

Incoherence in Business Model Innovation in Digital Transformation

Abstract

Firms face various challenges in business model innovation (BMI) in digital transformation (DT). To study this problem, the coherence view of internal fit has been extensively studied in strategy and business models (BMs). In addition, a dialectical alternative to fit-based models of strategy emphasizes the importance of “disciplined incoherence” for strategic renewal and transformation. However, few have drawn on systematic and empirical research into the nature of incoherence. Sorting incoherence into groups helps to understand its nature, especially its structure, and components. This research focuses on identification and classification of the incoherence and relevant sources and solutions in BMI in DT in firms. Based on the case studies of 50 interviews and two workshops in five years with firms in diverse industries, the researchers summarize six types of incoherence, six types of sources of incoherence, and six types of solutions. Theoretically, this study classifies different types of incoherence, relevant sources and solutions, extends the theory of strategic contradiction, and contributes to the conceptual Business Model Cohesiveness Scorecard (BMCS) framework. Practically, this research aims to help managers clearly and accurately identify and understand the types of incoherence in BMI in DT in their firms, find appropriate solutions to manage the incoherence and have an in-depth understanding of the role that incoherence plays in BMI in DT.

Keywords

Business Model Innovation, Digital Transformation, Strategic Contradiction, Incoherence, Business Model Cohesiveness Scorecard

1. Introduction

From a firm-level perspective, many companies are currently transitioning from hardware-oriented to software-oriented operations. Despite significant investments in R&D for digital technologies and the launch of new software features, these firms often fail to receive positive

market feedback, struggle to increase product prices, and fail to achieve the expected returns. The nature of the problem and how to address it remain unclear to these organizations.

From an industry-level perspective, despite the widespread adoption of digital technologies, global productivity growth has slowed down over the past two decades. This phenomenon, known as the productivity paradox, has been observed in several G7 countries (Syverson, 2011). The lack of business model innovation (BMI) due to insufficient management information on the effectiveness of business models (BMs) in the context of digital technology adoption is considered a primary reason for the productivity paradox (Velu, 2020).

Amit and Zott (2001) describe a BM as the frame of architecture, content, and governance of trades, introducing value creation sources as a model. Value creation is reflected in four interdependent dimensions (primary and interrelated value drivers): productivity, complementary relationships, lock-in, and novelty. A firm's BM integrates innovation and value creation sources for the company and its stakeholders, with a scope that extends beyond the company itself, encompassing the capabilities of multiple companies across various industries.

Based on Velu's (2017) research, BMs are complex activity systems that outline a company's structure, logic, value proposition, value creation, value network, and value capture (4Vs) around stakeholders. In other words, a BM is a complex system that connects the value offered, the creation of value, the methods for capturing value, and the stakeholders within the value network.

Business model coherence (BMC) refers to the alignment between a company's capabilities and its strategic intent. It involves identifying the core capabilities that a company excels at and developing them to a best-in-class level while ensuring they are interlocking. By doing so, a company can focus intensely on its strengths and align its capabilities with the right marketplace opportunities, resulting in sustained superior returns.

In addition to the productivity paradox, many other paradoxes and barriers related to BMs exist. Many studies (Andriopoulos & Lewis, 2009; Smith et al., 2010) in the related field have focused

on describing these paradoxes and barriers, providing insights from various perspectives, BM-related reasons, and potential solutions. However, researchers have not thoroughly explored the deeper reasons for these paradoxes and barriers within firms. Although a few researchers (Demil & Lecocq, 2010; Farjoun & Fiss, 2021) acknowledge that incoherence is a deeper reason for these paradoxes and barriers, there has been little systematic research into the incoherence itself or methods to identify and classify it within firms. Therefore, this research focuses on how to identify and classify incoherence in firms, explain the deeper reasons and solutions for the barriers and paradoxes of BMI, and provide potential solutions based on the experience of firms.

This paper is structured as follows: Section 2 presents the theoretical background, covering key concepts of BMI, BMC, and DT. Section 3 outlines the research methodology, detailing the case study approach and data collection methods. Section 4 discusses the findings, including the identification and classification of incoherence types, sources, and solutions. Section 5 integrates the discussion on the implications for theory and practice. Finally, Section 6 concludes the study, highlighting limitations and suggesting future research directions.

2. Theoretical Background

BMI

Extensive research has been conducted on BMI from various perspectives, such as cognition in strategy and differentiation within strategy. Martins et al. (2015) propose a theory explaining how generative cognition processes can actively innovate BMs without needing external changes. They view BMs as a framework that groups management insights into value creation activities and exchanges, suggesting innovative changes through proactive frame change processes. This approach underscores the cognitive viewpoint in strategy and proposes company-level strategic processes for designing BMI. Additionally, "BM" describes the "logic of the firm" – how it contributes to value creation for stakeholders, inherently linking it to strategy. Casadesus-Masanell and Ricart (2010) note that a firm's BM reflects its strategy, with significant differences when strategy drives BM changes. If the strategy directly maps onto the BM, separating the concepts offers little benefit. These insights present BMI from various angles, highlighting the need for further research perspectives.

Classification is a key research perspective for BMI. Foss and Saebi (2015) categorize BMI by the magnitude and range of BM changes, identifying four types linked to management challenges and requiring different leadership strategies. C-Suite involvement is crucial for BMI implementation, corresponding to the BMI type. Brandenburger (2017) classifies the origins of successful strategy innovation into four components: Contrast, Combination, Constraint, and Context. These components highlight how BMI can convert vulnerabilities into strengths and apply solutions across domains. Overall, BMI is vital for evolving BM elements and enhancing value creation. A systematic framework would further benefit BMI research.

