Received 14 February 2023
Revised 18 March 2023
Accepted 18 March 2023

Digital transformation strategies of project-based firms: case study of a large-scale construction company in China

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Abstract

Purpose – This study aims to explore how project-based firms, which generally organize most of their work around temporary projects in discontinuous and fragmented types of business contexts, proactively formulate and implement digital transformation strategies under institutional pressures in a predigital era.

Design/methodology/approach – An exploratory case study was conducted in a large-scale construction company in China using multiple data collection methods, including semistructured interviews, documentation collection and observation.

Findings – An integrated framework is developed to conceptualize three key dimensions of digital transformation strategies of project-based firms: strategic adaptation for organization-environment fit through balancing the internal efficiency needs with the external legitimacy pressures; proactive business transformation through comprehensively managing the roles of digital technologies in optimizing defined business processes and fostering new business models; and delicate organizational transformation to integrate temporary project-level operation processes with ongoing firm-level business processes.

Originality/value – This study represents an exploratory effort to empirically investigate how project-based firms strategically organize complex digital transformation imperatives in their discontinuous and fragmented business contexts. The findings contribute to deepened understandings of how complex organizational and environmental contexts can be comprehensively managed for systemic business and organizational transformations to leverage the value of emerging digital technologies for project-based organizations.

Keywords Project-based firms, Digital transformation strategy, Institutional pressures, The construction industry

Paper type Research paper

This study is financially supported by the National Natural Science Foundation of China (Grant Nos. 71802150 and 72271186).

Asia Pacific Journal of Innovation and Entrepreneurship
Vol. 17 No. 2, 2023
pp. 82-98
Emerald Publishing Limited
e-ISSN: 2398-7812
p-ISSN: 2071-1395
DOI 10.1108/APJIE-02-2023-0027

1. Introduction

Emerging digital technologies, including Internet of Things (IoT), blockchain, cloud computing, big data analytics, artificial intelligence (AI) and other related techniques which could collectively cover data collection, modeling, sharing and application processes, hold the potential to fundamentally reshape the way we work and live and thus lead to a new wave of industrial revolution (Schwab, 2016; Zhou *et al.*, 2018). The integration and exploitation of digital technologies to restructure organizational business models and value-creation paradigms, which are generally termed as digital transformation, have been widely considered as the key for firms to achieve and sustain competitive advantages under current volatile, uncertain, complex and ambiguous environments (Hess *et al.*, 2016; Veldhoven and Vanthienen, 2021; Verhoef *et al.*, 2021). As digital transformation is generally associated with rather challenging tasks of articulating and implementing simultaneous changes that touch upon diversified areas within an organization (Vial, 2019; Hanelt *et al.*, 2021), it is of vital importance to elaborately develop appropriate digital transformation strategies to guarantee the success of the transformation initiatives (Hess *et al.*, 2016; Sebastian *et al.*, 2017). With the criticality of the digitalization tendency being increasingly recognized by practitioners, researchers, as well as policymakers, digital transformation initiatives not only hold the potential to present game-changing opportunities for industry firms but also closely related to significant external institutional pressures to which organizations have to elaboratively respond in the current predigital economy (Sebastian *et al.*, 2017). How to appropriately formulate and implement digital transformation strategies to achieve a favorable match between the external environment and the internal organizational needs and resources has become a crucial but challenging endeavor (Gurbaxani and Dunkle, 2019).

Extant studies in the innovation and strategy management domains tend to suggest that the innovation and strategic actions of organizations are closely related to the organizational type and business nature (Gurbaxani and Dunkle, 2019; Kankam-Kwarteng *et al.*, 2019). A particularly salient type of organization whose digital transformation practices need to be specifically investigated are project-based firms, not only due to their significant roles in social and economic developments but also because of their distinctive performance problems and specific business characteristics hindering integrated implementations of innovative practices. For example, it is estimated that about 41% of economic activities are organized in the form of projects in Germany in 2019 (Schoper *et al.*, 2018) and that the global market of the project-based construction industry alone will grow to be worth around $17.5tn in 2030 (GCP&OE, 2015). Despite being increasingly significant, project activities have generally suffered from diversified performance problems, with only around 35% of the projects undertaken worldwide being successful (Nieto-Rodriguez, 2021). These performance problems are closely related to the discontinuity and fragmentation characteristics of project-based firms' business contexts that tend to constrain experimentation, learning and systemic changes (Håkansson and Ingemansson, 2013; Keegan and Turner, 2002). Extant studies have examined the adoptions and implementations of specific digital technologies (such as building information modeling [BIM] and blockchain) in project-based firms form different perspectives, covering a wide range of discrete issues such as technology acceptance intentions and adoption motivations (Cao *et al.*, 2017a; Choi *et al.*, 2017), technology implementation benefits and challenges (Bonanomi *et al.*, 2020; Cao *et al.*, 2022) as well as the impacts of organizational and institutional contexts on technology diffusion (Murguia *et al.*, 2021; Xing *et al.*, 2023). While project-based firms are suggested to be highly dependent on the stakeholders in the external

