International Journal of Electronic Commerce

ISSN: 1086-4415 (Print) 1557-9301 (Online) Journal homepage: www.tandfonline.com/journals/mjec20

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To cite this article: Divya Sharma, Neetu Yadav, Yogesh K. Dwivedi & Mihalis Giannakis (2024) Digital Transformation of Incumbent Pipeline Firms through Platformization, International Journal of Electronic Commerce, 28:2, 186-216, DOI: 10.1080/10864415.2024.2332047

To link to this article: https://doi.org/10.1080/10864415.2024.2332047

INTERNATIONAL JOURNAL OF ELECTRONIC COMMERCE
2024, VOL. 28, NO. 2, 186–216
https://doi.org/10.1080/10864415.2024.2332047

Routledge
Taylor & Francis Group

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ABSTRACT

Advancements in digital technology necessitate a shift from traditional linear buyer-supplier value chains to a network-centric approach facilitated by digital platforms. Despite digital platforms being a dominant model for transformation, limited research has explored the enablers for incumbent pipeline firms to embrace platformization. To address this gap, this study reviews existing literature on digital transformation, identifying nine enablers for digital platformization: changing client behavior, information technology (IT) capabilities development, structural efficiencies, disruptive competitive forces, scope advantages, economic triggers, disruptive third-party technology, creation of autonomous corporate structures, and regulatory compliance. Case studies of platformization in diverse industries are analyzed using the modified total interpretive structural modeling (m-TISM) approach, resulting in a hierarchical model with five levels. This model delineates interrelationships among trigger events, external enablers, internal organizational enablers, process enablers, and outcome drivers. Furthermore, the study highlights that the creation and extraction of value from digital platforms are operationalized through e-business strategies, contributing insights to e-business literature by discussing the implications of these enablers on dimensions such as commerce, collaboration, communication, connection, and computing.

KEYWORDS AND PHRASES

Digital platformization; digital transformation; structural modeling; pipeline firms; e-business; digital webs

Introduction

Platform firms, propelled by technological advancements like cloud computing, Internet of Things (IoT), artificial intelligence (AI), and so on, are reshaping the business landscape. Born-digital platform firms, like Google, Airbnb, and Alibaba [23], create value through the network-centric approach of intermediating transactions between multiple sides of a market, where some sides may subsidize others [135]. This approach results in significantly greater value creation [53, 66, 77], as is exemplified by the most valuable firms in the S&P 500 index—Microsoft, Apple, Amazon, Meta, and Google [104]—deriving value from their digital platform business models. Practitioners also acknowledge that digital platforms address organizational inefficiencies and have the potential to mitigate future challenges, fostering greater customer orientation [6, 26]. Platform-based business models empower firms to lower costs, seize opportunities, and withstand disruption [33].

CONTACT Yogesh K. Dwivedi y.k.dwivedi@swansea.ac.uk Digital Futures for Sustainable Business & Society Research Group, School of Management, Swansea University – Bay Campus, Swansea, UK
Supplemental data for this article can be accessed online at https://doi.org/10.1080/10864415.2024.2332047

Despite recognizing the high potential for value capture through digital platforms and witnessing disruption by platform businesses [7, 8, 115], incumbent firms find it challenging to adopt the platform business model due to strategic, cultural, and implementation constraints [24, 65]. This is because, as opposed to the network-centric intermediation approach of platforms, most incumbent firms follow a "pipeline" business model. Pipeline firms are characterized by *value creation from close control over a linear series of activities in the value chain as suppliers' inputs are transformed into feature-rich products* [3, 135]. In the face of mounting pressure from the digital platform ecosystem, incumbent pipeline firms are renewing and transforming their linear business processes. This evolution of incumbent pipeline firms is often evident in their manifestations as e-commerce and e-business platforms, signaling a shift in how these firms create and appropriate more value employing digital platforms [74, 82, 115].

Digital platformization, that is, making a digital platform the infrastructural and economic core of the firm [50], is among the most prominent digital transformation strategies adopted by incumbent pipeline firms [30, 43, 46]. However, there is limited scholarly work available on the platformization of pipeline firms. Therefore, this article attempts to uncover the forces driving digital platformization of incumbent pipeline firms and their implications for the digital economy. The objectives of this study are (a) to identify the enablers and drivers of digital platformization, (b) to develop a conceptual framework that explains the dynamics of these forces, and (c) to understand the implications of these enablers and drivers for a firm's e-business strategy. Hence, we ask the following research questions:

RQ1: What are the external and internal forces that enable the digital platformization of incumbent pipeline firms?

RQ2: What are the interrelationships between and dynamics of these enablers and drivers?

RQ3: What are the implications of these enablers and drivers for the e-business strategy of incumbent pipeline firms?

To address RQ1, we conducted an extensive literature review of digital strategy and transformation, identifying the enablers propelling incumbent pipeline firms toward digital platformization. For RQ2, we complemented findings from the literature review with an inductive inquiry, developing cases on the digital platformization of six prominent, incumbent pipeline firms. Using a modified total interpretive structural modeling (m-TISM) approach, we established hierarchical relationships among the enablers based on the case studies, resulting in a conceptual framework of digital platformization that was subsequently validated. To answer RQ3, the framework's implications for e-business aspects were delineated [139]. The study enriches existing knowledge by highlighting the enablers of digital platformization and proposing a conceptual framework for further exploration.

The remainder of the article is structured as follows: The second section presents the theoretical underpinnings of digital platformization, identifying enablers of digital transformation as delineated in the extant literature. The third section charts the methodology used to conduct the study. The fourth section presents the cases developed on well-known, incumbent pipeline firms. The fifth section discusses the application of the m-TISM methodology to prepare a conceptual framework. The sixth section identifies the

implications of the conceptual hierarchical framework for e-business strategy. The last section presents the concluding remarks.

Theoretical Background

Digital technologies are transforming traditional businesses, making them more "modular, distributed, cross-functional, and global," enabling work processes to transcend the boundaries of time, distance, and function [17]. Beyond mere technological optimization, digital transformation changes "how a firm employs digital technologies, to develop a new digital business model that helps to create and appropriate more value for the firm" [115]. This transformation has fundamentally shifted the competitive landscape, and necessitates incumbent pipeline firms to reconsider their business models and value creation logic [55].

Traditional pipeline approaches focus on linear value creation, converting inputs into outputs along the value chain. In contrast, platforms create value by facilitating interactions between external producers and consumers, orchestrating their resources [3, 115, 135]. Value creation in digital platforms occurs across three dimensions. First, network effects enhance platform value as more customers join, leading to dominance and customer lock-in, as seen with Uber and Airbnb [86, 123]. Second, platforms capture user information to enhance customer experience and overall value. Third, platform owners control markets, deriving value from competitive knowledge and offerings [136]. Platforms offer enhanced scale and scope, enabling dynamic coordination among participants and control over digital infrastructure [17, 40, 44], ultimately decentralizing traditional organizations [1].

While scholars emphasize the advantages of platformization for incumbent pipeline firms [17, 55, 115], scant attention is given to a comprehensive exploration of the drivers, processes, and imperatives guiding a firm's transformation into a digital platform. Recognizing that the full potential of digital platforms emerges when they constitute a central element of the wider digital transformation strategy of organizations [101], we contend that the digital transformation literature serves as a powerful foundation for identifying and understanding the enablers of organizational platformization.

Therefore, we reviewed literature in digital strategy, digital transformation, and digital platforms, guided by the building blocks [117] and strategy elements [75] of the digital transformation process [115] identified in prior research. Drawing on recent research, our intent was to comprehend the antecedents facilitating the adaptation of incumbent pipeline firms to technological change [11, 37, 56, 57].

Previous studies have pinpointed external drivers for digital transformation, including disruptive digital technologies, digital competition, and digital consumer behavior [115, 119]. Economic pressures and evolving regulations further propel digital transformation [13]. Internally, digital transformation is fostered by cross-functional teams, rapid decision making, and executive support [119]. Limitations in existing capabilities and infrastructures push firms to transform processes to be more digital-friendly [13]. Strategic imperatives for digital transformation encompass digital resources, organizational structures, growth strategies, and metrics and goals [115], and its intended outcomes include ensuring digital readiness, enhancing digital channels, facilitating product innovation, and exploring new business models [13].

Our engagement with existing research enabled the identification of nine recurring themes deemed relevant for this study. In-depth exploration of literature on each theme

Table 1. Factors enabling digital platformization derived from themes in extant literature

Theme from literature	Support in extant literature	Potential enablers of digital platformization included in this study
Customer-related factors	Digital consumer behavior [115]; Disruptions altering Consumer behavior and expectations [117]	Changing Client Behavior
Need for IT skills	Use of technologies [75]; Digital resources [115]; Structural changes [117]	Development of IT Capabilities
Change in organization structure	Structural changes [75; 117]; Organizational Structure [115]	Need for Structural Efficiencies
Competition	Digital competition [115]; Disruptions altering Competitive landscape [117]	Disruptive Competitive forces
Growth and expansion	Changes in value creation [75]; Growth strategy [115]; Operational efficiency [117]	Scope Advantages
Financial factors	Financial aspects [75]	Economic triggers
Disruptive technology	Use of technologies [75]; Use of digital technologies [117]	Disruptive third-party Technology
Independent unit	Structural changes [75]; Organizational Structure [115]	Creation of Autonomous Corporate Structure
Legal factors	Regulatory frameworks [114]	Regulatory Compliance

determined its significance to the phenomenon of digital platformization. Subsequent deliberation among the authors regarding the inclusion or exclusion of the nine themes revealed that digital transformation is often spurred by the *client's changing behavior* due to emergence of digital technologies and associated business models [10, 25, 55]. Firms develop *information technology (IT) capabilities* [18, 83, 97] as a response to the *need for structural efficiencies* [18, 83, 97] and *disruptive competitive forces* emerging from adoption of digital technologies [13, 51], with the expectation of *scope advantages* from platformizing [22, 44]. *Economic triggers*, such as macroeconomic events impacting a firm's financial strength (e.g., economic downturns), also contribute to digital transformation [5, 75]. A firm's digital transformation may be propelled by access to disruptive technology through *third-party digital technology* providers [75, 120], and executed through the creation of an *autonomous corporate structure* aligning with the firm's vision of digital transformation [13, 21]. Finally, prevailing laws and regulations may necessitate digital transformation of firms to ensure *regulatory compliance* [4, 22]. In this way, nine specific factors potentially enabling digital platformization were derived from broad themes related to the elements supporting digital transformation. The initially identifies themes and rationalized factors derived from these themes that were finally included in this study are shown in Table 1.

We analyze the existing literature, providing detailed descriptions of each of these nine factors in the following.

Changing Client Behavior

Irrespective of whether a firm serves retail customers (for example, in a B2C context) or enterprise clients (for example, in a B2B context), digital technologies empower consumers to demand and extract more value from firms by fostering greater connectivity among people, firms, and objects [87, 116]. Customers expect firms to personalize and customize offerings, leveraging the power of social media, online reviews, customer relationship management (CRM) systems, and big data analytics [134]. Combining the digital resources of clients with those of firms

facilitates novel digital ecosystems that foster value creation through greater collaboration [85].

Digital platforms reshape customer experiences by allowing platform users to adopt multiple identities (facilitators, users, providers) [12, 20]. Consumers actively co-create value with firms, partners, allies, and competitors, driven by the shift from value chains to networks accelerated by digital technologies [88]. However, co-creation poses challenges in reconciling tensions across physical, digital, and social realms [20]. For instance, a Meta whistle-blower revealed that the company was aware about filter usage on Instagram leading to addictive behavior among children and teens [93].

