thereby transforming the BM. Any gaps must be identified and addressed. Subsequently, all tasks defined at the definition level, such as implementing new BM archetypes, patterns, building blocks, and their key enablers, must also be executed for the new value makers. Potential tensions between value makers and the new BM must be monitored to identify them at an early stage (Batocchio et al., 2016). This process is broken down into the definition, identification, and deployment levels. The final task is to execute the new value delivery measures and ensure that the added value (across all three levels of sustainability) from the new BM reaches the customer (Alonso-Martinez & Di Maria, 2021). In addition to delivering value-added to the customer, it is critical to ensure the successful establishment of value capture mechanisms for the company.

5.2. Theoretical and managerial implications

Our study makes three distinct contributions across methodological, theoretical, and practical dimensions. First, our study adopts a multi-method approach, combining a multistage literature search, topic modeling, thematic synthesis, and qualitative content analysis. We contribute to the field of data-driven literature reviews by using automated text analysis for systematic literature mining to explore the co-occurrence of interdependent keywords and identify nine relevant global themes. Additionally, our research advances DC theory by integrating it with DDBMI and identifying DCs as key prerequisites for the successful implementation of DDBMs.

Second, the study identifies DCs across nine global themes, categorized into three groups: value enablers, value makers, and value outcomes, which are summarized as the value-added concept. We examine the specific capabilities necessary to establish value drivers (value enablers and value makers) and achieve the planned value outcomes. Leveraging value enablers requires digital capabilities in areas such as cloud computing and data analytics, as well as strategic capabilities, including driving service innovation. Value makers enable incumbents to effectively propose, deliver, capture, and create value through DDBMs, for example, through servitization, which integrates digital technologies and value-added services to enhance competitiveness (Minaya, Avella, & Trespalacios, 2024). Implementing value-maker concepts requires strategic capabilities, including business foresight. A key value outcome of DDBMI is sustainability, enabled by firms' capabilities to create, capture, and deliver economic, environmental, and social value. Therefore, our research provides a more actionable understanding of how companies can leverage DCs for DDBMI.

Third, we propose a meta-level conceptual framework for DDBMI, introducing the value-added concept for defining, identifying, and deploying DCs. This framework integrates DC implementation into the DDBMI process and is mapped onto the four phases of the BMI process, as outlined by Frankenberger et al. (2013). Serving as a practical guide for practitioners, the framework supports them in navigating the DDBMI process by assisting with the definition, identification, and deployment of the digital and strategic DCs required to implement value drivers and value outcomes, ultimately facilitating successful DDBMI.

Comparing existing research with our study highlights its added value, particularly for practitioners navigating real-world challenges (see Table 2). Previous studies on DCs related to DDBMI primarily focus on DCs as mediators that enable firms to strategically adapt through sensing, seizing, and transforming processes or BMs. These studies

examine barriers, challenges, and opportunities in identifying or developing DCs. Various frameworks and process models have been proposed with different focuses, including digital transformation (Abebe, Tangpong, & Ndofor, 2024; Albino, da Silva, & de Souza, 2023; Wardhana, Gautama So, Warganegara, & Hamsal, 2023; Warner & Wäger, 2019), big data (Brewis, Dibb, & Meadows, 2023; Liao & Xie, 2024), AI-enabled BMs (Sjödin, Parida, & Kohtamäki, 2023), the Industrial Internet of Things (Xu, Shahzad, & Hu, 2025), and circular BMI (Pascucci, Pizzichini, Sabatini, Temperini, & Mueller, 2024; Santa-Maria, Vermeulen, & Baumgartner, 2022; Sjödin et al., 2023).

Building on insights from prior case study research and identified research gaps, we demonstrate how our theoretical findings and conceptual framework provide practical benefits (see Table 3). Research on frameworks for harnessing DCs to support BMI is a promising and evolving field, as evidenced by complementary studies on capability deployment configurations (Wilhelm, Maurer, & Ebers, 2022), the necessity of DCs for rapid adaptation in dynamic environments (Cavusgil & Deligonul, 2025), and the role of BM frameworks in addressing market shifts (Khodaei & Ortt, 2019).

Previous studies, such as Lin et al. (2020), examined how DCs facilitate BMI in platform enterprises, focusing on value proposition, product, partnership, and profit model innovation. Further research avenues include exploring the impact of DCs on BMI across industries and contexts, with particular emphasis on digital transformation's role in enhancing DCs and thereby supporting BMI (Lin et al., 2020). Our study expands this perspective by emphasizing sustainability as a value outcome and platformization as a value maker while directly linking digital transformation elements—such as IoT, big data, and AI—as value enablers.

Several researchers have examined the link between DCs and sustainability from different perspectives. Oliveira-Dias et al. (2022) conducted a multiple-case study identifying various DC-related innovations and activities and proposed a framework connecting these DCs to BMI processes. Inigo et al. (2017) focused on organizational and managerial DCs, presenting evolutionary and radical BMI as two innovation pathways supported by sensing, seizing, and transforming capabilities. van Eechoud and Ganzaroli (2023) explored how DCs contribute to digital circular BMI through a grounded, systematic inductive analysis of seven case studies and highlighted the long-term impacts of circular BMI as a key area for future research.