BMC

Previous research has established the concept of coherence within related tools. Demil and Lecocq (2010) explore dynamic consistency in BM evolution through two approaches: a static method guiding consistency between BM elements and a transformative method addressing change and innovation. They introduce the Resources Organization Costs Value (RCOV) framework to reconcile these methods, viewing model evolution as fine-tuning core components and emphasizing the importance of dynamic consistency in a firm's adaptability. Additionally, Fritscher and Pigneur (2015) propose the BM Canvas Coherence, which helps beginners evaluate BM component coherence through set rules. While these studies aid in understanding BMC, practical examples in industrial sectors are limited.

The existing body of research on BMC highlights its critical importance in firms. Leinwand and Mainardi (2010) argue that coherence is achieved when a capability system is deliberately chosen and aligned with a focused strategic goal and the appropriate product and service portfolio. Coherent businesses ensure each product and service aligns with their capability framework. Farjoun and Fiss (2021) add that a cohesive understanding of internal fit simplifies organizations and strategy, dismissing the strategic advantages of conflicts and minimizing strategy development changes. They propose "disciplined incoherence," where contradictions and tensions drive strategic renewal and transformation. This dynamic understanding contrasts with conventional equilibrium-based models. Studies conclude that cohesiveness—whether termed coherence, consistency, alignment, or fit—is vital for BMs, while incoherence or

misalignment fosters BMI. This underscores the need for a framework to explain BMC, evaluate BMs, and design cohesive BMs.

BMC framework

Existing research recognizes the critical role played by BMC-related frameworks. First, Solaimani and Bouwman (2012) suggest a framework to connect BM with underlying business processes by identifying generic horizontal and vertical inter-organizational and intra-organizational interaction components (BPs). This research identifies the theoretical gap between practical BPs and strategic BM, developing a general framework for analyzing this gap. The proposed framework is beneficial for innovation projects, especially scaled-up trans-sector endeavors where diverse BPs from different stakeholders support a group BM. Second, Solaimani et al. (2015) propose frameworks explaining BM alignment. One, based on qualitative case studies of smart living initiatives, is called Business Model Alignment (BMA). The other, Value, Information, and Process (VIP), helps reveal obstacles to BMA and BM implementation, contributing to theory development by identifying problems that aid in achieving BMA. Third, according to Sjödin et al. (2020), the effectiveness of a BMI is determined by three process phases: value proposition definition, value provision design, and value-in-use delivery. For a BM shift from offering products to outcome-based services to succeed, certain value creation and capture activities must align over these phases. While most studies focus on the analytical foundation and process phases of BMC frameworks, they often fail to address how to evaluate BMC.

Business Model Cohesiveness Scorecard (BMCS)

Velu (2020) proposes the BMCS framework, which provides insights into the connections within and across businesses, enabling senior management to identify opportunities for BMI. This study demonstrates how the BMCS can evaluate the alignment between various BM components, facilitating the successful and cost-effective achievement of the organization's primary objective. The framework highlights key opportunities for reactivating, relinking, repartitioning, or relocating, serving as the foundation for BMI.

Velu suggests that the BMCS can be analyzed through four key components, known as the 4Vs. The first component, the value proposition, communicates to customers why they should opt for specific products or services, encompassing the company's solution and the promised value. The second component, value creation, involves transforming labor and resources into something that fulfills others' needs, including tangible elements like manufacturing products and intangible assets like software and creativity. The third component, value capture, refers to retaining a portion of the value delivered in each transaction, considering the cost structure and revenue stream. Lastly, the value network comprises relationships among key players in the business ecosystem, facilitating connections between external partners and customers.

In addition to the 4Vs, Velu introduces four perspectives, collectively referred to as PIDI: Physical flow, Information flow, Decision rights, and Incentives. Physical flow pertains to the movement of raw materials and finished products, prevalent in traditional industries. Information flow involves the transfer of data and knowledge crucial for decision-making, especially in data-driven industries. Decision rights refer to the authority granted to individuals or systems within any industry to make decisions. Lastly, incentives motivate individuals to take actions that lead to better outcomes. Properly aligning incentives across stakeholders ensures optimal decision-making. By examining BM components through the PIDI perspectives, a comprehensive understanding of fundamental processes and driving forces can be achieved.

In conclusion, while the current BMCS framework is useful for evaluating BMC, it lacks a systematic approach to effectively identify and classify incoherence and misalignments within firms. Therefore, studying a more consistent and comprehensive conceptual framework of BMCS from a system-based perspective is merited.

DT as a trigger of incoherence in BM

In the contemporary context, Digital Transformation (DT) refers to the adoption of digital technologies such as broadband, cloud, telecom technologies, AI/ML, and production technologies like additive manufacturing, and the data they generate to connect resources and processes. The goal is to capitalize on customer needs, achieve efficiencies, enhance decision-making effectiveness across the organization, and enable innovative BMs.

Numerous studies have established the link between DT and BMI. Hao et al. (2020) investigate DT's potential, providing key insights and best practices for successful DT implementation. Hao et al. (2021) further examine the pandemic's impact on DT, offering valuable insights from research interviews. Joglekar et al. (2020, 2022) explore how advanced digital manufacturing technologies drive BMI, proposing strategies for unlocking BMI through advanced manufacturing. They acknowledge the complexity of this path and identify five strategies commonly used by top players to navigate forward. While DT and related strategies drive BMI, negative effects also exist.

Recent evidence suggests that DT can negatively impact BMI. Matt et al. (2015) argue that DT strategies must coordinate with other operational and functional strategies, emphasizing the challenges of integrating IT initiatives with other methods. Vial (2019) provides a comprehensive review and research agenda for understanding DT, highlighting it as a disruptive process that triggers organizational strategic responses aimed at altering value creation pathways while managing structural changes and barriers. Lessons from Hao et al.'s (2021) research on the pandemic's impact on DT underscore that DT leads to incoherence in BMs.