Development of IT Capabilities

Leveraging the resource-based view, scholars highlight that the impact of rare, nonsubstitutable, and nonreplaceable IT capabilities on firm performance is mediated by digital transformation [83]. These capabilities encompass IT resources, skills, and knowledge that can be deployed synergistically with other resources [18]. Superior IT capabilities enable organizations to transform existing products, services, and processes into digital offerings [83].

The entire stock of digital artifacts, including software, interfaces, and data structures, forms organizational capital that offers investment or liquidation options for current IT capabilities with an eye on expected future gains [97, 127]. Organizations that simultaneously explore emerging technologies, methodologies, and skills, while exploiting their current digital resources, are known to better respond to emerging business needs [70]. Research suggests that possessing specialized complementary assets, like manufacturing capabilities, complementary technologies, and access to distribution channels and service networks that remain relevant amid competence-destroying technological changes, aids organizations in adaption [96, 112]. Recent research also underscores the role of employees' digital literacy as a digital transformation enabler [27]. Equipping the workforce with digital skills promotes collaboration, scientific decision making, and better management through automation [122].

Need for Structural Efficiencies

Digital technologies optimize and coordinate organizational activities, fostering connections between internal and external stakeholders [14, 85]. Recent research advocates replacing traditional organizational structures, boundaries, and hierarchies with networks and ecosystems to enhance dynamism, iterations, and evolution in digital transformations [53, 60, 73].

While organizational departments enhance efficiency, they constrain flexibility and agility [13]. A strategy transcending functional areas and business processes promotes a transfunctional approach to digital transformation [17]. Increased integration facilitates vertical and horizontal information exchanges, expediting decision making in response to change [71]. Cross-functional teams reduce frictions in bureaucratic structures, fostering autonomy, experimentation, and risk taking [58]. Some organizations boost agility with a flexible organizational form, comprising self-steering teams with decision-making responsibilities [115].

Disruptive Competitive Forces

Organizations gain a competitive edge by leveraging emerging technological capabilities to develop new products, services, and business strategies [51]. The rise of digital technologies intensifies global competition, leading to a shift in the competitive landscape and the emergence of new, unknown competitors [13]. Existing capabilities may depreciate, prompting firms to compete and collaborate with suppliers, customers, allies, and complementors [37]. Traditional companies must invest in analytical capabilities, platform functionality, and connected intelligence to transform customer value propositions [55].

Digital assets facilitate business process modularization and plug-and-play capabilities offering advantages in platform ecosystems [17]. Technology platforms, characterized by a modular core–periphery architecture, "federate and coordinate constitutive agents who can innovate and compete," encouraging standalone and recombination-based innovation [44]. Such platforms foster collaboration and competition, transforming industry competition [138]. Additionally, digital platforms transcend traditional industry boundaries, giving rise to niche and specialized competitive spaces [17].

Scope Advantages

Adopting digital technologies enhances organizations by optimizing internal processes, reducing errors and breakdowns, achieving operational integration with suppliers, and increasing employee efficiency [71]. Moreover, these technologies facilitate the development of new products and services that complement the existing portfolio, expanding corporate scope [17].

Scope expansion is further driven by information abundance from digital technologies, including data from IoT sensors, e-commerce transactions, and social media. Real-time analytics enhance understanding of consumer behavior, allowing firms to optimize processes and make data-driven decisions [22, 72]. Digital technologies democratize content, enabling sharing, redistribution, and remixing for fundamentally different and new sources of value creation [17].

Technology platforms create value through supply and demand side economies of scope [44]. They offer advantages across various dimensions, facilitating partner discovery, providing access to and accumulation of relevant data, offering developer tools for novel use cases, enabling price discovery, building trust through rating mechanisms, and enhancing competition by eliminating gatekeepers [138].

Economic Triggers

Information and communication technology (ICT) significantly and positively impacts productivity, contributing to economic competitiveness and growth [25, 59]. Financial endowments play a vital role in fostering organizational resilience through digital transformation [64]. However, finance serves as both a driver and a limiting factor for digital transformation [75]. While strong financial positions may reduce the urgency for digital transformation, weak financial positions can hinder response to core business challenges, competition, and customer demands in a competitive digital ecosystem. Nonetheless, economic crises like downturns and pandemics accelerate the diffusion of IT innovations and transformation [5], as crises often prompt organizations to make changes that were challenging in more stable times [22].

Disruptive Third-Party Technology

Even without being technological leaders, organizations can leverage established technological standards and tools to meet business needs [75] or orchestrate digital resources from partners and competitors in the business ecosystem for organizational benefit [17]. Cloud computing, for instance, offers on-demand access to a shared pool of networked resources, enabling rapid scaling of infrastructure based on current needs. Instead of in-house development, organizations can explore various partnerships, including joint ventures, crowdsourcing, and collaboration with competitors, to develop digital solutions and capabilities [55]. Additionally, the application of older technologies in new ways can foster innovation and *recombinant growth* [120].

Creation of Autonomous Corporate Structure

Digital technologies destroy incumbent organizations' current competences and require them to experiment, learn, and develop innovative business models [115]. A lack of IT infrastructure and capabilities to quickly react to technological change can cripple digital transformation efforts [13].

Implementing structural changes in organizations with respect to the placement of digital activities within the corporate structure is aligned with a focus on digital transformation [75]. For limited transformations, digital activities can be integrated into the existing corporate structure, while substantial changes may require creating a separate subsidiary to house these activities [32]. Establishing separate business units for digital transformation helps eliminate administrative barriers that hinder information flow, data exchange, and creativity [13]. Firms like Dell and Pepsi rely on separate, multifunctional, and integrative command centers to manage information flow and respond to changes quickly [17].

Scholars suggest that detecting and reacting to technological developments can be expedited by establishing autonomous business units, geographically and/or contextually separate from the headquarters. This allows disruptive models to be developed without fears of cannibalization and conflict [115]. Separate business units also facilitate self-disruption by enabling the development of their own strategy, culture, and processes, separate from that of the incumbent parent [21].

Regulatory Compliance

Conforming to rules and regulations is an important aspect of all organizational activities, including digital transformations. National and international legislative changes often force organizations to rethink their products and processes, instigating them to undertake digital transformations [13]. Favorable legal frameworks, in terms of patent and intellectual property laws, encourage digital innovation [22]. Furthermore, recent financial crises have led to stricter regulations for "separating retail and investment banking (e.g., Dodd–Frank Act), for protecting consumers and markets (e.g., MiFID), reporting schemes to prohibit fraudulent behaviour (e.g., AIA, FATCA) and requirements for higher capital coverage (e.g., the Basel agreements)" that may drive IT-based innovation in organizations [4].

Table 2 defines the enablers of digital transformation just identified.

Table 2. List of Enablers of Digital Transformation of Traditional Incumbent Pipeline Firms

S.No.	Enabler/Force	Description	References
E1	Changing Client Behavior	Expectations of customers for greater value in terms of personalization, customization, connectivity, responsiveness, and the possibility of co-creating value, due to the emergence of digital technologies	Cardona, Kretschmer and Strobel, (2013); Venturini, (2015); Iansiti and Lakhani, (2014); Ballestar et al., (2020); Yang, (2022); Brynjolfsson, (2011); Katz, Koutroumpis and Martin, (2014); Benoit et al., (2017); Bolton et al., (2018)
E2	Development of IT Capabilities	IT skills, resources, and knowledge to explore emerging technologies and develop digital offerings	Nwankpa & Roumani, (2016); Bharadwaj, (2000); Sandberg, Mathiassen and Napier, (2014); Yoo et al., (2012)
E3	Need for Structural Efficiencies	Advantage arising from organizational structures, networks, and ecosystems that foster the capabilities to transform digitally	Pagani and Pardo, (2017); Majchrzak, Markus and Wareham, (2016); Bharadwaj et al., (2013); Liere-Netheler, Packmohr and Vogelsang (2018)
E4	Disruptive Competitive forces	The emergence of intense competition arising from access to digital technologies resulting in devaluation of existing capabilities and transformation of traditional competitive landscape	Henderson and Venkatraman, (1999); Verhoef et al., (2021); Berghaus and Back, (2017); Eggers and Park, (2018); Gawer, (2014)
E5	Scope Advantages	Development of new products and services that augment the current portfolio of offerings of the firm due to the use of digital technologies	Liere-Netheler, Packmohr and Vogelsang, (2018); Bharadwaj et al., (2013); Brynjolfsson, (2011); Gawer, (2014)
E6	Economic triggers	Macro-economic events that affect the financial strength of a firm	Cardona, Kretschmer and Strobel, (2013); Khurana, Dutta and Singh, (2022); Matt, Hess and Benlian, (2015); Alt and Puschmann, (2012)
E7	Disruptive Third-party Technology	Digital resources provided by other partners or competitors that enable digital transformation	Matt, Hess and Benlian, (2015); Weitzman, (1998); Bharadwaj et al., (2013); Iansiti and Lakhani, (2014)
E8	Creation of Autonomous Corporate Structure	Separate business unit established to spearhead digital transformation, often geographically distant from the firm's corporate headquarters, to inhibit the impact of organizational barriers to creativity and data/information flow.	Verhoef et al., (2021); Berghaus and Back, (2017); Matt, Hess and Benlian, (2015); Broekhuizen, Bakker and Postma, (2018)
E9	Regulatory Compliance	Adherence to national and international laws and regulations	Berghaus and Back, (2017); Brynjolfsson, (2011); Alt, Beck and Smits, (2018)

We find that most of the research reviewed in this study uncovers factors that, in general, encourage an organization to transform digitally. Further, digital platforms are a more lucrative means for digital transformation in comparison to digital products [30, 43]. However, we found a dearth of studies that specifically identify the drivers for the digital platformization of organizations. Building on the enablers for digital transformation, we extend these to the context of digital platformization and identify interrelationships between them. We believe that understanding these interrelationships is essential for organizations to plan and diagnose their digital platformization exercises, owing to the complex and uncertain business dynamics in digital ecosystems. The following sections describe the methodology used to arrive at a hierarchical model for digital platformization.

Methodology

This study employs a modified version of an interpretive methodology, namely, modified total interpretive structural modeling (m-TISM), that has a long legacy derived from interpretive structural modeling (ISM) and total interpretive structural modeling (TISM)

[106, 107, 118]. While ISM helps to deal with fundamental questions of theory building, such as "what," "how," and "why" by identifying a hierarchical structure among the variables of interest [118], TISM enables the interpretation of the links between the variables by incorporating experts' opinions or by establishing them through a literature review [106].

In the conventional ISM/TISM process, $n(n-1)/2$ pairwise comparisons are made (here n = number of variables of interest) to create the initial reachability matrix, which is then subject to transitivity checks. The direct pairwise comparisons and transitivity checks are done sequentially, making the process time-consuming and creating redundancies. In the m-TISM approach, this anomaly is addressed by merging these steps to carry out pairwise comparisons and transitivity checks side-by-side, so that the pairs that are related by the logic of transitivity are not required to be compared by experts. This results in a drastic reduction in the number of pairwise comparisons to be made by experts [107].

The remaining process—preparing a level partitioning matrix and a digraph of hierarchical relationships and translating the digraph into an interpretive model—is the same as in the TISM methodology. This method has been applied in various contexts, with recent applications in the domains of cybersecurity, marketing resources and capabilities, and efficacy of COVID vaccination drives [28, 92, 102].