Building on these perspectives, our study conceptualizes sustainability as the value outcome of DDBMI and integrates DCs into the three levels of definition, identification, and deployment. By aligning these levels with the phases of the BMI process, we enhance BMI support at each stage and provide structured guidance on DC selection. Additionally, integrating the insights from van Eechoud and Ganzaroli (2023) with our conceptual framework could further strengthen the circularity dimension. Our approach, which incorporates value drivers and value outcomes, is designed to track outcomes and identify opportunities for refining and iterating process steps at each level, offering a pathway for studying the long-term impacts of circular BMI.

Previous research consistently highlights the need for further practical studies, real-world applications, and applicability across various industry domains. Additionally, existing studies emphasize the limitations of current approaches and the absence of a comprehensive framework that integrates BMI, DCs, circularity, sustainability, and related aspects. Our research addresses these gaps by proposing a conceptual framework that, together with our investigation of the DCs required for DDBMI, extends existing frameworks and contributes to a more holistic approach to leveraging DCs for DDBMI.

6. Conclusion

This study contributes to research and practice by advancing the understanding of DCs in DDBMI. Methodologically, we employ a multi-method approach, integrating topic modeling, thematic synthesis, and

qualitative content analysis to identify nine global themes related to DDBMI. Theoretically, we extend DC theory by structuring DCs within the value-added concept, categorizing them as value enablers and value makers, with sustainability emphasized as a key value outcome. Practically, we propose a meta-level conceptual framework that aligns DC implementation with the four phases of BMI, providing structured guidance for incumbents navigating DDBMI. Our study addresses existing gaps by integrating DDBMI, DCs, and sustainability, paving the way for future research on DC deployment across various industries and contexts.

6.1. Limitations and further research

Given the interdisciplinary nature and broad scope of DDBMs, we acknowledge several limitations in our analysis. Firstly, the database search was confined to Scopus, potentially causing us to overlook key DDBM-related papers. Secondly, the automated semantic content analysis relied solely on titles, abstracts, and keywords, which may have omitted less-represented topics. It hindered our ability to discuss specific areas comprehensively within the context of DDBMs. Thirdly, the interdependence among various topics within DDBMI necessitates further exploration to optimize DDBMI strategies. Future research could delve into the interdependencies of these topics within the context of DDBMI. Exploiting the value of data through digitalization and BMI, as well as commercializing digital technologies through BMI, are areas for future research (Zare & Persaud, 2024). Lastly, the study's results are theoretical and do not conclusively demonstrate the practical applicability of the conceptual frameworks for DC definition, identification, and deployment. Evaluating the relevance of the framework and the accompanying DCs with practitioners is a direction for future research, potentially through focus groups and expert interviews for empirical validation and confirmatory analysis.

CRedit authorship contribution statement

Shailesh Tripathi: Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Nadine Bachmann:** Writing – review & editing, Writing – original draft, Visualization, Formal analysis, Data curation, Conceptualization. **Manuel Brunner:** Writing – original draft, Visualization, Formal analysis, Data curation, Conceptualization. **Herbert Jodlbauer:** Writing – original draft, Validation, Supervision, Project administration, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used Grammarly and ChatGPT to improve language and readability. After using these tools/services, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Declaration of competing interest

The authors declare that they have no known competing financial

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Appendix A

Table A1
Topics of Papers Identified Using the LDA Model for Incumbent Manufacturers (138 Papers).