environment to organize their complex, bespoke and temporary project initiatives in discontinuous and fragmented types of business contexts (Gann and Salter, 2000; Håkansson and Ingemansson, 2013; Winch, 2014), however, there is a limited understanding of how project-based firms comprehensively consider the complex impacts of both organizational and environmental contexts to strategically execute systemic changes and thus successfully manage their complex digital transformation endeavors.

To address this gap, this study focuses on exploring how project-based firms comprehensively balance their internal needs and external institutional demands to proactively formulate and implement digital transformation strategies for organizational success in their specific business contexts. To investigate this issue, this study uses the empirical data from an in-depth case study of a large-scale Chinese construction company that has recently experienced a successful digital transformation process. As a typical and significant type of project-based firms, construction companies not only generally possess substantive internal needs of using digital technologies to address traditional performance problems but also in many regions worldwide, tend to be under complex institutional pressures from government agencies, industry peers and professional organizations for digital transformation (Cao *et al.*, 2017a; Lee and Borrmann, 2020; Xing *et al.*, 2023). As such, construction companies provide a particularly appropriate setting within which to empirically investigate how project-based firms comprehensively consider the complex impacts of organizational and institutional contexts to strategically manage their complex digital transformation endeavors. The remainder of this paper is organized as follows. The next section presents the theoretical background and the literature relevant to the research question. This is followed by the illustration of the research method in Section 3. Section 4 proposes an integrated framework to conceptualize key dimensions of digital transformation imperatives of project-based firms based on the case analysis results. Section 5 summarizes this paper.

2. Theoretical background and literature review

2.1 Digital transformation as a strategic management challenge

Digital transformation, which can be generally conceptualized as "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication and connectivity technologies" (Vial, 2019, p. 121), has emerged as a critical social and economic development tendency widely recognized by practitioners, researchers, as well as policymakers (Hess *et al.*, 2016; Veldhoven and Vanthienen, 2021; Verhoef *et al.*, 2021). At the industry or society level, digital transformation generally encompasses the profound and accelerating transformation of business and social activities, processes and competencies across the industry or the society through the integrated use of digital technologies (Agarwal *et al.*, 2010; Majchrzak *et al.*, 2016). At the organizational level, digital transformation is concerned with the process where digital technologies create disruptions in organizational business models and trigger organizations to alter their value creation paths while managing the structural changes and contextual barriers that affect the outcomes of these disruptions (Hess *et al.*, 2016; Vial, 2019). The transformation process generally covers three incremental stages (Verhoef *et al.*, 2021): *digitization*, which is primarily concerned with the encoding of analog information into a digital format that can be processed by computer systems or electronic devices; *digitalization*, which is primarily concerned with how digital technologies can be used to change existing business processes; and *digital transformation*, which is primarily concerned with an organization-wide change that generally leads to the development of new organizational business models.

As the digital transformation process is generally associated with rather challenging tasks of articulating and implementing simultaneous changes that touch upon diversified areas within an organization (Vial, 2019; Hanelt *et al.*, 2021), it is of vital importance to elaborately develop appropriate digital transformation strategies to guarantee the success of the transformation initiatives (Hess *et al.*, 2016; Sebastian *et al.*, 2017). Many organizations fail with their digital transformation initiatives because they largely begin with technological changes without formulating systematic plans and coherent digital strategies to successfully manage the structural changes and contextual barriers that affect the outcomes of the digital transformation process (AlNuaimi *et al.*, 2022). While traditional information technology strategies are typically viewed as functional-level strategies and primarily focus on the efficient management of technology infrastructure and application systems, they often lack a transformational and business-centric perspective that is needed to effectively manage the structural changes accompanying the process of leveraging digital technologies to enable business improvements (Hess *et al.*, 2016). Due to the great potential of digital technologies (viewed as combinations of information, computing, communication and connectivity technologies) to fundamentally transform organizational products, processes, capabilities and key interorganizational relationships in extended business networks, it is critical to effectively manage the close connections between organizational digital transformation strategies and organizational strategic visions as well as other business strategies (Bharadwaj *et al.*, 2013; Hess *et al.*, 2016).