The detailed process for preparing the m-TISM model is summarized in the following steps, following Sushil's [106, 107] work.

Step I: Identification of Factors

Elements relevant to the problem or phenomenon are identified either through a literature review or through inductive methods. In this research, we performed a review of literature in the domains of digital strategy, transformation, and platforms to identify nine enablers of digital platformization for incumbent pipeline firms, as discussed earlier.

Step II: Definition and Interpretation of Contextual Relationship Between Identified Factors

Pairwise comparison of factors identified in step I is conducted to establish contextual relationships between them. Simultaneously, the relationships among the factors are checked for transitivity for all the pairs. Once all the transitive links are identified, a structural self-interaction matrix (SSIM) of the factors is developed that indicates the presence or absence of pairwise relationship between the elements, providing the potential for further theory building [38, 39].

In this research we defined the contextual relationships between the nine enablers of digital platformization based on evidence from six case studies of companies that had recently platformized. To include sufficient variety to discern the interrelationships between the enablers, we chose case companies from diverse industries, including heavy machinery and equipment, investment banking, auto supply, publishing and printing, metals, and apparel retail. The six cases companies chosen are General Electric [68, 125], Goldman Sachs [48], Michelin [47], the Washington Post [34, 71, 118], Klöckner & Co. [67], and Red Collar Group [105, 109, 132]. We consciously chose case companies that had been entrenched in pipeline logic for long and possessed varying levels of global presence, as

Table 3. Description of chosen cases companies

Name	Year of Establishment	Global Presence	Industry
General Electric	1892	> 130 countries	Industrial Machinery and Equipment
Goldman Sachs	1869	38 countries	Investment banking
Michelin	1889	170 countries	Auto supply
Washington Post	1877	25 countries	Publishing and Printing
Klöckner & Co.	1906	13 countries	Metals
Red Collar Group	1995	-	Apparel Retail

shown in Table 3. This helped in ensuring comprehensiveness in identifying the interrelationships between enablers and developing the hierarchical model.

The case studies were prepared based on rich information drawn from a variety of data sources [131], such as case studies published by Harvard and Ivey, journalistic and news articles, Web articles, and the official websites of the case companies. The qualitative evidence in the form of case anecdotes was used to develop hierarchical relationships, while checking for transitivity among the nine enablers of digital platformization.

Step III: Developing a Reachability Matrix and Level Partitioning

A reachability matrix is developed from the SSIM obtained in step II by adding 1 for relationships that are present, and 0 for relationships that are absent. All transitive links are converted to a 1. Thereafter, the reachability matrix is partitioned into levels, as in the TISM approach. The level partitions form the basis for development of the hierarchical model.

Step IV: Developing a Digraph and Interaction Matrix

Based on the relationships in the reachability matrix from step III, a directed graph (or digraph) is developed, showing the directed links between the factors. All transitive links are retained in the digraph. Thereafter, an interaction (binary) matrix is developed from the digraph, with 1 representing a direct and significant transitive link, and 0 representing the absence of a relationship.

Step V: Developing m-TISM Model

Finally, an m-TISM model is constructed by supplementing the interpretations of the links based on expert consultations. In this research, expert consultation was operationalized through a focus-group discussion (FGD) with six industry experts from content management, publishing, chemical manufacturing, agricultural sciences, construction, and manufacturing domains who are responsible for driving digital platformization at their own organizations. The FGD was conducted in an online setting where the industry experts discussed "how does enabler A influence/enhance enabler B?," expressing diverse interpretive logics for each pairwise relationship. The FGD lasted for around two hours, where one of the authors facilitated the discussion and consensus building on the multiple interpretive logics presented [106]. Seeking inputs from diverse industries helped us foster greater generalizability of the interpretations of linkages, while remaining contextually relevant. Based on inputs from the FGD, the interpretation and the m-TISM model for digital platformization were finalized.

After completing steps I through V, we validated the significance of each link in the m-TISM model through an expert survey. Using snowball sampling, we contacted 32 senior managers working in incumbent pipeline firms globally to seek their expert response on a five-point scale ranging from "strongly agree" to "strongly disagree" in relation to the linkages and interpretations from the FGD. These managers were informed about the objectives of this study, after which one of the authors solicited observations and responses about the developed linkages in an interactive virtual setting. This resulted in the development of the validated m-TISM hierarchical model for digital platformization.

Next, we present a description of the case studies, followed by the details of the model development (steps II–V) and validation process in subsequent sections.

Description of Case Studies

This section describes six cases of incumbent pipeline firms to discern the relationships between the forces and enablers of digital platformization.

Case I: General Electric

The 2008 economic crisis prompted General Electric (GE) to develop the industrial Internet, integrating machines, the Internet, and data, in response to client demands for a "data strategy" to navigate uncertainty and enhance productivity [69]. By 2012, advancements in sensor and network technologies led GE to equip its operational technologies with sensors for real-time monitoring [42]. Despite the presence of sensors in most customer machines, the data was not effectively tracked and analyzed. Since the early 2000s, GE had been investing in technologies to gather, process, and use information from its machines, with most assets featuring embedded software by 2011. At that time, GE was among the largest software companies, generating billions in revenue from software. However, the software development process was inefficient, with only 17% of offerings proving profitable [69].

In response to competition from nontraditional competitors like SAP and IBM, GE Software was established in late 2011, tasked with connecting all GE machines to a cloud-based platform—Predix. Predix facilitated sensor connection, secure data collection, analysis, and application development for the industrial Internet [110]. It aimed to establish a common language and practices, ensuring security, compliance, a seamless user experience across GE machines, and efficient management of distributed computing and analytics.

With the industrial Internet, GE sought to collect data from 10 million sensors, analyze historical sensor data for predictive maintenance, and inform product development by identifying performance differentiators among machines. By October 2016, GE promoted Predix as a cloud platform for partners and customers to connect their own machines and build their own analytics applications. The cloud-based, open Predix platform facilitated updates and maintenance, enabling original equipment manufacturers (OEMs) like Siemens to utilize it for data analysis and improve their equipment operation. Traditionally entering long-term contractual service agreements, GE could now explore alternative outcome-based business models with Predix, potentially commercializing software assets through a subscription model instead of licensing [113].

Case II: Goldman Sachs

After the 2008 financial crisis, Goldman Sachs faced challenges such as a global downturn, new regulations, and volatile markets [19]. By 2011, the company experienced a decline in net revenue and pretax earnings by 36% and 69%, respectively, compared to 2009 [45]. Recognizing the need for operational efficiencies, the leadership prioritized technological interventions to enhance transparency and reduce risks. Technological advancements, including large databases, complex algorithms, and accessible cloud platforms, facilitated the rise of fintech (financial technology) startups in lending (e.g., Lending Club), payments (e.g., PayPal), funding (e.g., GoFundMe), and personal finance (e.g., Credit Karma). Goldman Sachs viewed these fintech startups as less challenging, operating in the retail consumer segment, distinct from Goldman Sachs's focus on institutional clients. Risk intermediation, being a highly regulated domain requiring global operations and substantial infrastructure investment, posed challenges for immediate fintech entry [29]. Nevertheless, the leadership recognized the pivotal role of technology in the organization's future and the financial industry.

To enhance operational efficiency, Goldman Sachs centralized core technology components, eliminating duplication of functional efforts. The common technology platform, utilizing SecDB (Securities Database), Goldman Sachs's 20-year-old proprietary database, provided common functions for siloed business units. Applications for risk analysis, portfolio construction, market research, sales, trading, and posttrade tracking were developed on this platform, with the flexibility to make them available to external clients through application program interfaces (APIs). The culmination of these efforts resulted in Marquee, an internal platform extended to institutional clients, allowing them access to the same data and risk models as Goldman Sachs's traders and risk managers [126]. While concerns about clients using Marquee for research and trading elsewhere were raised, proponents emphasized that advice had always been free, while execution incurred charges. Additionally, Marquee aligned with future regulatory compliance, such as MiFID II regulations in the European Union (EU) requiring the unbundling of research and transactions [62].

Case III: Michelin

Michelin's is the second largest tire manufacturer, and its leadership had recognized the potential in third-party maintenance as early as 2009. At that time Michelin had initiated ONCall Emergency Roadside Service [80], which enabled truck drivers to access roadside assistance for tire-related services by calling a telephone helpline. This was later expanded to ONCall 2.0 in 2014, with the addition of towing and mechanical repair services [79]. ONCall 2.0"s success uncovered operational inefficiencies and extensive paperwork in processing each truck-service transaction at a dealer. To ease resultant order processing and payment delays for large fleet operators, Michelin launched Truck Care—developed through an outsourcing arrangement—in 2014 [81]. However, its poor design and scalability issues resulted in its discontinuation.

Undeterred, Michelin formed the Services and Solutions (S&S) group in 2017, aiming for innovative solutions in connected mobility [78]. The group envisioned a digital marketplace, Maestro, to streamline transactions among fleet operators, service providers, dealers,

and Michelin, solving administrative complexities. Maestro offered the best alternative for Michelin to tap into the service market, where providers like Dickinson Fleet Services had seen exceptional growth, especially during the overcapacity and stagnation period of 2019. Despite initial challenges in platform adoption, Michelin officially launched Maestro in August 2020. It reached out to non-Michelin dealers and mandated franchised dealers to deploy the platform by mid-2021, offering payment options of monthly subscription or per-transaction fees.

Case IV: The Washington Post

Amid financial challenges post the 2008 economic crisis, The Washington Post faced declining revenues from circulation and advertising, as did the rest of the newspaper industry. This necessitated a reassessment of its operational obstacles [61], and led to the identification of its monolithic content management system (CMS) as a hinderance to productivity and adaptability. Not only did journalists and writers have to use different tools for different tasks, but a slow loading time also plagued the experience of its readers. Recognizing the need for change, The Washington Post, under the leadership of its chief information officer (CIO), developed the in-house publishing platform PageBuilder by early 2013 [76].

Despite efforts to navigate the changing landscape, persistent revenue declines led to the sale of The Washington Post to Jeff Bezos of Amazon in October 2013, marking a transformative shift toward digitalization. Bezos's acquisition reinvigorated The Washington Post's technology initiatives, drawing inspiration from the Amazon Web Services (AWS) model [76]. A pivotal moment came when The Washington Post initiated a pilot program, allowing student newspapers from the University of Maryland and Columbia University to use PageBuilder for free.

In 2016, The Washington Post decided to leverage its in-house platform for broader impact, leading to the creation of Arc Publishing, a comprehensive platform encompassing PageBuilder and additional tools for story scheduling, video content optimization, performance analysis, and more. Powered by AWS, Arc was licensed to other news organizations, scaling to 500 million monthly unique visitors across 90 websites and apps by 2018. Its feature set expanded to include personalization, audience insights, and paywall management [124]. This marked a strategic integration of engineering and journalism, offering publishers a unified technology solution [36].

Arc's success prompted a rebranding in 2021 as Arc XP, evolving into a digital experience platform that incorporated e-commerce services alongside its digital publishing tools. Clients such as AvalonBay, BP, Boston Globe Media Partners, Le Parisien, and the Philadelphia Media Network adopted Arc XP, solidifying its position as a significant revenue source for The Washington Post by 2022, complementing its traditional revenue streams of subscriptions and advertising [108].