Topic	mean topic proportion	Top keywords (topic-word distribution)	FREX keywords
1	0.136	manufacture, technological, service, business, energy, model, digital, industrial, business model, product, transition, smart, research, innovate, develop, economic, 3d print, economy, global, company, change, firm, platform, cloud, manage, transform, roadmap	retrofit, world energy, kibs, service composition, smart retrofit, energy, connotation, prosumer, d print, print, energy transition, carbon, service business, carbon neutral, cloud manufacture, drive force, ecologic, ir technology, manufacture innovation, neutral, politic, specific roadmap, technological convergence, roadmap, cloud, digital economy, composite, digital manufacture, service truck, engineer material, dl truck, occupational, health safety, intercommunicating, material datum, occupational health, business intercommunicating, india, road, wave, mobile, decouple, intercommunicating system, engine, transport, safety, city, system base, reliability, material, format, standard, document, control, digitalisation, smart city
2	0.107	system, industrial, research, base, technological, datum, manage, engine, design, business, mobile, digital, model, analysis, study, material, product, smart, process, develop, truck, manufacture, method, require, service, transition, engineer material, integrate, chain, safety	mot, post, digital world, post digital, iiot, machine, grind machine, lean, learn, support vector, vector, vector machine, grind, robot, smes, software, simulate, choice behavior, megatrends, train, innovation strategy, choice, experience, bmc, iiot business, thing iiot, medium, industrial internet, personal, support
3	0.124	industrial, model, business, digital, business model, technological, iiot, process, machine, manufacture, product, datum, design, research, service, study, innovate, transition, system, internet, change, require, support, world, smes, paper, base, enterprise, learn, analysis	local energy, integrate system, ceramic, holonic, logistic player, sustainable construction, circular economy, circular, circular business, logistic, share economy, economy, construction business, eco design, environmental social, gig, gig economy, intelligent asset, logistic infrastructure, talent, fashion, construct, sustain, share, asset, sustain business, recycle, principle, ceramic tile, digitisation
4	0.21	business, model, industrial, business model, digital, circular, economy, technological, sustain, circular economy, study, company, logistic, product, develop, transition, transform, manufacture, process, research, innovate, circular business, system, case, digital technology, manage, construct, digital transformation, practical, integrate, success	reputation, corporate reputation, value innovation, capability provide, creation strategy, sustainability, model innovation, capability, corporate, incumbent, conflict, digital leadership, experience orientation, innovation value, longitudinal study, taiwan, wine, wine industry, innovate, logic, platform, digital platform, ecosystem, develop business, bmi, distinct, longitudinal, i environment, singapore
5	0.145	innovate, industrial, business, model, business model, digital, value, study, capability, develop, model innovation, ecosystem, platform, technological, manufacture, sustain, transform, research, transition, strategy, incumbent, firm, creation, base, implicate, paper, market, provide, company, system	model disrupt, technology roadmap, servitization, pattern, mine, start, disrupt, bm innovation, i bms, model pattern, niche innovation, taxonomy, redistribute, model business, redistribute manufacture, industrial internet, bms, transition technology, big datum, technological business, legal, drive business, african, emphasize, internet business, laser technology, legal tech, mine automation, network organisation, process innovation
6	0.146	business, model, business model, industrial, technological, manufacture, digital, innovate, service, research, develop, product, process, disrupt, servitization, paper, company, internet, transition, challenge, base, value, transform, impact, revolution, industrial internet, firm, industrial revolution, competition, framework	nano, micro nano, nano fabrication, laser micro, laser process, upgradability product, sensor, laser, library, fabricate, library service, process technological, artificial intelligence, interact, micro, artificial, collaborate, upgradability, caevs, interdependence, journalist, plm, wearable, technological gap, cycle, preparation, perform, network, device, life cycle
7	0.128	product, technological, industrial, model, business, value, process, business model, service, system, digital, laser, develop, network, sensor, manage, collaborate, innovate, base, transition, manufacture, creation, approach, high, enable, intelligence, design, study, interact, fabricate	

Table A2
Topics of Papers Identified Using the LDA Model for Incumbents (275 Papers).

Topic	mean topic proportion	Top keywords (from topic-word distribution)	FREX
1	0.094	inform, model, business, service, system, social, design, develop, technological, information system, digit, innovate, base, manage, process, business model, network, effect, analysis, medium, customer, decision, software, user, impact, approach, online, fintech, strategy, project	information security, software developer, agent base, healthcare organization, shenzhen, behavior information, cohesion, disease, health information, improve medical, information disclosure, outsource, sentiment, sentiment analysis, service failure, software project, interface design, collective intelligence, design principle, dominant logic, fintech bank, local newspaper, model fintech, visualisation, collective awareness, infrastructure transformation, mental model, route optimization, asymmetric, communication decision

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Table A2 (continued)