In conclusion, cutting-edge digital technologies present opportunities but also pose significant challenges to BM coherence. Managers often struggle to comprehend the systemic impacts of adopting digital technologies on BMC, leading to a fragmented approach rather than a systematic one. Moreover, DT has introduced a greater variety of incoherence types.

The theoretical background introduced above reveals several gaps in the existing literature. Some theories discuss different barriers and paradoxes related to BMI but fail to delve into the underlying reasons for these obstacles (Kshetri, 2007; Chesbrough, 2010; Sivertsson and Tell, 2015; Rizos et al., 2016; Andriopoulos & Lewis, 2009; Smith et al., 2010). Other theories lack underpinning and cumulative empirical inquiry in BMI (Foss and Saebi, 2017). While some theories acknowledge the coherence between BM components (Demil and Lecocq, 2010), they do not provide guidance on measuring, amending, and managing BMC. Farjoun and Fiss (2021) introduce a model for driving strategic transformation by managing incoherence, contradiction, and tensions, but do not develop a framework to further broaden and deepen the model. Velu

(2020) offers insights into interlinkages within and across firms to identify opportunities for BMI, but there is a lack of systematic research on the identification and classification of different types of incoherence in BMI during DT, the sources of incoherence, and appropriate solutions to address it.

Based on the identified gaps in the existing literature, the following research questions are proposed:

1. How can incoherence in BMI during DT be identified and classified in firms?
2. What are the sources of this incoherence?
3. What solutions do firms employ to address the incoherence?

These research questions are crucial because they enable us to explain the phenomena (paradoxes and barriers) and remove related barriers in BMI during DT, as well as explore the nature and deeper reasons behind these paradoxes and barriers. From a theoretical perspective, this study is the first to investigate how to identify and classify different types of incoherence in BMI during DT in firms, as well as the relevant sources and solutions to the incoherence.

Furthermore, it contributes to the strategic contradiction and BMCS framework. From a practical standpoint, this research helps managers clearly and accurately identify and understand the types of incoherence in BMI during DT in their firms, as well as the sources of the incoherence. It also provides recommendations for appropriate solutions to manage the incoherence.

Our research will fill the identified gaps for the following reasons. Firstly, classification is an investigative approach that involves grouping or categorizing objects or concepts. This method of identifying and sorting is essential as it allows for a better understanding of the types and impacts of various incoherence, which are the deeper reasons behind the barriers and paradoxes of BMI in DT. Secondly, by conducting interviews and a case study across various industries, our findings are more convincing and practical. Additionally, we develop a conceptual framework to illustrate the relationships among components of a BM and analyze the relevant incoherence among them.

3. Methodology and data

In general, both qualitative and quantitative research methodologies can be used for BM related research (Van Looy, 2021). This research focuses on qualitative methods because they enable an in-depth understanding of how or why questions that are not easily obtained from fixed-choice investigations. Moreover, respondents are allowed to express their opinions, views, and experiences without restrictions. Qualitative research is particularly useful for studying complex problems more deeply (Graebner et al., 2012; Marshall and Rossman, 2014). In terms of BMI processes, there are no distinct borders between the research object and its context (Laudien and Daxbock, 2017). Furthermore, qualitative research provides deep insights into relatively new and as yet understudied areas (Eisenhardt and Graebner, 2007). In contrast, quantitative methods can only be used if there is structured data with sufficient volume, dimension, and granularity.

Regarding research philosophy, pragmatism recognizes the reality and importance of both the social and psychological world, which includes language, culture, human institutions, and subjective thoughts, as well as the natural physical world (Johnson and Onwuegbuzie, 2004). After considering the debate between ontological and epistemological views, this research adopts a pragmatic approach.

There are many BM-related "truths," and the facts are affected by the observer's point of view. Thus, relativism is more suitable for this research compared to realism, internal realism, and nominalism in ontology (Easterby-Smith, Thorpe, and Jackson, 2015).

The subjectivist perspective recommends exploring the reality of BM-related processes and relationships to produce innovative ideas and theories. Additionally, subjective interpretation informs how these occurrences are depicted. As a result, the philosophical perspective in this research falls generally on the constructionist end.

A wide variety of approaches and designs fall under the constructionist research stance. According to Easterby-Smith, Thorpe, and Jackson (2015), the three major strategies for data collection are case study research, action research, and process research. This study employs case study research because it enables the researcher to preserve the comprehensive and significant traits of real-world activities, such as organizational and management processes, neighborhood

variations, global relationships, and the maturation of industrial verticals (Yin, 2009). A constructionist case study includes the following features: 1) in-person interactions, such as through interviews and direct observation; 2) many people in a single organization; and 3) ongoing data gathering encompassing both current and historical events (Easterby-Smith, Thorpe, and Jackson, 2015).

Based on Flick's (2009) assertion that the inductive method is most appropriate for new social contexts and perspectives arising from rapid social change and the resulting diversification of life worlds, this research employs the inductive method for the identification and classification of incoherence in firms.

Regarding the case study, the research involves conducting interviews and site visits across various industries and utilizing the case study method to analyze the interview data. The case study offers the advantage of enabling data analysis both within and across different situations, as well as the exploration of multiple cases to identify similarities and differences among them. This approach contributes to the classification of incoherence among different companies in various industries. Additionally, the case study could produce strong and trustworthy evidence to help determine the worthiness of the findings related to incoherence. Furthermore, it could enable a broader exploration of the theoretical development of the BMCS framework. By deeply rooting insights in diverse empirical data, the case study could produce a more compelling theory of BMCS (Gustafsson, 2017).