Case V: Klöckner & Co

Klöckner & Co., an established steel producer and distributor with a history spanning a century, faced considerable challenges in the wake of the 2008 financial crisis. While there was a 20% decline in steel demand in Europe, overcapacity prevailed due to uninterrupted

production and the added pressure of Chinese steel dumping in European markets [98]. The company also acknowledged the looming threat from emerging competitors like China's Alibaba and the potential entry of industry giants like Amazon into the B2B segment.

In response to these challenges, Klöckner & Co.'s leadership recognized the transformative potential of digitization to differentiate their offerings and stimulate growth. Initial attempts to innovate internally faced hurdles attributed to a lack of disruptive thinking at the company's headquarters in Duisberg. Consequently, the company established an office in Berlin, leveraging the vibrant startup ecosystem, to develop a customer-centric digital strategy and initiate the digitization of its supply chain.

Steel prices, known for their volatility, prompted Klöckner & Co. to address the complex and time-consuming nature of steel transactions involving contacting suppliers, seeking and comparing quotes, and placing orders, often over phone calls, e-mails, and fax. In collaboration with startups, the company launched klöckner.i (KCI), an online marketplace, in December 2014. This platform allowed clients to place orders 24/7, introducing transparency in steel prices and facilitating online transactions. KCI's digital tools, including a contract portal, parts manager, and order transparency tracker, aimed to enhance the overall customer experience.

Recognizing the evolving needs of their clients and positive feedback from operating KCI, Klöckner & Co. transformed the marketplace into a digital platform in 2018. This platform was selectively opened to third-party sellers dealing with products complementary to Klöckner & Co.'s offerings. The platform was eventually spun off as XOM Materials, an independently managed entity in which Klöckner only played the role of an investor expecting financial reports.

By the end of 2019, XOM Materials had successfully onboarded 50 distributors and 600 customers across Europe and the United States [128]. XOM Materials expanded its product offerings to encompass more than 20,000 different commodity products, including plastic, and emerged as a crucial source of revenue for Klöckner & Co. by 2022, supplementing traditional revenue streams like subscriptions and advertising.

Case VI: Red Collar Group

The Red Collar Group (RCG), originating from Qingdao, China, in 1995, initially operated as a garment factory, specializing in business suits since 1987. Challenges such as rising costs and declining profit margins prompted RCG to pioneer mass customization by transitioning to a made-to-measure business model in 2000. Establishing Kutesmart as a separate company, RCG implemented a customer-to-manufacturer (C2M) platform in 2015, enabling customers to place orders directly [52]. The C2M system captures measurements through various methods, such as home appointments, proprietary Magic Buses utilizing three-dimensional (3D) technology, or in-store manual measurements. A mobile app launched in August 2015 streamlined the ordering process by incorporating 3D measurement technology.

Kutesmart's C2M system transforms measurements into patterns using algorithms based on RCG's tailoring knowledge and data from millions of customers. Customers have the freedom to customize every aspect of their suits. The system breaks down the manufacturing process into more than 300 procedures, optimizing each procedure based on worker skill and availability. By simplifying the value chain, Kutesmart eliminates intermediaries, enabling mass product customization. With the capacity to produce 4,000 custom suits daily, the system significantly improves product quality and production efficiency.

Recognizing Kutesmart"s success, the Chinese government encouraged RCG to assist other manufacturers in digital transformation. RCG extended IT and operations consulting services and introduced source data engineering (SDE) to enable manufacturers to join the Kutesmart C2M platform. Despite challenges such as a small IT department and the need for three months to transform a traditional factory to SDE, Kutesmart"s C2M system expanded to 70 companies across 20 industries by 2018, ranging from apparel to machinery. This widespread adoption marked Kutesmart as a transformative force, particularly for small and medium-sized enterprises.

Findings

m-TISM Framework for Digital Platformization

We used an m-TISM approach [106, 107] to develop the hierarchical relationship among the enablers of digital platformization in traditional, incumbent pipeline firms. The nine enablers identified from the literature review were considered for the modeling, namely, changing client behavior, development of IT capabilities, need for structural efficiencies, disruptive competitive forces, scope advantages, economic triggers, disruptive third-party technology, creation of autonomous corporate structure, and regulatory compliance. The contextual relationship among the enablers is mentioned as "A → B," implying that "enabler A will influence/enhance enabler B," and the explanation for the relationship corresponds to "how or in what way will enabler A influence/enhance enabler B?"

Table A1 of the Appendix presents the list of enablers, contextual relationships, and the explanation for the relationship. The successive relationships among the enablers are identified through case anecdotes. For example, in the case of The Washington Post, the customers' expectation of a quick response time from news portals (E1) and structural efficiency achieved by the close integration of journalism and engineering (E3) led to the creation of a new in-house CMS (E2)—PageBuilder—which made us infer that E1 → E2 and E3 → E2, respectively.

The reachability matrix is prepared by identifying such relationships between enablers from the case information. The pairwise analysis of relationships is done in a sequential order, as initially the hierarchy of the enablers is not known. In m-TISM, all the transitive relationships (here, transitivity means if A → B and B → C, then A → C) are checked at the initial level to reduce the number of relationships to be verified from the experts/literature/case settings [101]. The final reachability matrix with transitive links is presented in Table A2 of the Appendix. Figure 1 presents the successive comparison digraph of the identified enablers.

Next, the reachability and antecedent sets are developed, and the partitioning matrices are developed (see Tables A3(a), A3(b), A3(c), A3(d), and A3(e) of the Appendix). The reachability set contains the row elements, whereas the antecedent set corresponds to the column elements of the final reachability matrix. The intersection set contains the common elements of the reachability and antecedent sets [129]. The factors that have similar reachability and intersection sets are put in the topmost-level group (level 1). Further, the top-level factors(s) are eliminated in the next partitioning matrix and the process is repeated until all the levels have been determined.

Table A4 of the Appendix shows the level matrix where each identified factor is placed on a level based on its leveling in the partitioning matrices. In Figure 2, the digraph ISM has been developed, which shows the relationship between the enablers and their leveling. The direct line indicates direct relationships, and the dotted line shows the transitive

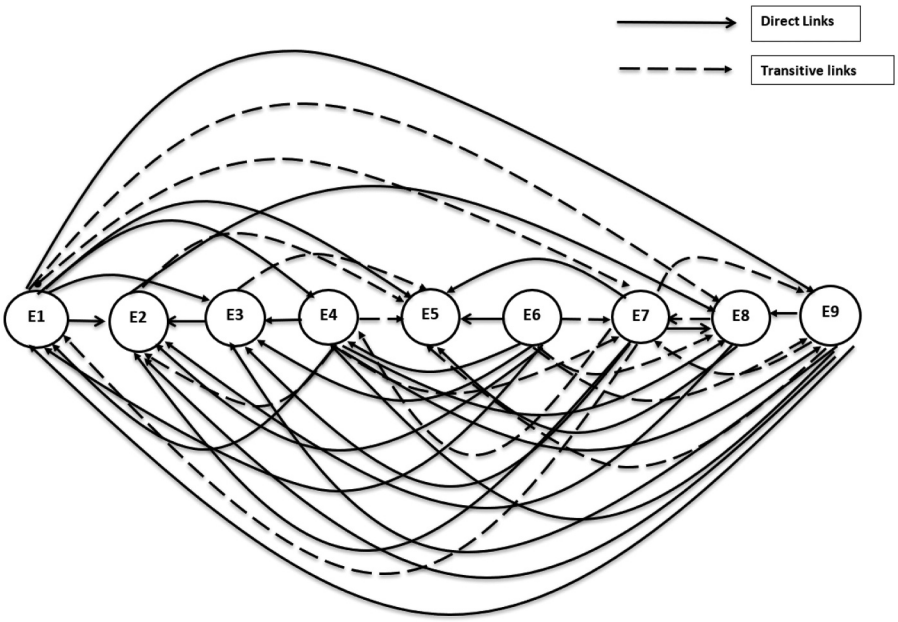

Figure 1. Successive Comparison Digraph as per m-TISM Process

relationships. The transitive links that have no relationship identified in the cases have been eliminated from the digraph. Further, an interaction matrix was prepared, as shown in Table A5 of the Appendix, where all direct relationships are represented as **1** (bold 1), transitive links are represented as *1* (italic 1), and absence of any relationship as 0.

The interpretation of the relationship among the enablers is crucial in the TISM model, differentiating it from the traditional ISM. The interpretation of the 21 identified relationships was developed through an FGD with six digital transformation experts from diverse industries. as discussed in step V in the Methodology section. The final m-TISM model based on in-depth domain knowledge represented as the interpretation of each directed link is shown in Figure 3.

Validation of the m-TISM Framework

Since the m-TISM model was built based on anecdotal evidence and expert interpretations, there was a need to validate the links in the model. With the intent of building robust theory [99], we adopted a multimethod approach by combining the qualitative approach with a quantitative survey to validate the 21 links identified in the previous section [106]. Research hypotheses for all the links were developed. The sample hypothesis is enumerated as follows:

H0 (i): There is no significant difference between the observed mean and the specified mean in relation to the opinion of current experts.

HA (i): There is a positive significant difference between the observed mean and the specified mean in relation to the opinion of current experts.

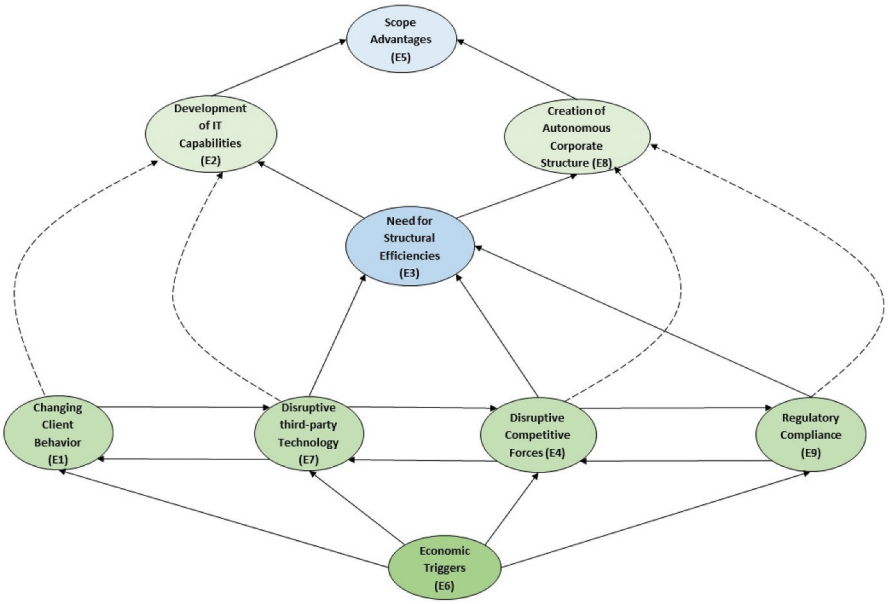

Figure 2. ISM Digraph After Hierarchical Partitioning of Factors

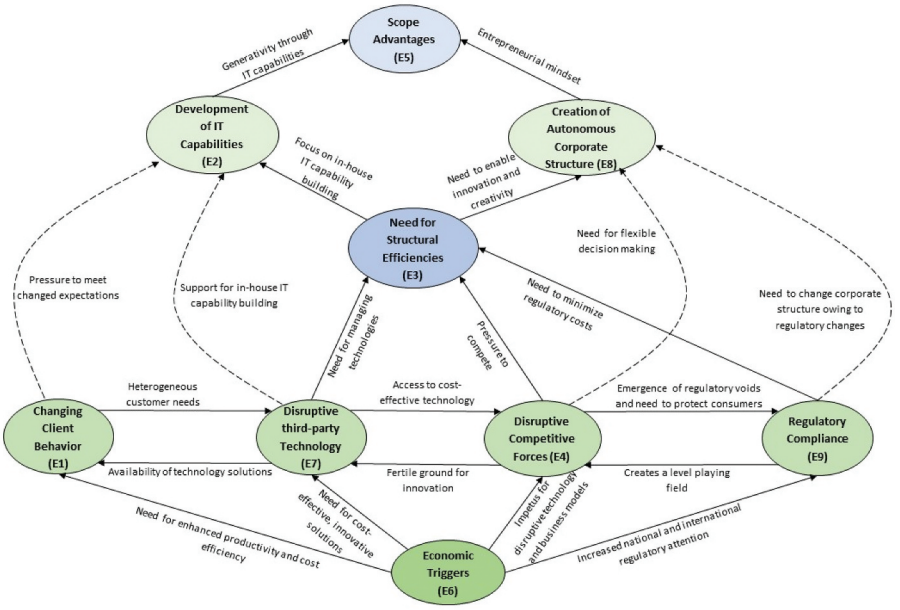

Figure 3. m-TISM Model

That is,

H0 (i): mean (observed) – mean (specified) = 0 and HA (i): mean (observed) – mean (specified) > 0. Here, $i = 1–21$.