Topic	mean topic proportion	Top keywords (from topic-word distribution)	FREX
2	0.149	business, model, digit, business model, industrial, technological, market, innovate, value, study, research, approach, develop, service, product, transit, sustain, smes, operate, firm, base, system, transform, paper, datum, design, strategic, publish, organizational, mobile, mobile network	knowledge complexity, organizational collaboration, physical system, spanish publish, cooperate, inter, inter organizational, medicine, music, datum share, resilience, rural, music industry, transfer, blend, standard, supplier, base medicine, cooperation behavior, drug, kibs, mscd, strategic alliance, translation precision, supply chain, electronic
3	0.178	digit, business, platform, model, business model, innovate, disrupt, technological, study, transform, strategy, develop, value, research, energy, market, incumbent, digital platform, organic, company, process, service, industrial, case, enable, product, transit, manage, publish, firm	side platform, platform company, luxury, platform strategy, multisided, multisided platform, publish process, market entry, multi side, platform, digital platform, disrupt, digital disruption, disruption innovation, agricultural, side, access economy, acquisition, agribusiness, cba, commercial property, consumer robot, dsi, embed system, entrepreneurial ecosystem, farm, firm growth, flip
4	0.13	energy, model, business, house, business model, digit, transit, develop, technological, policy, provide, system, afford, innovate, governance, market, affordable house, profit, sector, service, study, economy, sustain, datum, industrial, build, operate, base, energy transition, work	affordable house, procure, tax, urban energy, solar, energy model, house developer, profit house, tenant, blue, blue ocean, house industry, ocean, house, afford, parental labour, profit provider, sbm, energy, energy system, fund, energy transition, australia, governance, australian government, build environment, civil, economic analysis, economy profile, energy performance
5	0.142	business, model, datum, digit, business model, value, manage, innovate, economy, process, share, operate, firm, creation, role, transit, value creation, market, study, technological, paper, develop, approach, design, drive, industrial, organic, company, base, hybrid	incubation, vessel, pathologist, reference model, refer, application orient, datum science, diy, diy lab, epc, turnaround, vessel design, hybrid, share economy, omni, omni channel, tourism, antagonistic, antagonistic asset, net neutrality, resource orchestration, sap, sap reference, talent, datum drive, datum, datum analytics, schedule, distribution system, healthcare model transform, urban datum, discontinuous innovation, digital opportunity, effectual, innovation adoption, digital business, complementary asset, energy company, hesitant fuzzy, print house, digital innovation, digital transformation, iot, path dependence, innovation
6	0.234	business, digit, model, business model, innovate, transform, digital transformation, technological, incumbent, company, value, industrial, model innovation, digital technological, research, study, service, digital business, firm, energy, digital innovation, datum, manage, understand, case, disrupt, change, develop, strategic, base	digital, model innovation, cps, dffs, fuzzy, transform digital, path, digital technological, incumbent, impact digital, transform, professional service, establish company, model digital, business model digital leadership, privacy economics, heuristic, develop dynamic, digital entrepreneurship, leadership, entrepreneurship, dynamic capability, datum protection, guardian, innovation capability, parent guardian, personal datum, risk analysis, socialist, innovation system, smart city, risk, city, protect, creative, innovation ecosystem, universal, cognition, art, entrepreneurial, capability, communicate, market orient, expect
7	0.074	digit, model, innovate, develop, business, business model, system, technological, manage, capability, city, risk, process, datum, inform, economy, entrepreneurship, ecosystem, economic, communicate, dynamic, study, industrial, company, market, project, smart, transit, leadership, dynamic capability	

Table A3
References, Excerpts, and Basic Codes.

Reference to the Analyzed Article	Excerpts Corresponding to Each Basic Theme	Basic Codes
Buer, Strandhagen, Semini, and Strandhagen (2021)	"[L]arge enterprises (LEs) have a significantly higher level of shop floor <i>digitalization</i> and organizational <i>IT competence</i> than small and medium-sized enterprises (SMEs)." (p. 621)	Digitalization; dynamic capabilities
Chauhan, Parida, and Dhir (2022);	"The present analysis reveals that <i>PSS [Product Service Systems]</i> is an important <i>business model innovation</i> that drives the <i>CE [circular economy]</i> with the help of <i>digitalisation</i> ." (p. 13)	Product service system; digital business; digital innovation; circular economy; digitalization
Kagermann and Wahlster (2022)	" <i>Industrial AI</i> will enable a second wave of <i>digitalization</i> of production." (p. 4)	Digitalization; AI
Kim, Kuah, and Thirumaran (2022)	" <i>Digital capabilities</i> were utilized not only to create value but also to deliver value in many South Korean cases." (p. 838)	Digitalization; dynamic capabilities
Parida, Sjödin, and Reim (2019)	"[E]xploiting <i>digitalization</i> goes hand-in-hand with <i>business model innovation</i> , which requires novel offerings and processes that define how value is created, delivered and captured between providers, customers, and other value chain actors." (p. 2)	Digitalization; digital business; digital innovation
Ranta, Aarikka-Stenroos, and Väisänen (2021)	"[D]igital technologies enabled companies to <i>innovate</i> supplier and customer interfaces, for example, through increased customer knowledge and material tracking." (p. 8)	Digital technologies; digital innovation
Thomson, Kamalaldin, Sjödin, and Parida (2022)	"[C]ustomers need to have the requisite <i>data management capabilities</i> and <i>digital maturity</i> to handle the new ways of working with <i>autonomous solutions</i> " (p. 145)	Big data; dynamic capabilities; digital maturity; IoT-enabled intelligent system
Wardhana et al. (2023)	"[A]dvertising agencies aggressively acquired specialized <i>digital technology</i> firms to enhance their <i>digital and data capabilities</i> . Integrating the existing advertising agency model with the <i>digital technology</i> -based model required the ability to sense critical threats, seize opportunities and <i>transform</i> the current <i>business model</i> ." (p. 1831)	Digital technologies; big data; dynamic capabilities; digital business; digital innovation
Warner and Wäger (2019)	"Our research provides further context on situations where <i>digitalization</i> is driving changes in corporate strategies that aim to <i>digitally transform</i> an incumbent's <i>business models</i> ." (p. 344)	Digitalization; digital transformation; digital business; digital innovation
Bröring et al. (2017)	"[O]ur notion of <i>IoT ecosystems</i> is concerned with technical design and realization. We concentrate on technologically supporting interoperability [...] we support interoperability among <i>IoT applications</i> , services, and <i>platforms</i> by leveraging Semantic Web technologies." (p. 55)	IoT ecosystem; platform
Haaker, Ly, Nguyen-Thanh, and Nguyen (2021)	"The <i>Internet-of-Things (IoT)</i> empowers remote monitoring and management of the performance of machines, vehicles, processes, etc., which facilitate <i>service business models</i> . However, companies in emerging and transitional economies, in particular,	IoT; service business; digital innovation