Eisenhardt (1991) asserts that for case studies, the number of cases depends on the existing knowledge and the novel insights each instance adds. The researcher captured sufficient new information from each case in the case studies. Thus far, companies and organizations have been enlisted across diverse industries, including manufacturing, semiconductors, software, health care, personal care, luxury jewelry, publishing, etc. Most of the enlisted companies and organizations are actively engaged in BMI in DT, with some cited in the media as leaders in DT. Furthermore, some companies and organizations have developed and implemented their DT solutions and BM for a few years. This research aims to reveal the insights and practices of these companies and organizations in terms of BMI in DT.

3.1 Data collection

In order to make sure the findings are generalizable and transferable in various industries and geographic areas, data was collected from 50 interviews and two workshops with companies and organizations from 2019 to 2024 in 9 industries. No restrictions were imposed on the geographic location, scale of production, or ownership type (private vs. public) of the participating companies and organizations. To ensure an open discussion of sensitive information, each company was provided with anonymity. Additionally, participants were assured that no money was received from any government agency or customer, and no information would be disclosed to clients.

To ensure rigorous qualitative research, data was collected from three sources: 1) semi-structured interviews, which were the main way firms learned about BMI in DT; 2) structured observations of how BMI is designed and implemented within the focal companies; and 3) historical data gathered while visiting factories, as well as from corporate annual reports, industry reports, newspapers, public databases, etc. These various sources helped to triangulate information about BMI in DT within and across companies.

Companies and organizations were contacted through emails, and 50 of them agreed to participate in the interviews. They were from various industries such as manufacturing, automobile rental, banking, software, health care, education, personal care, luxury jewelry, publishing, etc. One to two experienced informants from each participating company or organization took part in the interviews. The informants included CIOs, EVPs, VPs of Digital IT, Executive Directors of Innovation, Heads of Digital Business, General Managers of Core Services Engineering, and Chief IT Architects.

Most of these companies and organizations did not develop uniform metrics for the evaluation of their BM; however, they understood the importance of a framework for BM evaluation. Most of the non-participants refused the interviews because they had no critical BM-related problems, had no time, or had strict confidentiality requirements.

In addition, the researchers conducted two rounds of 90-minute online workshops on the BMCS in 2022. There were about 17 attendees from various companies in each workshop. The researchers introduced the BMCS framework and interacted with the attendees on the following topics: 1) How do they identify the key points of incoherence between the existing operational model and the novel BM in their organization? 2) What approach is used in their organization to identify tensions between business units and across the ecosystem of partners? Would a BMCS-type framework help, and how? The attendees shared not only their stories of success but also their failures in DT. The researcher has written summary notes of the workshops.

Semi-structured interviews

At least one and as many as two informants were interviewed from each participating company and organization. The interview protocol is attached in Appendix 1. Follow-ups with informants were conducted to cross-validate information gathered from other sources and to supplement missing data. The companies and organizations are located in the US, Europe, and Asia. With the informants' consent, more than half of the interviews were taped. To support the analysis, the interviews were documented and transcribed.

Semi-structured observations

Seven participating companies provided opportunities for factory site visits, which were not intended as audits but rather as a means to gain a comprehensive understanding of the challenges these companies faced. Before each visit, discussions were arranged with the factory manager, technical engineers, and workers. Job shadowing was performed at all sites to understand the production processes and identify the challenges encountered. Following this, interviews were conducted with randomly selected engineers and workers at their respective work sites. As recording interviews in the factories was not permitted, field notes were taken to capture key phrases and direct quotations. Within 24 hours of each visit, detailed memoranda summarizing these meetings were compiled. This data proved invaluable for corroborating managers' responses and comparing them with the practices observed among factory engineers and workers in addressing challenges and implementing BMI processes within a given setting.

Archival data

Various sources of in-house information were gathered, such as internal consulting reports, company evaluation scorecards, benchmarked practices reports, etc. Moreover, external documents were collected, including corporate annual reports, industry reports, newspapers, and archival databases. As most of the companies and organizations are major public entities, a significant amount of open-source information was collected. The small, private companies and organizations provided limited information, necessitating more time to gather their data during visits. Where beneficial, external reports from third-party organizations were also collected. This data supported the triangulation of information collected through observations and interviews. The data are from interview companies, archival interview companies, and workshop companies. The data sources are shown in table 1, table 2, and table 3 below.

Table 1. Data Source-Interview Companies

Index	Industry	Country	Informant Role
1	Manufacturing	Sri Lanka	CIO
2	Manufacturing	Germany	CTO
3	Personal care	France/US	CIO
4	Manufacturing	Sri Lanka	Business Head; Innovation Director; Innovation Lead
5	Personal care	Germany	VP of Innovation
6	Finance	US	CIO
7	Logistics	US	VP of Innovation, Marketing Director
8	Transportation	China	General Manager of Innovation
9	Infrastructure	Switzerland	Head of Business; Head of Sustainability
10	Pharmaceutical	France	Head of Engineering
11	Finance	Netherlands	Founding Partner
12	Manufacturing	Belgium	SVP of R&D
13	Pharmaceutical	Germany	Digital Director
14	Finance	China	Investment Director
15	Manufacturing	China	General Manager of Automation, General Manager of International Business, Vice Chief Engineer
16	Manufacturing	China	CFO, General Manager of Robotics
17	Manufacturing	China	Principal Engineer, Solution Manager
18	Manufacturing	China	CEO
19	Manufacturing	China	CEO, CTO, Chief Engineer
20	Manufacturing	China	CEO, CTO
21	Manufacturing	China	Assistant to the General Manager, Factory Director, Deputy General Manager
22	Manufacturing	China	Deputy General Manager
23	Manufacturing	China	Digital Director, Principal Engineer, Engineer
24	Software	China	CEO, CTO
25	Manufacturing	China	COO
26	Software	China	President, CEO
27	Human resource	China	CEO
28	Software	China	CEO, VP of Sales
29	Manufacturing	China	Digital Director
30	Software	China	Deputy General Manager
31	Manufacturing	China	Assistant to the General Manager
32	Manufacturing	China	Marketing Director, Marketing Manager, Engineer
33	Finance	China	Deputy General Manager
34	Consulting	China	CEO
35	Manufacturing	China	Product Director
36	Finance	UK	Investment Director