Figure 4. Validated m-TISM Model

As the alternative hypothesis is unidirectional (positive significant difference), a one-tailed, one-sample *t*-test was found appropriate to evaluate these hypotheses. The test value was set as 3.5. SPSS 28.0.1 was used to run the *t*-test. The results of the hypotheses testing based on the sample statistics and *t*-values are shown in Table A6 of the Appendix. At the 5% significance level, all links except 7 and 18 were found to be significant. The relationship of regulatory compliances to need for structural efficiencies is found not to be significant and the data do not support a significant relationship between disruptive competitive forces and the creation of an autonomous corporate structure; hence, these two links were dropped from the final model. Figure 4 shows the final framework for digital platformization of incumbent pipeline firms in the digital economy. Findings of the final m-TISM model are portrayed in Table 4, which provides the interpretation of various validated links in the final m-TISM model.

Discussion

Recent research posits platforms as the dominant intermediation structure in online environments [121], where they act as precursors for the digital transformation of businesses across diverse industries, from food and health care to property [16, 35, 100]. This study explores the specific case of digital transformation operationalized through platformization in dyna mic business environments, extending existing literature on the challenges and prospects of digital innovation [41, 54, 84].

Hierarchical Framework of Digital Platformization

The hierarchical model (Figure 4, Table 4) developed in this study outlines the key factors in the platformization of incumbent pipeline firms. Economic events (level 1) act as critical

Table 4. Summary of Findings of m-TISM Model

Enabler	Enabler	Link	Interpretation
E1	E2	Transitive	Pressure to meet changed expectations
E1	E7	Direct	Heterogeneous customer needs
E2	E5	Direct	Generativity through IT capabilities
E3	E2	Direct	Focus on in-house IT capability building
E3	E8	Direct	Need to enable innovation and creativity
E4	E3	Direct	Pressure to compete
E4	E7	Direct	Fertile ground for innovation
E4	E9	Direct	Emergence of regulatory voids and need to protect consumers
E6	E1	Direct	Need for enhanced productivity and cost efficiency
E6	E4	Direct	Impetus for disruptive technology and business models
E6	E7	Direct	Need for cost-effective, innovative solutions.
E6	E9	Direct	Increased national and international regulatory attention.
E7	E1	Direct	Availability of technology solutions
E7	E2	Transitive	Support for in-house IT capability building
E7	E3	Direct	Need for managing technologies
E7	E4	Direct	Access to cost-effective technology
E8	E5	Direct	Entrepreneurial mindset
E9	E4	Direct	Creates a level playing field
E9	E8	Transitive	Need to change corporate structure owing to regulatory changes

triggers, influencing external drivers (level 2) like regulatory changes, competitive forces, evolving client behavior, and disruptive third-party technologies. For instance, the 2008 global financial crisis led to regulatory shifts (E6 → E9), such as the EU"s MiFID II legislation, prompting firms like Goldman Sachs to develop a digital platform for financial research. External drivers can interact; for instance, the availability of third-party technologies reduces fintech development costs, posing a competitive challenge for firms like Goldman Sachs (E7 → E4). The fintech ecosystem, in turn, fosters third-party technology services (E4 → E7). Moving down the hierarchy, internal organizational factors (level 3) drive structural efficiencies. Access to third-party technologies can lead to organizational silos as each silo adopts different third-party digital solutions (E7 → E3), necessitating structural efficiencies to manage diverse technologies, as seen in the case of GE. Internal efficiencies, in turn, propel process drivers (level 4), like IT capability development and autonomous corporate structures. For example, Kutesmart was setup as a separate company by RCG to create a digital C2M platform, reducing weeks of lead time required in the made-to-order market for suits (E3 → E8). Process drivers, finally, lead to scope advantages (level 5). For example, Klöckner & Co."s XOM platform, initially developed for internal use, was extended as a marketplace to other distributors, fostering overall growth (E8 → E5). In summary, our framework delineates the mechanisms of incumbent pipeline firms" platformization triggered by economic events, navigating through external drivers, internal factors, and process drivers towards scope advantages.

Platformization and e-Business Strategy

The analysis of cases used to develop the hierarchical model reveals that the infrastructure of digital platforms offers opportunities for value creation and capture through e-business implementation. This insight extends the literature on e-business strategy, demonstrating that platformization enablers significantly impact the e-business strategy of incumbent pipeline firms undergoing digital transformation. These implications span the five domains

Case Company / Platform	Platform Characteristics	Prominent E-business Dimensions				
		Commerce	Collaboration	Communication	Connection	Computing
General Electric / Predix	Platform that could be used by other OEMs or third-party app developers to write applications for industrial equipment and analyze the data to optimize industrial processes of client companies.	X	X		X	X
Goldman Sachs / Marquee	Platform that allowed institutional clients access to Goldman Sachs' data and risk models to research and trade in financial securities.	X	X	X	X	X
Michelin / Maestro	Platform to intermediate the processing of payment between service providers and dealers on one side, and fleet operators on the other side.	X	X	X	X	
Washington Post / Arc XP	Platform for providing publishing tools and e-commerce services to publishers and websites.	X	X			
Klöckner & Co. / XOM	Platform to allow trade in metals between distributors and customers.	X	X	X	X	
Red Collar Group / Kutesmart C2M	Platform to service the demand for made-to-measure suits from customers	X	X		X	X

Figure 5. Platform characteristics and prominent dimensions of e-business.

of e-business: commerce, collaboration, communication, connection, and computing [139, 140]. Figure 5 outlines the platform characteristics adopted by the case companies, showcasing evidence of key e-business dimensions.

Commerce

The drivers of platformization significantly impact the commercial aspect of e-business. Evolving client behavior demands greater transaction efficiency, pricing transparency, and faster commercial gains, as seen in the cases of Klöckner and Michelin. Digital platforms address this demand by creating marketplaces that leverage market mechanisms for efficiency gains [31, 109]. Platforms also intermediate buyer–supplier chains [31], exemplified by Alibaba challenging B2B markets, compelling firms to either establish their own platforms or engage as sellers on established platforms. Both options present challenges—building a platform requires overcoming the chicken-and-egg problem of bringing sufficient number of buyers and sellers for network effects to play out, while participating as a seller cedes market control to the platform provider [31, 43].

Third-party technology providers offer quick access to computing infrastructure, applications, and interfaces, influencing how firms adapt to stay competitive and offer new value propositions [75]. For instance, The Washington Post swiftly built PageBuilder on AWS cloud infrastructure. Existing third-party technology can also challenge the competitive survival of incumbent pipeline firms, as was the case of fintech startups challenging Goldman Sachs, which may adopt platform-based business models to alter their traditional offerings and value propositions [9]. Regulatory changes also force firms to embrace platform-oriented approaches [13], as was the case of Goldman Sachs in response to MiFID II. Regulators and policymakers are also promoting platform-based market mechanisms, leading to government-sponsored initiatives like Kutesmart in China and Government e-Marketplace (GeM) in India. Finally, scope advantages from online platforms drive incumbent firms to create open e-business platforms. While benefiting the platformizing firm with new revenue streams and potential for setting industry standards [63], this also

grants joining firms access to a broader customer base, precise demand forecasting, and efficient order fulfilment.

Collaboration

E-business success relies on establishing enduring partnerships, emphasizing collaboration with customers [139]. Platformization addresses structural inefficiencies from siloed operations [1, 30, 100], fostering streamlined collaboration (for example, GE's software development) and efficient transactions (for example, Michelin's Maestro) [43, 60, 91].

While firms often depend on third-party technology providers for platformization, failure to collaborate can hinder success (for instance, Michelin's Truck Care). Further, we find that creating autonomous corporate structures facilitates platformization but poses challenges in managing differences in location, culture, and entrepreneurial mindset [43]. Hence, platforms require extensive collaboration not only with external partners, but also with internal stakeholders in autonomous units [14, 91]. Embracing coopetition by opening platforms to competitors, as seen with GE's Predix, intensifies the need for collaboration further [30, 100]. Hence, the symbiotic opportunities from platformization necessitate strategic approaches [94] to manage the challenges from platform-based coopetition [63, 111] and barriers to collaborative consumption [49].

Communication

Effective communication with customers is a crucial precursor for customer-centricity, particularly in the digital era when customer expectations are high [5]. In the context of platformization, communication gains added importance due to customer expectations for closer integration, swift transactions, and comprehensive solutions (for example, in the case of Goldman Sachs and Klöckner). In instances where autonomous corporate units drive digital transformation, direct communication becomes even more vital to directly interact and transact with customers to establish credibility for the emerging platform [91].

Connection

The foundational connective infrastructure supporting inter- and intra-organizational systems is pivotal in the realm of e-business platforms. Platformization, spurred by competitive dynamics, frequently leads to incorporating competitors as partners within the platform ecosystem. This collaboration relies on interconnectedness fostered through online channels, encompassing social media for interpersonal connections and the Internet of things for machine-to-machine interactions [15, 87, 91]. Platforms also contribute to decentralizing firms, delegating customer interactions to mobile apps and internal interactions to online communication and connectivity technologies like RFID. This mediation of interactions by connective technologies stems from the forces driving IT capability development in the context of platformization. Lastly, the quest for structural efficiency is often realized through a technological connective tissue woven across the platformizing firms, eliminating layers of inefficient intermediary structures. This connective tissue includes software connections (like enterprise social networks) and hardware connections (like networks of machines, sensors, applications) [53, 55].

Computing

The pervasive access to and utilization of computing infrastructure represent the fifth vital facet of e-business. Harnessing client data to model customer behavior aids firms in navigating the evolving client behavior propelling platformization [30]. To fortify IT capabilities for platformization, firms often leverage preexisting operational technology and data computing capabilities [72]. For instance, Goldman Sachs utilized the SecDB to establish the Marquee platform. Addressing structural inefficiencies, firms employ computing infrastructure to streamline operations [103], as exemplified by Kutesmart optimizing workforce planning. Regulatory compliance, as a driver for platformization, also influences the computing dimension of e-business, with regulations like GDPR impacting overall e-business strategies.