Due to its distinctive business-centric orientation, digital transformation strategy is closely related to the concept of digital business strategy, which refers to the "organizational strategy formulated and executed by leveraging digital resources to create differential value" (Bharadwaj *et al.*, 2013, p. 472). While a digital business strategy focuses more on the future states of organizational digital business models and typically provides less guidelines on the actual transformational steps to achieve the states, a digital transformation strategy is more about providing a blueprint that guides organizations to effectively govern the transformation processes and outcomes resulting from the integration of digital technologies (Hess *et al.*, 2016; Vial, 2019). The two types of closely related digital strategies both highlight the criticality of reinventing organizational business models and relationship networks to capture the business value of digital transformation initiatives. Based on the framework proposed by Bharadwaj *et al.* (2013), there are four dimensions of themes to capture the key attributes of a digital strategy, including scope, scale, speed and sources of business value creation and capture. Specifically, the theme of scope is primarily concerned with the extent to which organizational business scope is impacted by digital technologies; the theme of scale is primarily concerned with how cost effectively can the digital infrastructure and associated transformation efforts scale up and down to enable the digital transformation initiative to foster structural changes and bolster strategic capabilities; the theme of speed is primarily concerned with how quickly does the digital transformation initiative bolster new strategic capabilities, enable the formation of new business networks and accelerate new product launches; the theme of sources of business value creation and capture is primarily concerned with how effective is the digital transformation initiative in leveraging value from changed business models and processes (Bharadwaj *et al.*, 2013).

2.2 Digital transformation under institutional pressures

While implementing strategic and innovative actions, organizations tend to be significantly impacted by the pressures from different external entities and stakeholders, such as the

government, professionals, interested groups and general public (Cao *et al.*, 2014; Waeger and Weber, 2019). Different from the transaction cost theory which highlights the efficiency-seeking logic of organizational actions (Williamson, 1985), institutional theory argues that organizational decision-making processes could be substantially motivated by social worthiness, external compliance and cultural interests to achieve adherence to rules, norms and beliefs in external institutional environments and thus to obtain social legitimacy (Meyer and Rowan, 1977; Oliver, 1991; Scott, 2001). With the criticality of the digitalization tendency being increasingly recognized by practitioners, researchers, as well as policymakers, digital transformation initiatives not only hold the potential to present game-changing opportunities for industry firms to address internal efficiency problems but also closely relate to significant external institutional pressures to which organizations have to elaboratively respond in the current predigital economy (Sebastian *et al.*, 2017). How to appropriately formulate and implement digital transformation strategies to achieve a favorable match between the external environment requirements and the internal organizational needs and resources has become a crucial but challenging endeavor (Gurbaxani and Dunkle, 2019).

According to institutional theory (Meyer and Rowan, 1977; Oliver, 1991; Scott, 2001), pressures from the external institutional environment can originate from both formal rules (regulations and mandates) and informal constraints (norms, conventions and beliefs). Specifically, there are three basic types of institutional pressures shaping organizational actions: regulative pressure, cognitive pressure and normative pressure (Scott, 2001). Regulatory pressure is generally derived from laws, rules and policies promoting or restricting certain organizational behaviors (Berrone *et al.*, 2013; Kostova and Roth, 2002). Cognitive pressure reflects the prevalently perceived knowledge and thoughts driving organizations to imitate the actions of other role-equivalent actors in a specific domain (Cavusoglu *et al.*, 2015). Normative pressure refers to the norms, values and beliefs preserved by professionals, stakeholders or the public regarding what constitute appropriate and desirable actions (Scott, 2001). Despite the potential impacts of these institutional pressures, organizations do not necessarily respond reactively to the expectations or requirements from the external institutional environment. By contrast, organizations can proactively make strategic responses to achieve a goodness of fit with the institutional environment and the effects of the institutional pressures on organizations can be either beneficial or adverse (Goodstein, 1994). Due to the close relationships between organizational actions and the external institutional environment, recent years have witnessed increasing scholarly interest in the impacts of institutional pressures on other types of organizational innovation initiatives, especially in the regions (such as China) which tend to be with specific and substantial institutional pressures on industry organizations. For example, many scholars have empirically investigated the impacts of institutional pressures on organizational green innovation initiatives and provided relatively inconsistent findings (Chen *et al.*, 2018; Chu *et al.*, 2018; Qi *et al.*, 2021; Shu *et al.*, 2016). With regard to the digital transformation initiatives, which tend to have attracted more substantial attentions from the society and require more radical changes in organizations, extant empirical investigations on digital transformation practices have primarily focused on the impacts of internal efficiency needs on transformation practices. There is limited understanding of how organizations comprehensively consider their internal efficiency needs and the impacts of external institutional pressures to strategically execute systemic changes and thus successfully manage their complex digital transformation endeavors.