Table 2. Data Source-Archival Interview Companies

Index	Industry	Country	Informant Role
1	Manufacturing	US	CTO
2	Car rental	US	Digital Director
3	Finance	Spain	Digital Head
4	Manufacturing	Germany	Head of Innovation
5	Jewelry	UK	CTO
6	Education	US	CIO
7	Healthcare	US	CIO
8	Publishing	US	Digital Director
9	Healthcare	US	CIO
10	Personal care	France	CIO
11	Software	US	VP
12	Government	US	Digital Director
13	Manufacturing	US	Digital Director
14	Jewelry	US	VP of Digital

Table 3. Data Source-Workshop Companies

Index	Industry	Country	Informant Role
1	Consulting	US	Managing Partner, Head of innovation
2	Manufacturing	US	VP of Digital; Director of Strategy
3	Manufacturing	Belgium	Digital Innovation Manager
4	Manufacturing	Denmark	Digital Director
5	Personal care	US	VP of Engineering
6	Personal care	US	Director of Innovation
7	Healthcare	US	VP of Digital
8	Manufacturing	US	Digital Manager, IT Director
9	Finance	US	Digital Director
10	Healthcare	US	Marketing Director
11	Food	US	Digital Lead
12	Software	US	VP of Strategy
13	Healthcare	US	VP of Innovation
14	Finance	US	SVP of Strategy
15	Healthcare	US	CMO

3.2 Data analysis

To address the research question, interview data, field notes, and archival data were analyzed together. The three-step process of Gioia et al. (2013) for developing theories was used to construct the theoretical model, as the Gioia method is helpful for thoroughly analyzing the acquired data to facilitate understanding and decision-making based on the data. First, 1st-order categories in the data were identified. These categories emerge when consistent patterns in the data constitute sufficient evidence for a representative practice. All 1st-order practices were labeled based on the informants' language (Strauss and Corbin, 1990). Second, the 1st-order categories were grouped into 2nd-order themes. Then, the themes were summarized as dimensions. Through this step, a data structure was generated, serving as the foundation for a general framework.

To ensure the reliability of the results, the interview data was independently coded by one researcher and then reviewed by the other researchers. Any discrepancies in coding were discussed until a consensus was reached. These discussions aimed to guarantee that the findings were not reliant on a single researcher's analysis but represented a collective agreement among all researchers. This approach helped in understanding the categories, sources, and solutions to incoherence. Because its core components are proven effective practices and its emerging dimensions are theoretically grounded, the resulting framework addresses Thomas and Tymon's (1982) call for theory that is valuable for both practice and conceptualization.

4. Case vignettes

A world leading cosmetics company sells its diverse range of beauty and cosmetic products, including skincare, hair care, makeup, fragrances, and men's grooming items online through various retailers such as Amazon and Walmart. The challenge is that the retailers also sell products of its competitors. The firm which used to sell its products through its own physical channels is now able to get information real-time way via retailer's online platforms. Through DT, the marketing team monitor the sales every hour, and make correction on their strategy in case competitors outbid them. However, DT adopted by the marketing team only did not fully solve the problem. It was difficult for the finance and production team to cooperate real-time

with the marketing team and be reactive to changes in prices and volume mix (E.g. the financial analysis was not automated and was not updated in real-time due to the legacy systems). In production, there were too much inventory; right things were not in the right places; and algorithms and automation in supply chain management were not suitable for frequent adjustments to cater for the real-time changes. This presents a major challenge of coordination.

As for another case with a large global apparel manufacturer. It is a vendor to many of the world's largest brands such as Nike, Lululemon, H&M. These retailers predict trends in advance for up to 9-12 months in order to set production targets, but excess inventory or shortages can result in wasted capacity or discounted prices. The challenge is reducing inventory costs. Through DT, the company adopted a print-on-demand model and integrated its software system with digital printer suppliers. The company planned to serve its customers with this model. However, customers were not keen to use it due to the changes required in their existing operating model, IT system and warehouse management system which were all geared towards a longer order and payment cycle. The customers' IT, financing and warehouse management systems were not compatible with new print-on-demand BM.

5. Findings

Top 5 findings from our research are as follows: six types of incoherence, six types sources of incoherence – challenges or changes from BMCS perspectives, a framework for incoherence analysis, and six types of solutions to incoherence.

5.1 Finding 1 - Six types of incoherence

Based on the research, various BMI initiatives in DT across diverse industries lead to challenges or changes, resulting in three types of internal (strategic, organizational, and operational processes-related) incoherence, as well as three types of external (partner-driven, demand or market-driven, regulatory-driven) incoherence. Table 4 presents the classification of types of internal and external incoherence.

Strategic incoherence involves conflicts between traditional and new BMs, as well as differing value propositions across technology, business, and ethical perspectives. For example, in a hearing aid manufacture, there is incoherence between new BM's R&D investment and disproportionate market return. There is a quote which illustrates this point.