Figure 6 succinctly outlines the implications of platformization drivers for the e-business strategy of firms. Trigger economic events are not included in this table, as these are unlikely to directly affect the dimensions of e-business but have indirect impact on the e-business strategy of firms.

Contributions

Existing research has delved into disruptions like changing consumer behavior, competitive shifts, and data availability that prompt strategic responses resulting in digital transformation [115, 117]. However, scant attention has been given to the intricacies and drivers of platformization as a digital transformation strategy for incumbent pipeline firms. Contributing to the evolving literature on digital transformation and e-business [34, 60, 89, 110], our research identifies a comprehensive set of nine enablers driving the platformization of incumbent pipeline firms through an extensive review of prior literature. Additionally, we establish a five-level hierarchy of these platformization enablers, starting from trigger events (level 1) that propel external organizational enablers (level 2). These, in turn, drive internal organizational enablers (level 3), leading to process enablers (level 4), resulting in outcome drivers (level 5). We also outline the specific impact of digital

Enablers of Platformization		Dimensions of e-business				
		Commerce	Collaboration	Communication	Connections	Computing
External Enablers	Changing Client Behaviour	X	X	X		
	Disruptive Third-party Technology	X	X		X	X
	Disruptive Competitive forces	X	X			X
	Regulatory Compliance	X				X
Internal enablers	Need for Structural Efficiencies		X		X	
Process enablers	Development of IT Capabilities				X	X
	Creation of Autonomous Corporate Structure		X	X		
Outcome driver	Scope Advantages	X				

Figure 6. Impact of Enablers of Platformization on the dimensions of e-business.

platformization drivers on all five dimensions of e-business strategy: commerce, collaboration, communication, connection, and computing [139, 140]. The detailed implications of this research are outlined next.

Managerial Implications

Our research underscores the ability of organizations to transform crises and external triggers, such as regulations, customer behavior, and competition, into opportunities for digital platformization, leading to scope advantages. However, achieving these advantages requires more than external triggers; managerial actions are crucial. The managerial implications span three perspectives: enabler, model, and model implementation.

First, from the enabler perspective, managers can actively promote internal organizational drivers by identifying inefficient structures and processes that can be improved by digitalization. Organizational leadership also plays a pivotal role in creating an environment conducive to the effectiveness of process enablers. This involves acquiring necessary IT capabilities through technology integration, recruiting suitable talent, and establishing and managing autonomous organizational structures for exploring digital opportunities.

Second, from the hierarchical model perspective, our research offers a practical guiding framework for practitioners devising, operationalizing, or troubleshooting a digital platformization strategy. Managers can use the model to identify potential pitfalls, prioritize initiatives, and implement a holistic plan by leveraging external and internal enablers, process enablers, and outcome drivers.

Lastly, from the model implementation perspective, practitioners benefit from understanding the strategic imperatives associated with platformization through e-business. Internal and process enablers within managerial control significantly impact the digital commerce dimension of collaboration, communication, connection, and computing. This insight guides managers to focus on specific dimensions of digital commerce and devise an effective implementation strategy for platformization.

Theoretical Implications

The hierarchical framework of digital platformization is a novel contribution, distinct from prior research on digital transformation of single ecosystems [95]. Based on curated case studies from diverse industries—heavy industry, manufacturing, publishing, finance, retail, and distribution—and validated by senior industry practitioners, the hierarchical framework offers a generalizable model.

Even though digital platformization offers an infrastructural basis for e-business, research has not focused on the implication of digital platformization for a firm's e-business strategy. We contribute to e-business literature by specifically elaborating the implications of the enablers of digital platformization on the different dimensions of e-business [132, 133], making the implicit link between drivers for platformization and dimensions of e-business strategy explicit.

While not predicting platform success or failure, we echo calls for future research on sustaining competitive advantages arising from platformization [30]. Given platformization's practical significance, we advocate for further research on the drivers behind its success and failure.

Conclusion

This research identifies nine enablers of platformization and establishes a hierarchical model outlining their relationships. It reveals that events affecting the economic well-being of a firm trigger digital transformation, influencing external enablers like changing client behaviors, availability of disruptive third-party technologies, changing competitive forces, and need for regulatory compliance. These external enablers, in turn, influence internal drivers toward structural efficiencies, impacting processes leading to development of IT capabilities and autonomous corporate structures. Process enablers result in scope advantages as outcome drivers for digital transformation. In doing so, this research contributes to platformization and e-business strategy literature, laying the groundwork for traditional firms to thrive in the digital era.

Despite its novelty, this research suffers from a few limitations. First, the conceptual framework is based on case studies from six industries, warranting validation across other industries, such as telecom, health care, consumer goods, and utilities, to generalize the model. Second, this research relies on secondary data; hence scholars are urged to use primary data to identify more drivers of platformization. Third, the conceptual framework requires empirical validation using large-scale surveys.

Digital platforms, like other emerging technologies, exhibit diverse and evolving effects, providing ample opportunities for future research [9]. Many organizations are building in-house platforms atop third-party technologies, such as blockchain, IoT, and cloud computing, while others are adopting third-party platforms to aid their digital transformation [16]. While in this research we have explored the former aspect, future research is encouraged to understand the driving factors for adopting third-party platforms versus creating in-house alternatives and the subsequent impact on the platformization strategy of incumbent pipeline firms. Notably, this research remains neutral on the success or failure of platforms, underscoring the need for future studies to uncover the factors contributing to sustained competitive advantages, ensuring platform viability and success [30, 31].

The selected cases in this study provided insights into how organizational structures, processes, and capabilities facilitate platformization. However, the crucial role of leaders and leadership styles in platformization was not thoroughly examined [2, 90, 137]. Future research on the softer aspects of digital transformation is encouraged to better understand the drivers of platformization. In summary, this study outlines the enablers of digital platformization for traditional incumbent pipeline firms, serving as a foundational resource for navigating the digitalized era.

Acknowledgments

We thank the anonymous reviewers and the guest editors for providing detailed feedback and suggestions for improvement of this article. The final article was improved due to the meticulous review process.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Notes on contributors

Divya Sharma (divya.sharma@mdi.ac.in) is an assistant professor of information management at MDI Gurgaon, India. She completed her doctorate at IIM Calcutta, where she was the recipient of the Satish K. Sehgal Doctoral Student Award. Dr. Sharma's corporate experience in the private and public sectors, along with more than a decade of engagement with academia, are a source of her expertise in the domains of digital innovation and transformation, AI and analytics, digital platform ecosystems, and technology regulation. She has presented her research at prestigious conferences such as ICIS, ECIS, ACIS, EGOS, AoM, and IFIP WG 8.2 Conference. Her research has been published in such journals such as the *AIS Transactions on Human–Computer Interaction, Journal of Global Information Management, Journal of Service Theory and Practice*, and others.

Neetu Yadav (neetu.yadav@mdi.ac.in) is an assistant professor of strategic management at MDI Gurgaon. She holds a Ph.D. from the Department of Management Studies, Indian Institute of Technology Delhi. Dr. Yadav was awarded the Paul R. Lawrence Fellowship to participate in the NACRA 2018 annual meeting and is also a recipient of Emerald Literati Awards 2019. She has also been awarded a senior research fellowship by University Grants. She earned a certificate of "Foundations in Design Thinking" from IDEO-U.

Yogesh K. Dwivedi (y.k.dwivedi@swansea.ac.uk; corresponding author) is a professor of digital marketing and innovation at Swansea University, Wales, and founding director of the Digital Futures for Sustainable Business & Society Research Group. He holds a distinguished research professorship at SIBM Pune, India, Dr. Dwivedi's research intersects information systems and marketing, focusing on digital innovations, e-government, and digital marketing, especially in emerging markets. He is the editor-in-chief of the *International Journal of Information Management*, an associate editor of the *Journal of Business Research, European Journal of Marketing*, and *Government Information Quarterly*, and senior editor of the *Journal of Electronic Commerce Research*.

Mihalis Giannakis (mgiannakis@audencia.com) is a full (HDR) operations and supply chain management professor at Audencia Business School, France. He holds a Ph.D. in both industrial and business studies from the University of Warwick, UK. Dr. Giannakis's work spans such areas as the digitalization of supply chains, supply chain sustainability, risk management, innovation, and supply-chain financing. He is a frequent speaker at international academic and business conferences and has published more than 100 peer-reviewed papers in leading international scientific journals and conferences. He has conducted research and consulting work in several economic sectors, such as oil and gas, professional services, food and agribusiness, and banking.

ORCID

Yogesh K. Dwivedi http://orcid.org/0000-0002-5547-9990

References

1. Alaimo, C.; and Kallinikos, J. Organizations decentered: Data objects, technology and knowledge. *Organization Science*, *33*, 1 (2022), 19–37.
2. AlNuaimi, B.K.; Kumar Singh, S.; Ren, S.; Budhwar, P.; and Vorobyev, D. Mastering digital transformation: The nexus between leadership, agility, and digital strategy. *Journal of Business Research*, *145* (2022), 636–648.
3. van Alstyne, M.W.; Parker, G.G.; and Choudary, S.P. Pipelines, platforms, and the new rules of strategy. *Harvard Business Review, April* (2016), 9.
4. Alt, R.; Beck, R.; and Smits, M.T. Fintech and the transformation of the financial industry. *Electronic Markets*, *28*, 3 (2018), 235–243.

5. Alt, R.; and Puschmann, T. The rise of customer-oriented banking—Electronic markets are paving the way for change in the financial industry. *Electronic Markets*, *22*, 4 (2012), 203–215.
6. Alt, R.; and Zimmermann, H.-D. The digital transformation of healthcare—An interview with Werner Dorfmeister. *Electronic Markets*, *31*, 4 (2021), 895–899.
7. Ansari, S.S.; Garud, R.; and Kumaraswamy, A. The disruptor's dilemma: TiVo and the U.S. television ecosystem: The disruptor's dilemma. *Strategic Management Journal*, *37*, 9 (2016), 1829–1853.
8. arcxp.com, Arc XP.
9. Bailey, D.E.; Faraj, S.; Hinds, P.J.; Leonardi, P.M.; and von Krogh, G. We are all theorists of technology now: A relational perspective on emerging technology and organizing. *Organization Science*, *33*, 1 (2022), 1–18.
10. Ballestar, M.T.; Díaz-Chao, Á.; Sainz, J.; and Torrent-Sellens, J. Knowledge, robots and productivity in SMEs: Explaining the second digital wave. *Journal of Business Research*, *108*, (2020), 119–131.
11. Battisti, E. Remote working and digital transformation during the COVID-19 pandemic: Economic–financial impacts and psychological drivers for employees. *Journal of Business Research*, (2022).
12. Benoit, S.; Baker, T.L.; Bolton, R.N.; Gruber, T.; and Kandampully, J. A triadic framework for collaborative consumption (CC): Motives, activities and resources & capabilities of actors. *Journal of Business Research*, *79*, (2017), 219–227.
13. Berghaus, S.; and Back, A. Disentangling the fuzzy front end of digital transformation: Activities and approaches. *ICIS 2017 Proceedings* (2017), 18.
14. Berntzen, M.; and Wong, S.I. Autonomous but interdependent: The roles of initiated and received task interdependence in distributed team coordination. *International Journal of Electronic Commerce*, *25*, 1 (2021), 7–28.
15. Beverungen, D.; Hess, T.; Köster, A.; and Lehrer, C. From private digital platforms to public data spaces: Implications for the digital transformation. *Electronic Markets*, *32*, 2 (2022), 493–501.
16. Bez, S.M.; Georgescu, I.; and Farazi, M.S. TripAdvisor of healthcare: Opportunities for value creation through patient feedback platforms. *Technovation* (2022), 102625.
17. Bharadwaj, A.; El Sawy, O.A.; Pavlou, P.A.; and Venkatraman, N. Digital business strategy: Toward a next generation of insights. *MIS Quarterly*, *37*, 2 (2013), 471–482.
18. Bharadwaj, A.S. A resource-based perspective on information technology capability and firm performance: An empirical investigation. *MIS Quarterly*, *24*, 1 (2000), 169.
19. Blankfein, L.C. Goldman Sachs Presentation to Credit Suisse Financial Services Conference. (2016).
20. Bolton, R.N.; McColl-Kennedy, J.R.; Cheung, L.; Gallan, A.; Orsingher, C.; Witell, L.; and Zaki, M. Customer experience challenges: Bringing together digital, physical and social realms. *Journal of Service Management*, *29*, 5 (2018), 776–808.
21. Broekhuizen, T.L.J.; Bakker, T.; and Postma, T.J.B.M. Implementing new business models: What challenges lie ahead? *Business Horizons*, *61*, 4 (2018), 555–566.
22. Brynjolfsson, E. ICT, innovation and the e-economy. *EIB Papers*, *16*, 2 (2011), 60–76.
23. Bughin, J.; Catlin, T.; and Dietz, M. The right digital-platform strategy. *McKinsey Quarterly*, (2019).
24. Bughin, J.; and van Zeebroeck, N. New evidence for the power of digital platforms. *McKinsey Quarterly* (2017).
25. Cardona, M.; Kretschmer, T.; and Strobel, T. ICT and productivity: Conclusions from the empirical literature. *Information Economics and Policy*, *25*, 3 (2013), 109–125.
26. Ceccagnoli, M.; Forman, C.; Huang, P.; and Wu, D.J. Cocreation of value in a platform ecosystem! The case of enterprise software. *MIS Quarterly*, *36*, 1 (2012), 263.
27. Cetindamar Kozanoglu, D.; and Abedin, B. Understanding the role of employees in digital transformation: Conceptualization of digital literacy of employees as a multi-dimensional organizational affordance. *Journal of Enterprise Information Management*, *34*, 6 (2021), 1649–1672.