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Table A3 (continued)

Reference to the Analyzed Article	Excerpts Corresponding to Each Basic Theme	Basic Codes
	face challenges when applying <i>IoT</i> , not only related to the use of technology, but especially regarding the need for a <i>new business model</i> .” (p. 126)	
Khan, Shah, Yu, and Tanveer (2022)	“[C]ompanies to implement <i>circularity</i> have to forgo and scrap many old <i>resources</i> that lack <i>technological capabilities</i> , e.g. in <i>IoT</i> and IR 4.0, machines are linked to integrate as a network.” (p. 773)	Circularity; resource orchestration; dynamic capabilities; IoT
Lopez, Castillo, and Corchado (2021)	“ <i>Internet of Things (IoT)</i> [...] should be seen as the basis for transition to a <i>new business model</i> that monetizes the <i>data</i> from an intelligent <i>ecosystem</i> .” (p. 1)	IoT ecosystem; digital business; digital innovation; big data
Matthyssens (2019)	“Industry 4.0 and the <i>IIoT</i> force established companies to break their industry recipe and to <i>reinvent</i> their <i>business models</i> . The <i>IoT mindset</i> is totally different from the present frames. This requires per definition value <i>innovation</i> and the learning and building of a new set of <i>capabilities</i> .” (p. 1208)	IIoT; IoT; digital business; digital innovation; dynamic capabilities
Mazhelis, Luoma, and Warma (2012)	“[T]he roles of the companies in an <i>IoT ecosystem</i> can be derived from the technical domains comprising the <i>IoT solutions</i> .” (p. 5f)	IoT ecosystem
Paiola and Gebauer (2020)	“[E]xtant manufacturing <i>resources</i> and <i>capabilities</i> – although critical – have to be complemented with new ones in order to successfully leverage on the possibilities offered by <i>IoT technologies</i> and to <i>develop</i> advanced <i>service-oriented business models</i> .” (p. 259)	Resource orchestration; dynamic capabilities; IoT; service orientation; digital innovation
Udoh and Kotonya (2018)	“ <i>IoT applications</i> depend on a heterogeneous mix of <i>technologies</i> and components. Moreover, <i>IoT stakeholders</i> require expertise in the underlying <i>technologies</i> and would need to clearly understand the domain knowledge. These factors make the development of <i>IoT applications</i> complex, time-consuming and challenging.” (p. 71)	IoT; digital technologies
Çetin and Bocken (2021)	“ <i>AI capabilities</i> offer a number of opportunities for <i>transitioning</i> to a <i>CE [circular economy]</i> , including design improvement, infrastructure optimisation and the operation of <i>circular business models</i> . Similar <i>AI competencies</i> can also be applicable in a <i>circular BE [built environment]</i> .” (p. 15)	AI; dynamic capabilities; circular economy; circular business model; digital innovation; sustainable innovation
Chatterjee, Chaudhuri, Vrontis, and Jabeen (2022)	“[F]irms must <i>transform</i> their existing <i>business model</i> to an <i>AI-CRM [customer relationship management] ecosystem-based business model</i> that uses disruptive <i>technology</i> to address customer needs, which are ever-evolving.” (p. 54)	Digital innovation; digital business; AI; ecosystem; digital technology
Samoili et al. (2020)	“The study of the definitions found in literature leads us to identify four characteristics that are commonly mentioned in <i>AI</i> : i) perception of the environment and real-world complexity, ii) <i>information processing</i> : collecting and interpreting inputs, iii) decision making, including reasoning, learning and taking actions; and iv) achievement of pre-defined goals.” (p. 4)	AI; information system
Sjödin, Parida, Palmié, and Wincent (2021)	“We conceptualize three sets of interdependent <i>AI capabilities</i> for industrial manufacturers: <i>data pipeline capabilities</i> , algorithm development <i>capabilities</i> , and <i>AI democratization capabilities</i> .” (p. 584)	AI; dynamic capabilities; big data