"This functionality was available only by a firmware update. So, we didn't do a new product. We didn't make a new housing. We didn't make a new box. No new adverts. But the most amazing bit was we had a lot of R&D work and I spent, I don't know, 20 or 30 million years into this particular feature. Right. So, it's quite significant effort, right. Cost of money and all that. And then we rolled it out and you know, we didn't increase the price for the hearing instruments, so the price stayed the same or actually was trickling down as it normally does."

--- CTO from a hearing aid manufacture, interview on Dec 20, 2022

Organizational incoherence often arises from poor collaboration between departments such as marketing, finance, and production, or from internal competition and conflicts among functionally similar teams. For instance, in a personal care company, there is incoherence among divisions of marketing, finance and production. One informant's quote could illustrate this point.

"So not only do we have brand sites, so what we call brand e-comm, but the the way we interact on an Amazon or a Walmart or a Target.com is still quite different than from the brick and mortar. So, on the finance side, we're trying to automate as much as possible. In terms of supply chain, I think our journey is still a bit young. Historically people would be sitting there with spreadsheets and excel, etc. The reason why I say we're still early days is because we don't really feel that that our our algorithms and our automation is good enough."

--- CIO from a personal care manufacture, interview on Dec 22, 2022

Operational processes-related incoherence is characterized by misalignment in resource allocation and reconfiguration between traditional and digital transformation (DT) related business units.

On the external side, partner-driven incoherence stems from integration issues between a firm's DT solutions and those of its suppliers, and competition versus collaboration dynamics with dealers. For example, in an apparel manufacture, there is incoherence with suppliers' existing system. The following quote could illustrate this point.

“So, the most popular printers, they are called xxx. You might have heard of them. So, they did not agree to let us integrate our vision systems or queuing this digital printing industry is the mafia. So, you sell the printer, but they say that you have to have this print heads which are so expensive and they say you can only do with this ink, otherwise you're expensive printed with woodblock.”

--- CIO from an apparel manufacture, interview on June 1, 2022

Demand or market-driven incoherence occurs when there is a mismatch between a firm's offerings and customer demands, or between the firm's and competitors' strategies. Finally, regulatory-driven incoherence arises when a firm's DT solutions are not aligned with the regulatory environment.

Table 4. Classification of types of internal and external incoherence

Level 0	Level 1	Level 2
Internal	Strategic	Incoherence between traditional BMs and new BMs or between different new BMs in terms of value capture such as R&D investment, market return, cost and risks as well as value propositions on DT and sustainability
		Incoherence with value propositions among technology, business and cultural or ethical views, such as DT's role in enhancement and replacement of human work and human instincts and intuition
		Incoherence with a lack of breakout BM vis-à-vis their competitors.
	Organizational	Incoherence with collaboration among departments of marketing, finance and production in the value creation process
		Incoherence with competition between functionally similar internal teams or conflict between teams responsible internally and externally in the value creation process
	Operational processes-related	Incoherence with value creation-related resources and rights reallocation and reconfiguration among group and regional offices, among traditional business and DT-related business in portfolios, and among individuals responsible for different business in top management
External	Partner-driven	Incoherence with integration between the firm's DT solution and solutions or existing systems of suppliers in the value network
		Incoherence between the competition and collaboration with dealers in the value network
	Demand or market-driven	Incoherence between the firm's offerings and capacity and demands and existing systems of customers in the value network
		Incoherence between the firm's strategies based on itself and competitors in the value network
	Regulatory-driven	Incoherence between the firm's DT solution and the regulatory environment in the value network

5.2 Finding 2 - Six types of sources of incoherence – challenges or changes from BMCS perspectives

Based on this research, challenges or changes that lead to the six types of incoherence can be categorized into six types from the BMCS perspectives. These sources are related to information flow, material flow, decision rights, incentives or key performance indicators (KPI), operational model and BM alignment, and appropriate partner engagement. Table 5 presents the classification of the sources for the incoherence based on the case studies in this research.

Table 5. Classification of the sources for the incoherence

Level 1	Level 2
Decision rights	rights for understanding and support of DT
	rights allocation among traditional business and DT-related business, among the group and regions, among similar teams, and among digital-driven and human ability-driven solutions
	rights affected by stakeholders such as solution suppliers, competitors, and regulatory environment
Key performance indicators	KPI such as growth rate, costs, and risks between new business and traditional business
	change between customer-demand-driven and self-driven KPI
Information-flow	a lack of data flow between a company and its customers
	a lack of information exchange and communication among internal departments
Material flow	change type or demand of material from traditional offerings to new ones
	change the frequency of use of material
Operational model and BM alignment	different preference for operational model and BM
Appropriate partners engagement	balance between competition and collaboration

5.3 Finding 3 - A framework for blockers/incoherence analysis

Based on the case studies, key insights are extracted and illustrated in Figure 1. A firm's BM structure could be divided into two main parts: internal and external. The internal structure of the firm has three basic components – organization, strategy, and operational processes. Through the combination of these three foundational components, a firm realizes three aspects of its business – procurement, production, and marketing & sales. Within the organization, there are internal departments, divisions, and teams. Moreover, strategies are plans to adopt appropriate BMs that are different from traditional ones. In addition, tangible operational resources include raw materials, infrastructures, equipment, and tools. Intangible operational resources are mainly intellectual property, branding, and influence. With labor organization and operational resources, a firm runs its production and operations. With a sales force organization and sales strategy, a firm manages its marketing & sales. With procurement strategy and financial resources, a firm procures raw materials, equipment, and tools from external suppliers.