28. Chakma, R.; Dhir, S.; Ongsakul, V.; Sakka, G.; and Ahmed, Z.U. Marketing resources, competitive advantage, and marketing performance: A modified TISM and MICMAC approach. *Journal of Strategic Marketing*, (2022), 1–17.
29. Chavez, R.M. Data, computing, and transformation in the financial industry. (2017). https://www.youtube.com/watch?v=VF6DrX9H0Ug
30. Chen, K.-L.; Lassen, A.; Li, C.; and Møller, C. Exploring the value of IoT data as an enabler of the transformation towards servitization: An action design research approach. *European Journal of Information Systems*, (2022), 1–27.
31. Chen, Y.; Chen, L.; Zou, S.; and Hou, H. Easy to start, hard to persist: Antecedents and outcomes of entrepreneurial persistence in online marketplaces. *International Journal of Electronic Commerce*, *25*, 4 (2021), 469–496.
32. Christensen, C.M.; Bartman, T.; and Bever, D.V. The hard truth about business model innovation. *MIT Sloan Management Review*, *58*, 1 (2016), 12.
33. Cozzolino, A.; Verona, G.; and Rothaermel, F.T. Unpacking the disruption process: New technology, business models, and incumbent adaptation. *Journal of Management Studies*, *55*, 7 (2018), 1166–1202.
34. Dang, D.; and Vartiainen, T. Digital strategy patterns in information systems research. *23rd Pacific Asia Conference on Information Systems* 2019.
35. Dehghani, M.; Popova, A.; and Gheitanchi, S. Factors impacting digital transformations of the food industry by adoption of blockchain technology. *Journal of Business & Industrial Marketing*, *37*, 9 (2022), 1818–1834.
36. Doctor, K. Newsonomics: The Washington Post offers an arc in the storm. *Nieman Lab*, (2015).
37. Eggers, J.P.; and Park, K.F. Incumbent adaptation to technological change: The past, present, and future of research on heterogeneous incumbent response. *Academy of Management Annals*, *12*, 1 (2018), 357–389.
38. Eisenhardt, K.M. Building theories from case study research. *The Academy of Management Reveiw*, *14*, 4 (1989), 532–550.
39. Eisenhardt, K.M.; and Graebner, M.E. Theory building from cases: Opportunities And challenges. *Academy of Management Journal*, *50*, 1 (2007), 25–32.
40. Eisenmann, T.; Parker, G.; and Alstyne, M.W.V. Strategies for two-sided markets. *Harvard Business Review* (2006), 12.
41. Fichman, R.G.; Dos Santos, B.L.; and Zheng, Z. (Eric). Digital innovation as a fundamental and powerful concept in the information systems curriculum. *MIS Quarterly*, *38*, 2 (2014), 329–343.
42. Floyer, D. Defining and sizing the industrial Internet. *Wikibon* (2013).
43. Furr, N.; Ozcan, P.; and Eisenhardt, K.M. What is digital transformation? Core tensions facing established companies on the global stage. *Global Strategy Journal*, *12*, 4 (2022), 595–618.
44. Gawer, A. Bridging differing perspectives on technological platforms: Toward an integrative framework. *Research Policy*, *43*, 7 (2014), 1239–1249.
45. Goldman Sachs 2011 Annual ReportGoldman Sachs, 2012. https://www.goldmansachs.com/investor-relations/financials/fulfillment/reports/GS_AR11_AllPages.pdf
46. Gregory, R.W.; Keil, M.; Muntermann, J.; and Mähring, M. Paradoxes and the nature of ambidexterity in IT transformation programs. *Information Systems Research*, *26*, 1 (2015), 57–80.
47. Gupta, S., and Godwin, C. Michelin: Building a digital service platform. (2022). https://hbsp.harvard.edu/product/520061-PDF-ENG
48. Gupta, S., and Simonds, S. Goldman Sachs' digital journey. (2019). https://hbsp.harvard.edu/product/518039-PDF-ENG
49. Hazée, S.; Zwienenberg, T.J.; Van Vaerenbergh, Y.; Faseur, T.; Vandenberghe, A.; and Keutgens, O. Why customers and peer service providers do not participate in collaborative consumption. *Journal of Service Management*, *31*, 3 (2020), 397–419.
50. Helmond, A. The platformization of the Web: Making Web data platform ready. *Social Media and Society*, *1*, 2 (2015).
51. Henderson, J.; and Venkatraman, N. Strategic alignment: Leveraging information technology for transforming organizations. *IBM Systems Journal*, *38*, 2 & 3 (1999).

52. Ho, J. China's suit maker Redcollar blazes trail for mass made-to-measure. *Forbes*, (2016).
53. Holland, C.P.; and Gutiérrez-Leefmans, M. A Taxonomy of SME e-commerce platforms derived from a market-level analysis. *International Journal of Electronic Commerce*, *22*, 2 (2018), 161–201.
54. Holmström, J. Recombination in digital innovation: Challenges, opportunities, and the importance of a theoretical framework. *Information and Organization*, *28*, 2 (2018), 107–110.
55. Iansiti, M.; and Lakhani, K.R. Digital ubiquity: How connections, sensors, and data are revolutionizing business. *Harvard Business Review, November*, (2014), dig.v45.n2.8.
56. Iivari, N.; Sharma, S.; and Ventä-Olkkonen, L. Digital transformation of everyday life—How COVID-19 pandemic transformed the basic education of the young generation and why information management research should care. *International Journal of Information Management*, *55*, (2020), 102183.
57. Jiang, Y.; and Stylos, N. Triggers of consumers' enhanced digital engagement and the role of digital technologies in transforming the retail ecosystem during COVID-19 pandemic. *Technological Forecasting and Social Change*, *172*, (2021), 121029.
58. Kane, G. The technology fallacy: People are the real key to digital transformation. *Research-Technology Management*, *62*, 6 (2019), 44–49.
59. Katz, R.; Koutroumpis, P.; and Martin Callorda, F. Using a digitization index to measure the economic and social impact of digital agendas. *info*, *16*, 1 (2014), 32–44.
60. Kauffman, R.J.; Li, T.; and van Heck, E. Business network-based value creation in electronic commerce. *International Journal of Electronic Commerce*, *15*, 1 (2010), 113–144.
61. Kennedy, D. The Bezos effect: How Amazon's founder is reinventing The Washington Post—and what lessons it might hold for the beleaguered newspaper business. *Shorenstein Center on Media, Politics and Public Policy*, (2016).
62. Kenton, W. MiFID II. *Investopedia* (2021).
63. Khanagha, S.; Ansari, S. (Shaz); Paroutis, S.; and Oviedo, L. Mutualism and the dynamics of new platform creation: A study of Cisco and fog computing. *Strategic Management Journal*, *43*, 3 (2022), 476–506.
64. Khurana, I.; Dutta, D.K.; and Singh Ghura, A. SMEs and digital transformation during a crisis: The emergence of resilience as a second-order dynamic capability in an entrepreneurial ecosystem. *Journal of Business Research*, *150*, (2022), 623–641.
65. Klos, C.; Spieth, P.; Clauss, T.; and Klusmann, C. Digital Transformation of incumbent firms: A business model innovation perspective. *IEEE Transactions on Engineering Management*, *70*, 6 (2023), 2017–2033.
66. Koch, T.; and Windsperger, J. Seeing through the network: Competitive advantage in the digital economy. *Journal of Organization Design*, *6*, 1 (2017), 6.
67. Kominers, S.D.; and Knoop, C.-I. Klöckner & Co.: Steeling for a digital world. (2020). https://www.hbs.edu/faculty/Pages/item.aspx?num=57658
68. Lakhani, K.R.; Iansiti, M., and Herman, K. GE and the industrial Internet. (2015). https://www.hbs.edu/faculty/Pages/item.aspx?num=47272
69. Leber, J. General Electric pitches an Industrial Internet. *MIT Technology Review* (2012).
70. Lee, O.-K. (Daniel); Sambamurthy, V.; Lim, K.H.; and Wei, K.K. How does IT ambidexterity impact organizational agility? *Information Systems Research*, *26*, 2 (2015), 398–417.
71. Liere-Netheler, K.; Packmohr, S.; and Vogelsang, K. Drivers of digital transformation in manufacturing. *Proceedings of the 51st Hawaii International Conference on System Sciences* (2018), 3926–3935.
72. Liu, Y.; Zheng, Y.; Wei, J.; and Yang, Y. The use of inside-out and outside-in big data analytics on e-platforms: Performance impacts and heterogeneity analysis. *International Journal of Electronic Commerce*, *27*, 1 (2023), 36–65.
73. Majchrzak, A.; Markus, M.L.; and Wareham, J. Designing for digital transformation: Lessons for information systems research from the study of ICT and societal challenges. *MIS Quarterly*, *40*, 2 (2016), 267–277.
74. Mashalah, H.A.; Hassini, E.; Gunasekaran, A.; and Bhatt (Mishra), D. The impact of digital transformation on supply chains through e-commerce: Literature review and a conceptual