Ulnicane (2022)	“The EU has been developing its approach to <i>AI</i> in the context when this new transformative <i>technology</i> is being applied more and more widely and when many governments and other organisations are developing their strategies and guidelines on <i>AI</i> .” (p. 265)	AI; digital technology
Benedettini (2022)	“In the case of green <i>servitization</i> into device reprocessing <i>services</i> , the <i>capability to analyze data</i> concerning device usage and return patterns needs to be complemented with <i>logistics capabilities</i> in order to effectively plan and manage flows of devices from/to multiple health care facilities and increase the availability of reprocessed devices.” (p. 16)	Servitization; dynamic capabilities; big data
Bi, Lin, Liao, Wu, and Parandoush (2021)	“The prevalence of <i>Big Data technology</i> can be an opportunity for AM [additive manufacturing] to become a viable fabrication technique in the manufacturing industry. [...] For AM research, massive amounts of <i>data</i> from the <i>3D printing</i> process can be processed by <i>Big Data analysis</i> to obtain various types of useful information.” (p. 194)	Big data; IoT-driven transformation in manufacturing
Ciampi, Demi, Magrini, Marzi, and Papa (2021)	“[T]his study gives a contribution to the strategic and innovation management literature by demonstrating for the first time the positive mediating role exerted by EO [Entrepreneurial Orientation] in the <i>BDAC [Big Data Analytics Capabilities]-BMI [business model innovation]</i> relationship.” (p. 9)	Big data; dynamic capabilities; digital innovation; digital business
Faraway and Augustin (2018)	“ <i>Data</i> is not an end in itself but a means to an end. The end is increased understanding, better calibrated prediction etc. More is not always better if this comes with increased costs. [...] We have seen the benefit of <i>big data</i> but we are now also realizing the extent of the associated damage.” (p. 145)	Big data
Hekler et al. (2019)	“Small and <i>big data</i> paradigms can and should be linked via a science of causality.” (p. 8)	Big data
Ibarra et al. (2018)	“This model proposes a radical <i>innovation</i> of the actual <i>Business Model</i> which follows the purpose of focusing on the core business [...], sharing the uncertainty with other agents or achieving new required <i>skills</i> and <i>resources</i> from associates, due to the introduction of technologies such as <i>Big Data</i> ” (p. 9)	Digital innovation; digital business; dynamic capabilities; resource orchestration; big data
Majeed, Lv, and Peng (2019)	“Key <i>technologies</i> including the <i>big data</i> acquisition and integration, <i>big data</i> mining and knowledge sharing mechanism were developed for the <i>big data</i> analytics for AM [additive manufacturing].” (p. 308)	Digital technology; big data
Mikaléf, Boura, Lekakos, and Krogstie (2019)	“Firms that focus their efforts on developing a strong <i>BDAC [Big Data Analytics Capabilities]</i> can use it to drive strategy and inform decision-making processes made by top executives.” (p. 290)	Big data; dynamic capabilities
Ghezzi, Balocco, and Mangiaracina (2012)	“The strategic clustering matrices led to the identification of four key <i>business models</i> currently adopted by <i>MMTPs [Mobile Middleware Technology Providers]</i> – ‘Pure Play’, ‘Full Asset’, ‘Third Parties Relationship-focused’ and ‘Platform and Content Management’” (p. 7)	Digital business; mobile network; platform
Jocevski, Arvidsson, Miragliotta, Ghezzi, and Mangiaracina (2019)	“[R]esearch about organisations transitioning to <i>omni-channel</i> retailing can benefit from a more integrated approach. Our study highlights the importance of a <i>BM</i>	Mobile network; business transformation through mobile networks; digitalization