2.3 Digital transformation strategies of project-based firms

Project-based firms, which are also termed as multiproject firms (Geraldi, 2008), project-intensive firms (Söderlund and Bredin, 2006) or project-oriented companies (Huemann *et al.*, 2007), refer to companies which organize most of their work around relatively discrete and temporary projects that bring particular groups of resources together to provide unique solutions for a variety of clients and purposes (Lindkvist, 2004; Whitley, 2006; Winch, 2014). This form of firms is often observed in a wide range of industries, including professional services sectors (e.g. advertising, architectural design and management consulting), cultural sectors (e.g. fashion, filmmaking, video games and publishing), high-technology sectors (e.g. software, multimedia and biopharmaceutical) as well as complex products and systems sectors (e.g. construction, aerospace, telecommunications and shipbuilding) (Schoper *et al.*, 2018; Sydow *et al.*, 2004). Different from traditional firms whose primary work is volume-based or operations-oriented, project-based firms have a main emphasis on the project dimensions as they generally need to provide bespoke products or services through temporary projects discretely organized in discontinuous and fragmented types of business contexts (Grabher, 2002; Havenvid *et al.*, 2016; Lindkvist, 2004; Sydow *et al.*, 2004). While providing bespoke products or services, project-based firms generally need to closely collaborate or interact with diversified stakeholders in the external environment to organize their project activities, not only due to the relatively extensive government regulations and industry standards on one-off but complex project initiatives (Miozzo and Dewick, 2004; Winch, 1998) but also due to their distinctive needs to gain financial resources as well as dynamic design instructions from project owners (Hobday, 1998; Winch, 2014) and to combine technical expertise as well as physical resources from suppliers to deliver their own technical capabilities (Dubois and Gadde, 2002; Gann and Salter, 2000).

A particularly significant and typical type of project-based firms are construction companies. The number of construction firms on the Chinese mainland, for example, has reached 2.26 million in 2021, with a total annual output value of RMB 29.3tn (NBSC, 2022), and it is estimated that the global market of the project-based construction industry will grow to be worth around $17.5tn in 2030 (GCP&OE, 2015). Similar to most project-based firms in other industries, construction firms are highly dependent on stakeholders in the external environment to organize their complex projects but generally manage their work in discontinuous and fragmented types of business contexts. First, while organizing most of their work around discrete and temporary projects, construction firms are characterized by distinct decentralized structures in which project work is organized in relatively episodic and autonomous manners (Håkansson and Ingemansson, 2013). Due to the episodic and autonomous nature of project work and the decentralized organizational structure, project-based construction firms generally rely heavily on casualized human and technical resources to increase the flexibility of organizational business processes (Winch, 2014). The temporary project processes and the ongoing business processes are frequently ineffectively integrated, which further hinders effective organizational learning from projects and the continuous renewal of organizational capability in the long term (Gann and Salter, 2000). Second, while construction firms are highly dependent on the financial, human, physical and technical resources from partners (such as project owners and suppliers) in the external environment to organize their discrete project activities, their couplings with related partners are primarily based on the temporary and discrete market-oriented interactions within corresponding individual projects in the short term, which results in relatively sparse industry-level interorganizational interaction networks with few long-term repeated and tight collaborative ties (Cao *et al.*, 2017b; Dubois and Gadde, 2002; Li *et al.*, 2019; Tang *et al.*, 2018). This type of tight couplings in individual projects and loose couplings in the

permanent network might benefit project efficiency in the short term but tend to substantially hamper the collective adaptations of construction firms and their partners for innovative solutions in the long term (Dubois and Gadde, 2002). As the digital transformation process is generally associated with the structural changes in organizational products, processes, capabilities and key interorganizational relationships in extended business networks, the successful implementations of digital transformation initiatives could also be substantially impacted by the discontinuous and fragmented business contexts of project-based construction firms.