framework. *Transportation Research Part E: Logistics and Transportation Review*, *165*, (2022), 102837.
75. Matt, C.; Hess, T.; and Benlian, A. Digital transformation strategies. *Business & Information Systems Engineering*, *57*, 5 (2015), 339–343.
76. McCracken, H. The Washington Post is a software company now. *Fast Company*, (2017).
77. McIntyre, D.P.; and Srinivasan, A. Networks, platforms, and strategy: Emerging views and next steps: Networks, platforms, and strategy. *Strategic Management Journal*, *38*, 1 (2017), 141–160.
78. Michelin introduces its digital services platform. *Michelin Media* (2020).
79. Michelin launches Oncall 2.0™, now much more than emergency tire service. *Michelin Media* (2013).
80. Michelin reaches ONCall milestone. *Today's Trucking*, (2021).
81. Michelin truck care brochure (2016).
82. Nambisan, S.; Lyytinen, K.; Majchrzak, A.; and Song, M. Digital innovation management: Reinventing innovation management research in a digital world. *MIS Quarterly*, *41*, 1 (2017), 223–238.
83. Nwankpa, J.K.; and Roumani, Y. IT capability and digital transformation: A firm performance perspective. *Thirty Seventh International Conference on Information Systems* (2016), 16.
84. Nylén, D.; and Holmström, J. Digital innovation strategy: A framework for diagnosing and improving digital product and service innovation. *Business Horizons*, *58*, 1 (2015), 57–67.
85. Pagani, M.; and Pardo, C. The impact of digital technology on relationships in a business network. *Industrial Marketing Management*, *67*, (2017), 185–192.
86. Parker, G.G.; Van Alstyne, M.; and Choudary, S.P. *Platform Revolution: How Networked Markets Are Transforming the Economy and How to Make Them Work for You*. New York: W. W. Norton & Company, 2016.
87. Penttinen, E.; Halme, M.; Lyytinen, K.; and Myllynen, N. What influences choice of business-to-business connectivity platforms? *International Journal of Electronic Commerce*, *22*, 4 (2018), 479–509.
88. Peppard, J.; and Rylander, A. From value chain to value network. *European Management Journal*, *24*, 2–3 (2006), 128–141.
89. Peruchi, D.F.; de Jesus Pacheco, D.A.; Todeschini, B.V.; and ten Caten, C.S. Moving towards digital platforms revolution? Antecedents, determinants and conceptual framework for offline B2B networks. *Journal of Business Research*, *142* (2022), 344–363.
90. Porfírio, J.A.; Carrilho, T.; Felício, J.A.; and Jardim, J. Leadership characteristics and digital transformation. *Journal of Business Research*, *124* (2021), 610–619.
91. Pundziene, A.; Gutmann, T.; Schlichtner, M.; and Teece, D.J. Value impedance and dynamic capabilities: The case of MedTech incumbent-born digital healthcare platforms. *California Management Review*, *64*, 4 (2022), 108–134.
92. Rajan, R.; Rana, N.P.; Parameswar, N.; Dhir, S.; Sushil; and Dwivedi, Y.K. Developing a modified total interpretive structural model (M-TISM) for organizational strategic cybersecurity management. *Technological Forecasting and Social Change*, *170*, (2021), 120872.
93. Regalado, A. The worst technology of 2021. *MIT Technology Review* (2021).
94. Reim, W.; Andersson, E.; and Eckerwall, K. Enabling collaboration on digital platforms: A study of digital twins. *International Journal of Production Research*, (2022), 1–17.
95. Riasanow, T.; Jäntgen, L.; Hermes, S.; Böhm, M.; and Krcmar, H. Core, intertwined, and ecosystem-specific clusters in platform ecosystems: analyzing similarities in the digital transformation of the automotive, blockchain, financial, insurance and IIoT industry. *Electronic Markets*, *31*, 1 (2021), 89–104.
96. Roy, R.; and Sarkar, M. Knowledge, firm boundaries, and innovation: Mitigating the incumbent's curse during radical technological change: Mitigating incumbent's curse during radical discontinuity. *Strategic Management Journal*, *37*, 5 (2016), 835–854.
97. Sandberg, J.; Mathiassen, L.; and Napier, N. Digital options theory for IT capability investment. *Journal of the Association for Information Systems*, *15*, 7 (2014), 422–453.
98. Schenker, J.L. Steeling For change. *The Innovator News* (2019).

99. Shah, S.K.; and Corley, K.G. Building better theory by bridging the quantitative–qualitative divide. *Journal of Management Studies*, *43*, 8 (2006), 1821–1835.
100. Shen, Q.; Hua, Y.; Huang, Y.; Ebstein, R.; Yu, X.; and Wu, Z. Knowledge management and modern digital transformation of the property management industry in China. *Journal of Knowledge Management*, *26*, 8 (2022), 2133–2144.
101. Simoni, M.; Schiavone, F.; Risitano, M.; Leone, D.; and Chen, J. Group-specific business process improvements via a port community system: The case of Rotterdam. *Production Planning & Control*, *33*, 4 (2022), 371–385.
102. Singh, S.; Dhir, S.; and Sushil, S. Developing an evidence-based TISM: An application for the success of COVID-19 vaccination drive. *Annals of Operations Research* (2022).
103. Sjödin, D.; Parida, V.; Palmié, M.; and Wincent, J. How AI capabilities enable business model innovation: Scaling AI through co-evolutionary processes and feedback loops. *Journal of Business Research*, *134*, (2021), 574–587.
104. SlickCharts. S&P 500 companies by weight (2023).
105. Su, N.; Qiu, D.; Sun, J., and Zhang, L. Kutesmart: The digital transformation of apparel manufacturing (2019). https://hbsp.harvard.edu/product/W19207-PDF-ENG
106. Sushil. Interpreting the interpretive structural model. *Global Journal of Flexible Systems Management*, *13*, 2 (2012), 87–106.
107. Sushil. Modified ISM/TISM process with simultaneous transitivity checks for reducing direct pair comparisons. *Global Journal of Flexible Systems Management*, *18*, 4 (2017), 331–351.
108. The long arc of WaPo revenue leans toward SaaS; Google comes to grips with more chaos. *AdExchange* (2022).
109. Tian, J.; Vanderstraeten, J.; Matthyssens, P.; and Shen, L. Developing and leveraging platforms in a traditional industry: An orchestration and co-creation perspective. *Industrial Marketing Management*, *92*, (2021), 14–33.
110. Tilson, D.; Lyytinen, K.; and Sørensen, C. Digital infrastructures: The missing 15 research agenda. *Information Systems Research*, *21*, 4 (2010), 748–759.
111. Tóth, Z.; Sklyar, A.; Kowalkowski, C.; Sörhammar, D.; Tronvoll, B.; and Wirths, O. Tensions in digital servitization through a paradox lens. *Industrial Marketing Management*, *102*, (2022), 438–450.
112. Tripsas, M. Unraveling the process of creative destruction: Complementary assets and incumbern survival in the typesetter industry. *Strategic Management Journal*, *18*, S1 (1997), 119–142.
113. Vanhemert, K. GE's radical software helps jet engines fix themselves. *Wired* (2013).
114. Venturini, F. The modern drivers of productivity. *Research Policy*, *44*, 2 (2015), 357–369.
115. Verhoef, P.C.; Broekhuizen, T.; Bart, Y.; Bhattacharya, A.; Qi Dong, J.; Fabian, N.; and Haenlein, M. Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, *122*, (2021), 889–901.
116. Verhoef, P.C.; Stephen, A.T.; Kannan, P.K.; Luo, X.; Abhishek, V.; Andrews, M.; Bart, Y.; Datta, H.; Fong, N.; Hoffman, D.L.; Hu, M.M.; Novak, T.; Rand, W.; and Zhang, Y. Consumer connectivity in a complex, technology-enabled, and mobile-oriented world with smart products. *Journal of Interactive Marketing*, *40*, 1 (2017), 1–8.
117. Vial, G. Understanding digital transformation: A review and a research agenda. *Journal of Strategic Information Systems*, *28*, 2 (2019), 118–144.
118. Warfield, J.N. Toward interpretation of complex structural models. *IEEE Transactions on Systems, Man, and Cybernetics*, *SMC-4*, 5 (1974), 405–417.
119. Warner, K.S.R.; and Wäger, M. Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. *Long Range Planning*, *52*, 3 (2019), 326–349.
120. Weitzman, M.L. Recombinant growth. *Quarterly Journal of Economics*, *113*, 2 (1998), 331–360.
121. Werthner, H. From absolute nonsense to the world's operating system. *Electronic Markets*, *32*, 1 (2022), 145–151.
122. Westerman, G. Why digital transformation needs a heart. *MIT Sloan Management Review*, *58*, 1 (2016), 5.
123. Wichmann, J.R.K.; Wiegand, N.; and Reinartz, W.J. The platformization of brands. *Journal of Marketing*, *86*, 1 (2022), 109–131.

124. Willens, M. How The Washington Post is building its tech platform, Arc. *Digiday* (2018).
125. Winig, L. GE's Big bet on data and analytics. *MIT Sloan Management Review, February* (2016).
126. With Marquee, institutions access data, cutting-edge ideas from Goldman Sachs. *Goldman Sachs* (2014).
127. Woodard, C.J.; Ramasubbu, N.; Tschang, F.T.; and Sambamurthy, V. Design capital and design moves: The logic of digital business strategy. *MIS Quarterly*, *37*, 2 (2013), 537–564.
128. XOM Materials revolutionizes steel distribution: Independent platform signs 50th distributor. Klöckner & Co. (2019).
129. Yadav, N.; and Sushil. Total interpretive structural modelling (TISM) of strategic performance management for Indian telecom service providers. *International Journal of Productivity and Performance Management*, *63*, 4 (2014), 421–445.
130. Yang, C.-H. How artificial intelligence technology affects productivity and employment: Firm-level evidence from Taiwan. *Research Policy*, *51*, 6 (2022), 104536.
131. Yin, R.K. *Case Study Research: Design and Methods*. Newbury Park, CA: Sage, 1994.
132. Ying, W.; Pee, L.G.; and Jia, S. Social informatics of intelligent manufacturing ecosystems: A case study of Kutesmart. *International Journal of Information Management*, *42*, (2018), 102–105.
133. Yoo, Y.; Boland, R.J.; Lyytinen, K.; and Majchrzak, A. Organizing for innovation in the digitized world. *Organization Science*, *23*, 5 (2012), 1398–1408.
134. Zaki, M. Digital transformation: Harnessing digital technologies for the next generation of services. *Journal of Services Marketing*, *33*, 4 (2019), 429–435.
135. Zhao, Y.; Von Delft, S.; Morgan-Thomas, A.; and Buck, T. The evolution of platform business models: Exploring competitive battles in the world of platforms. *Long Range Planning*, *53*, 4 (2020), 101892.
136. Zhu, F.; and Liu, Q. Competing with complementors: An empirical look at Amazon.com. *Strategic Management Journal*, *39*, 10 (2018), 2618–2642.
137. Zulu, S.L.; and Khosrowshahi, F. A taxonomy of digital leadership in the construction industry. *Construction Management and Economics*, *39*, 7 (2021), 565–578.
138. Zutshi, A.; and Grilo, A. The emergence of digital platforms: A conceptual platform architecture and impact on industrial engineering. *Computers & Industrial Engineering*, *136*, (2019), 546–555.
139. Zwass, V. Electronic commerce and organizational innovation: Aspects and opportunities. *International Journal of Electronic Commerce*, *7*, 3 (2003), 7–37.
140. Zwass, V. The framework and the big ideas of e-business. In F.J. Martínez-López (ed.), *Handbook of Strategic e-Business Management*. Berlin: Springer Berlin, 140 (2014), 3–14.