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Table A3 (continued)

Reference to the Analyzed Article	Excerpts Corresponding to Each Basic Theme	Basic Codes
	<i>[business model]</i> perspective in current retail transformation and in the digitalisation process of a retailer-customer interface" (p. 89)	
Liu, Ji, and Ji (2022)	"The mobile information technology capabilities are essential driving for an enterprise to achieve efficient service innovation performance." (p. 9)	Mobile network; dynamic capabilities; digital innovation; service-centric
Minatogawa et al. (2020)	"The customer segment that was previously considered a choice was now considered a hypothesis to be developed, since the data showed that there could be a misalignment between the audience reached by the channels and the audience that actually buys the company's products." (p. 22)	Mobile network
Awan, Sroufe, and Bozan (2022)	"[T]he dynamic dimensions of business models must be considered a departure from the traditional operational models. The dynamic model represents organizations that adapt to changes and continuously align their activities to the ecosystem in which they operate. [...] Digital transformations, such as those at the heart of 14.0, will be embedded in the value chain activities to drive emission reductions, economic growth, innovation, and competitive advantage." (p. 11)	Digital innovation; digital business; platform-based ecosystem; digital transformation
Cozzolino, Corbo, and Aversa (2021)	"In the early stage of the emergence of a platform-based ecosystem (phase 1), incumbent producers cooperate with entrant platforms [...] to commercialize incumbents' low-end products." (p. 395)	Platform-based ecosystem; platform dynamics
Dell'Era, Trabucchi, and Magistretti (2021)	"[S]ome of the incumbent's characteristics that reduce or block their innovation capabilities may become strengths to be exploited in building a multisided platform." (p. 42)	Dynamic capabilities; multisided platform
Karimi and Walter (2021)	"[M]anagerial cognitive abilities are critical drivers for entrepreneurial agility in building digital platform capabilities and business model innovation adoption." (p. 17)	Digital platform; dynamic capabilities; digital innovation; digital business
Lerch, Horvat, and Jasny (2024)	"Creating responsibilities and establishing new capabilities is one of the most important factors to achieve progress in the platformization pathway and traditional structures are mostly not designed for this" (p. 16)	Dynamic capabilities; platformization
Mancha and Gordon (2022)	"Value creation is the way the organization, through the MSP [multi-sided platform], creates value for its customers and other platform participants." (p. 181)	Multi-sided platform; platform dynamics
Reuver et al. (2018)	"The diffusion and importance of digital platforms operating as multi-sided markets are rapidly increasing, for example, facilitating social networks, smartphone app stores or the so-called sharing economy." (p. 133)	Digital platform; multi-sided platform; sharing economy
Şimşek, Öner, Kunday, and Olcay (2022)	"[T]he new product and rival platforms driven by digitalization offered by competitors in the market create high pressure on the established companies, force them to leave their comfort zone, and change the existing business models." (p. 14)	Digital platform; digital innovation; platform business
Tian, Vanderstraeten, Matthysens, and Shen (2021)	"[C]o-creation among all platform actors is pivotal to ensure platform leverage. [...] [T]hree higher order orchestration capabilities were explored to enable platform co-evolution [...]. Supporting firms were mobilized through these co-creation practices to jointly exploit and leverage the potential of platforms during the transition from production-oriented to transaction-oriented platform logics." (p. 26)	Platform dynamics; business ecosystem; dynamic capabilities; platform-driven business
Volberda, Khanagha, Baden-Fuller, Mihalache, and Birkinshaw (2021)	"[A]s firms with digital new ventures or platforms attempt to scale to address much broader markets, managers need to recognize the need to be able to implement new routines and structures effectively." (p. 8)	Digital innovation; platform
Yousaf, Radulescu, Sinisi, Serbanescu, and Păunescu (2021)	"[D]igital platforms enhance the impact of the digital orientation and IoT on the sustainable digital innovation of SMEs in the context of their lack of large resources on the developing markets." (p. 19)	Digital platform; digital orientation; IoT; sustainable innovation; digital innovation; resource orchestration
Hsuan, Jovanovic, and Clemente (2021)	"Through decomposition of business model innovation, DS [digital servitization] can be modularized into lower levels of complexity that reveal the operational characteristics of PSSw [product-service-software] modules that can be mixed and matched." (p. 612)	Digital innovation; servitization; digital servitized; product-service system
Khan and Wuest (2019)	"The channels describe how PSS [Product Service Systems] providers keep in touch with and reach their customers in order to deliver value. Three types of channels are common in PSS business models: communication, distribution, and sales channels." (p. 772)	Servitization; product-service system; service business
Langley (2022)	"The PSS [Product Service Systems] and Servitization business models hold enormous potential for enabling a sustainable manufacturing industry while at the same time offering continued competitiveness and innovation." (p. 14)	Product-service system; servitization; service business; sustainable business; sustainable innovation; digital innovation
Pfeiffer, Krempels, and Jarke (2017)	"By taking beneficiary's needs (value-in-context), focal service-based value propositions and resource base as well as network partnership contributions into account it additionally encompasses a network perspective on value creation and capturing." (p. 370)	Service-oriented architecture; resource orchestration
Soto Setzke, Riasanow, Böhm, and Krcmar (2021)	"By regarding DT [digital transformation] strategy building blocks as antecedents of DSI [digital service innovation], we add a new perspective to explain how effective DSI can be established." (p. 1029)	Digital transformation; digital innovation; service-centric
Curtis and Mont (2020)	"[O]ur aim was to elaborate an improved sharing economy business modelling tool designed specifically to support the design and implementation of SEBMs [sharing economy business models] for improved sustainability performance." (p. 10)	Sharing economy business model; sustainable innovation; sustainability
Dellaert (2019)	"In the sharing economy, consumers act as co-producers by creating value for other consumers with whom they engage on online platforms [...]. We first introduced consumer co-production networks as value creation systems in which consumers and firms work together" (p. 248f)	Sharing economy; digital platform; platform dynamics
Esmailian, Sarkis, Lewis, and Behdad (2020)	"We focus on servitization, social manufacturing, and sharing economy business models and discuss their smart manufacturing sustainability potential." (p. 7)	Servitization; sharing economy business model; sustainability
Gao and Li (2020)	"This study has some practical implications for firms in the sharing economy to realize sustainable development, and for the government to support firms doing so. [...] Furthermore, firms should actively innovate on their business models to achieve sustainability through deeply exploring the business environment." (p. 10)	Sharing economy; sustainable development; sustainable innovation

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Table A3 (continued)