3. Research method

A case study is considered an appropriate method for this study due to the dynamics of the research. We seek to explore how strategies are formulated and implemented in project-based firms characterized by discontinuous and fragmented types of business contexts, which belongs to the research category of "how" and matches the characteristics of the case study method in describing scenarios and deducing approaches (Mason, 2002). Also, focusing on one particular case can provide an in-depth analysis of the excavation and depiction of organizational strategizing processes, elicit systematic and thorough research insights, and effectively avoid the possibility of surface-data problems potentially associated with the multiple case study method (Dyer and Wilkins, 1991). The exploratory questions proposed by the present study can be well explicated through deep and intense attentiveness on the selected sample company, which encompasses rich data on related issues (Miles and Huberman, 1994).

The embedded single case study method used in this study requires that the case selected is prevailingly enlightening and representative (Yin, 2009). The empirical study was conducted on the case of a large-scale state-owned construction company, namely, the S Group (pseudonyms), in China. Due to the great potential of emerging digital technologies to fundamentally reshape traditional practices in the laggard construction industry, the criticality of the digitalization tendency has been increasingly recognized by practitioners, researchers, as well as policymakers in China. As such, Chinese construction companies, especially those large-scale state-owned ones, generally face significant external institutional pressures to elaboratively formulate and implement digital transformation strategies in the current predigital economy (Cao *et al.*, 2014, 2017a). The S Group, as a large-scale conglomerate with a turnover of more than RMB 280bn per year (year 2021), a history of nearly 70 years and over 50,000 employees, is the one of the leading Chinese construction companies whose projects are all over the country. The S Group has recently carried out a successful digital transformation initiative and provides an appropriate setting within which to empirically investigate how project-based firms comprehensively consider the impacts of organizational and institutional contexts to strategically manage their complex digital transformation endeavors.

The empirical data was collected through manifold information sources, including semistructured interviews, documentation, internal archival records and observations. The research team meticulously designed multidimensional interview outlines for different types of interviewees from diversified departments or units in the company. As shown in Table 1, a total of 11 face-to-face semistructured interviews with staff from managerial levels in the S Group and its subsidiaries were conducted from December 2021 to February 2022. All the interview data was audiotaped and transcribed verbatim by at least two members of the research team. The interview transcriptions were then confirmed by the interviewees to secure internal validity and then coded and analyzed using the thematic content analysis method.

Date (D/M/Y)	Key interviewees	Unit of analysis	Time (min)	Transcriptions (words)
06/12/2021	Project Manager (PM1)	MUA	77	20,000
07/12/2021	Deputy Director (DD1)	MUA	53	10,000
08/12/2021	General Manager (GM1)	SUA	85	16,000
09/12/2021	Deputy Chief Engineer (DCE1)	SUA	85	14,000
09/12/2021	Chief Technology Officer (CTO1)	SUA	60	14,000
10/12/2021	General Manager (GM2)	SUA	110	14,000
10/12/2021	Chief Engineer (CE1)	SUA	65	13,000
28/12/2021	Vice President (VP1)	SUA	110	14,000
10/01/2022	Chief Engineer (CE2)	SUA	90	17,000
21/02/2022	Chief Engineer (CE3)	MUA	65	15,000
28/02/2022	Deputy Chief Engineer (DCE2)	MUA	70	14,000
		Total:	870	161,000