Through the internal structure, a firm interacts with its external stakeholders – customers, partners (suppliers and distributors), regulators, and competitors. A firm's production & operations department needs to adapt itself and comply with rules and regulations set by regulators. Furthermore, a firm's marketing & sales department takes charge of the demand and supply between the firm and its customers, collaborates with its distributors, and competes with its competitors. Additionally, a firm's procurement department is in charge of the demand and supply between the firm and its suppliers. There are also interactions among the five stakeholders. For instance, customers might have business not only with the firm but also with the firm's distributors and competitors. Regulations also have an influence on a company's competitors and suppliers. Competitors might have business with the firm's suppliers and distributors as well. Distributors and suppliers may also have a supply and demand relationship. Through these relationships and interactions, a firm's internal components are linked with the external world.

BMI in DT might take place anywhere in the internal and external BM components. BM incoherence are related to these components. The sources of the incoherence – challenges or changes from BMCS perspectives – are also illustrated in Figure 1. For internal incoherence,

organizational incoherence's sources are challenges or changes in decision rights and information flow; strategic incoherence's sources are challenges or changes mainly in decision rights, KPI, and to a lesser extent, in material flow and alignment between operational models and BMs; operational processes-related incoherence's sources are only challenges or changes in decision rights.

For external incoherence, demand or market-related incoherence's sources are challenges or changes in KPI, information flow, and decision rights in customers and competitors; partner-driven incoherence's sources are challenges or changes in decision rights, KPI, and appropriate partner engagement in suppliers and distributors; regulatory-driven incoherence's sources are only challenges or changes in decision rights in regulators.

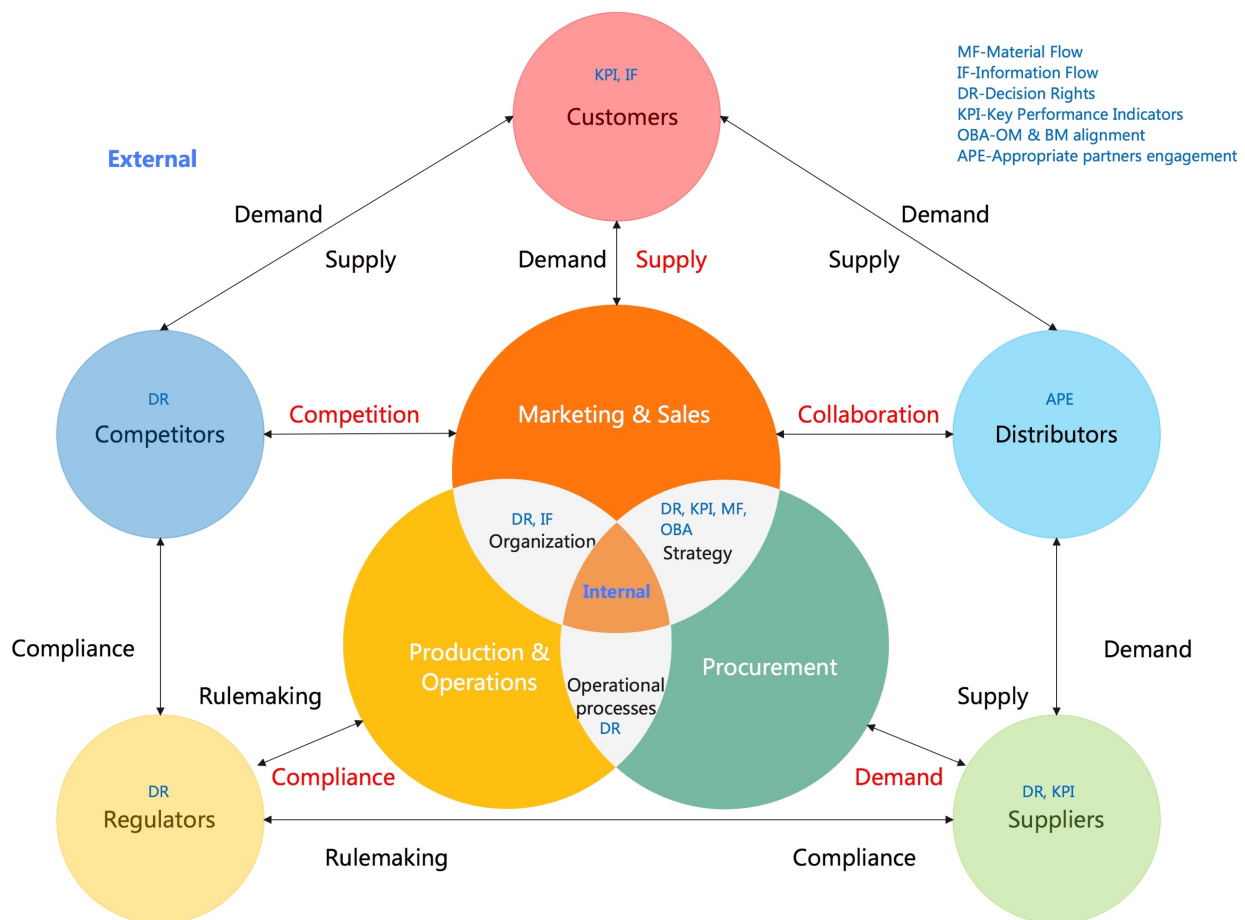


Figure 1. A framework for incoherence analysis

5.4 Finding 4 - Six types of solutions

Based on this research, to deal with the BM incoherence, there are three types of internal solutions (strategic, organizational, and operational processes-related) as well as three types of external solutions (partner-driven, demand or market-driven, regulatory-driven). Table 6 shows the classification of types of internal and external solutions.