Reference to the Analyzed Article	Excerpts Corresponding to Each Basic Theme	Basic Codes
Lange & Valliere (2020)	“[T]he disconnect between value creation and value capture inherent in <i>sharing-economy business models</i> and the resulting potential for dilution of investment returns among competing stakeholders act as deterrents to prospective investors.” (p. 44)	Sharing economy business model
Ritter and Schanz (2019)	“Four ideal-type market segments provide a comprehensive framework to cover all <i>business models</i> related to the <i>sharing economy</i> [...]: Singular Transaction Models, Subscription-Based Models, Commission-Based <i>Platforms</i> and Unlimited <i>Platforms</i> .” (p. 328)	Sharing economy business model; platform
Sanasi, Ghezzi, Cavallo, and Rangone (2020)	“[B]y leveraging on <i>BMI [business model innovation]</i> theory, we shed light onto the value creation and value capture mechanisms of <i>SE [sharing economy]</i> initiatives and their novel value configurations that give rise to <i>innovative BMs [business models]</i> .” (p. 906)	Sharing economy business model; sustainable innovation
Täuscher and Laudien (2018)	“As the taxonomy provides first empirically grounded insights about marketplaces discussed in the context of the <i>sharing economy</i> , it can further contribute to a better understanding about what distinguishes <i>sharing-based</i> marketplaces.” (p. 327)	Sharing economy
Bachmann, Tripathi, Brunner, and Jodlbauer (2022)	“[D]ata-driven and <i>AI</i> approaches have been and are likely to continue to be instrumental in achieving the <i>SDGs [Sustainable Development Goals]</i> , although the potential remains untapped to date.” (p. 23)	AI; sustainability
Brunner et al. (2024)	“[T]he <i>circular economy</i> has emerged as a prominent value proposition in the pursuit of <i>sustainability</i> ” (p. 8)	Circular economy; sustainability
Brunner et al. (2025)	“[C]ustomer satisfaction is not just a short-term goal but a necessary element for production companies' long-term success and <i>sustainability</i> , providing you with reassurance and confidence in your business strategy.” (p. 2930)	Economic sustainability
Ferreira, Lopes, Gomes, and Rammal (2023)	“[D]igital technologies (<i>AI, Cloud Computing, Robotics, BDA, and Blockchain</i>) positively impact manufacturing MNEs' <i>environmental and social sustainability</i> . Thus, <i>digital technologies</i> can be vital for manufacturing MNEs to be more competitive and simultaneously be <i>environmentally and socially sustainable</i> , thus contributing to <i>sustainable development goals</i> .” (p. 10)	Digital technologies; AI; IoT ecosystem; environmental sustainability; social sustainability; digital technologies
Frishammar and Parida (2019)	“Because business activities are one cause of such environmental problems, improved <i>sustainability</i> is now a priority for many large manufacturing firms. Incumbent firms respond to this challenge by implementing <i>circular business models</i> . [...] Therefore, we investigated how <i>circular business model transformation</i> actually takes place in incumbent firms.” (p. 24)	Sustainability; circular economy business model; sustainable innovation
Guldmann and Huulgaard (2020)	“[C]omparing barriers from the <i>CBMI [circular business model innovation]</i> related streams of literature with the empirically derived barriers from the specialised <i>CBMI</i> cases [...] showed that [...] the broader literature on <i>sustainable innovation</i> barriers thus seems relevant to the specific field of <i>CBMI</i> .” (p. 10)	Circular economy business model; sustainable innovation
Kumar and Chopra (2022)	“Blockchain-enabled <i>data-driven</i> tools may enable <i>CE [circular economy] business models</i> that improve trust and transparency in supply-chain networks, <i>shared</i> and performance <i>economy platforms</i> , stakeholder <i>participation</i> , and governance and management of organizations.” (p. 14)	Big data; circular economy business model; sharing economy; platform; platform dynamics
Lee, Hu, and Lim (2021)	“The most important instruments that improve <i>CE [circular economy]</i> and <i>sustainability</i> outcome, as well as the relationship between <i>CE</i> and <i>sustainability</i> are examined.” (p.11)	Circular economy; sustainability
Shang, Chen, and Li (2020)	“ <i>DSCs [dynamic sustainability capabilities]</i> positively impact corporate <i>sustainability</i> (economic, environmental, and social dimensions).” (p. 608)	Sustainability; dynamic capabilities
Singh and El-Kassar (2019)	“Our study was designed to investigate how <i>sustainable capabilities</i> are driven by corporate commitment and through integration of <i>big data technologies</i> , green HRM practices, and green SCM influences on firms' <i>economic and environmental performance</i> .” (p. 1270f)	Sustainability; dynamic capabilities; big data
Urbinati, Chiaroni, and Chiesa (2017)	“The paper explores the adoption of <i>Circular Economy</i> under the lens of the <i>business model</i> literature and proposes a new taxonomy that explains different degrees of <i>circularity</i> in practice adopted by firms in different industries.” (p. 496)	Circular economy business model; circularity

Data availability

Data will be made available on request.

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