Table 6. Classification of types of internal and external solution

Level 0	Level 1	Level 2
Internal	Strategic	Use tangible examples for demonstration
		Rethink value proposition
		Provide explanation and training about DT
		Align incentives
		Balance external innovations and internal priorities
	Organizational	Enhance interdepartmental collaboration
		Reasonably allocate Interdepartmental rights and responsibilities
	Operational processes-related	Provide training and enable feedback
External	Partner-driven	Promote new integration with suppliers
		Balance the relationship with dealers
	Demand or market-driven	Promote new integration with customers
		Rethink consumers' demands
		Find the sweet spot or right people with related demand and willingness
		Proactively find new demands
		Keep pace with competitors in the market
	Regulatory-driven	Learn BMI from industrial leaders

6. Discussion

6.1 Contributions

This study explores how to identify and categorize various types of incoherence that can arise when firms undergo DT and attempt to implement BMI. Firstly, it suggests that BMI in DT leads to challenges and hence leads to incoherence, and incoherence leads to opportunities and hence leads to solutions to deal with incoherence and promote BMI, which is a virtuous cycle. It extends the theory of strategic contradiction that drives strategic renewal and transformation. Moreover, it advances the BMCS framework for analyzing different types of BM incoherence in industries as well as sources and solutions to the incoherence.

From a practical standpoint, the research aims to assist managers in clearly identifying and understanding the types of incoherence that can emerge when their firms pursue BMI in DT. It also points out sources of incoherence, enabling managers to better understand the root causes of these incoherence. Moreover, it recommends suitable solutions for managing and resolving such incoherence.

6.2 Priority of sources of incoherence from BMCS perspectives

A clear business strategy is the foundation for coherence or incoherence in BMI in DT. This strategy should guide the design of both the business and operating models to ensure they work together effectively. To address potential issues, it is crucial to explicitly align the business and operating models with the overarching business strategy. Among the six types of sources of incoherence, challenges related to material and information flow are most fundamental. Changes in these areas can lead to shifts in incentives, decision rights, operational model alignment, BM alignment, and partner engagement.

6.3 Applicability of the framework

For some cases in the research, many companies experience challenges or changes in their process of BMI in DT. However, some companies experience challenges or changes in DT, but not in the scope of BMI; some companies experience challenges or changes in BMI, but not in

the context of DT. Nonetheless, the framework for incoherence analysis works for all of these cases.

6.4 Limitation

There are some limitations to the case studies. Firstly, one of the main criticisms is that findings from case studies may have limited generalizability. The specific cases in terms of incoherence and solutions chosen may not be representative of the broader businesses or may not be applicable to other business contexts. Secondly, the selection of cases about incoherence and solutions might introduce bias, especially if the cases are not chosen randomly. If cases are selected based on certain characteristics, the findings may be skewed and not applicable to a more diverse population. The research team makes an effort to randomly select companies of different sizes, in different industries, and in different geographic areas. However, there might still be relevant limitations to some extent.

Managers in companies have more interest in detailed solutions to the incoherence; however, these types of solutions are mainly at the strategic level. Although strategic solutions and recommendations are valuable and directional, solutions at the operational level are more practical and feasible for managers.

There might be different types of sources for one type of incoherence; however, there is no research on the priority of the sources of incoherence from BMCS perspectives. It is difficult to compare them with each other, such as which source is more essential, which source has more impact on the incoherence, and which source is the root cause. Therefore, there are some limitations in terms of the analysis of the sources of incoherence.

6.5 Future research direction

Future research includes in-depth single case studies using qualitative methods with companies in specific industries. This could help not only validate the general findings in terms of BM incoherence in this research but also provide a deep understanding of BM incoherence, sources, and solutions in particular fields.

Furthermore, solutions to BM incoherence at both the strategic and operational levels could be studied, including mapping solutions to incoherence, tracking the end result of the solutions, and evaluating the effectiveness of these solutions.

Additionally, among the six types of sources of incoherence, material flow and information flow related challenges are more fundamental because changes in material flow and information flow could lead to changes in KPI, decision rights, operational model and BM alignment, and partner engagement. The priority, importance, impact, and relationships among the sources of incoherence could be analyzed in future research.

7. Conclusion

This research introduces the identification and classification of incoherence and relevant sources and solutions in BMI in DT in companies. Through case studies involving 50 interviews and two workshops over five years with firms in various industries, the researchers summarize six types of incoherence, six types of sources of incoherence, and six types of solutions. It also helps managers clearly identify and understand the types of incoherence in BMI in DT in their firms and find appropriate solutions to manage the incoherence. Additionally, contributions, applicability of the framework, limitations, and future research directions are discussed.

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Appendix 1: Interview protocol

Discussion questions:

- Could you please let us know your roles, responsibilities, and involvement in DT-related projects/initiatives in the firm?
- What are the important opportunities and trends in terms of DT in the industry and what are the goals the firm has set for digital technology adoption? What are the key challenges?
- Could you share with us some DT-driven BMI initiatives that are seen to be a success and others that have been less so?
- Could you share the process by which these initiatives came about and how they were implemented leading to their success as well as challenges?
- How does DT or the adoption of technology affect the firm's current BM? (i.e., how it affects the process that creates, delivers, and captures values)
- What do you think are the major blockers internally (Internal misalignment or inconsistency between divisions or with the firm's existing operating model) and externally (misalignments with suppliers, partners, or customers)? Could you please give us some examples?
- How were these blockers identified and managed?
 - a. How do these blockers relate to the flow of materials and information in the firm (e.g., within a division or between divisions)?
 - b. How do these blockers relate to the right to make decisions within and across divisions?
 - c. How do these blockers relate to the KPI of the firm?
- What are the key lessons that the firm has learned about the adoption of digital technologies and BMI? How have you improved your processes to implement new BMs?