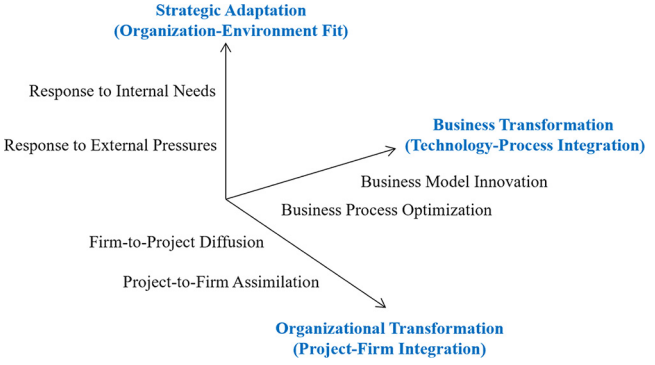
Source: Author's work

Table 1. Overview of the interview data

We investigated the parent company of the S Group as the main unit of analysis ("MUA") and its first tier and second tier subsidiary companies as subordinate unit of analysis ("SUA"). To gain a holistic picture of how the S Group, as a project-based firm, comprehensively considers the impacts of its discontinuous and fragmented business context to proactively formulate and implement digital transformation strategies under institutional pressures, we focused on the characteristics, heterogeneity and the interactions between the MUA and SUA. Based on the logic from the "part" (SUA) to the "whole" (MUA) (Li *et al.*, 2020), an integrated structure of how the S Group formulate and implement its digital transformation strategy finally emerged from the empirical data with completeness.

4. Results and discussions

As shown in Figure 1, our exploratory study of the S Group's digital transformation endeavors suggests an integrated framework conceptualizing three key dimensions of digital transformation strategies of project-based firms under institutional pressures. First, the company strategically adapts to match its organizational orientations and resources with dynamic environment opportunities and threats through balancing the internal



Source: Author's work

Figure 1. Key dimensions of digital transformation strategies of project-based firms

efficiency needs with the external legitimacy pressures for digital transformation. Second, the company proactively transforms its business processes and products through comprehensively managing the roles of digital technologies in optimizing defined business processes and fostering new business models. Third, the company delicately transforms its organizational structures and capabilities to integrate temporary project-level operation processes with ongoing firm-level business processes and thus to facilitate both the firm-to-project diffusion and the project-to-firm assimilation of knowledge resources. The following subsections will analyze and discuss these three key dimensions specifically.

4.1 Strategic adaptation for organization-environment fit

The classical view of strategy, which is in line with the open system perspective in organizational theory (Thompson, 1967), generally regards strategy as an iterated process to achieve desirable fits between the external environment and the organization's structures and activities (Venkatraman and Camillus, 1984). The success of complex digital transformation strategies in a fast-changing environment is also closely related to how the strategies appropriately respond to the opportunities and threats posed by the environment and thus achieve favorable organization-environment fits on an ongoing process. With regard to the S Group, it has been experiencing a transformative way of doing business from traditional to digital paradigms during the past decades. Instead of being merely impacted by economic motives to address internal efficiency and effectiveness problems, the adoption and implementation of digital technologies, including BIM, IoT, AI, robotics and three-dimensional (3D) printing, in the group are dramatically shaped by the dynamic balance between internal needs and external pressures, including regulative, cognitive and normative pressure, as depicted by PM1, CTO1, CE1, CE2 and CE3:

> Initially, we adopted BIM and related technologies upon client's mandatory requirements. [. . .] The application of digital technologies has brought us good reputations and competitiveness. [. . .] Digitization has gained more and more support and advocates from the government, professionals and the industry and we have to keep up with the digital market. [. . .] We set up pilot projects with high digital ability as showcases to government officials, professionals from peer projects and stakeholders. [. . .] The government has been working on promulgating and improving regulations related to BIM adoption. [. . .] We provide trainings on BIM and related technologies for different tiers of staff including front line workers, engineers and managers to gain both skill and mindset development. [. . .] In recent years, with more attentions and pressures from top management, a large amount of money has been spent on innovation and digitization, and we now are reaping the rewards of our investments.

Through dynamically balancing the internal efficiency needs with the external legitimacy pressures for digitalization, the S Group has strategically planned its long-term adaptive digital transformation imperatives to match its organizational orientations and resources with the evolving opportunities and threats posed by the external environment. In the past decade, aligning with the "five-year plans" successively initiated by the Chinese Government, the S Group has proactively organized its digital transformation endeavor with different strategic orientations in different periods to achieve favorable organization-environment fits on an ongoing process. In China, the state formulates a "five-year plan" every five years, which is a nation-wide strategic plan aiming to set up the blueprint and directions for future economic and societal development across the country. For example, the five-year plan for period from year 2011 to year 2015 is called the "Twelfth Five-year Plan" and the "Thirteenth Five-year Plan" refers to the development plan for year 2016 to year 2020. Accordingly, the S Group conforms to the same pattern to adjust its own short-term digitalization plans based on its long-term digitalization strategy. Based on the

framework of digital strategy themes proposed by Bharadwaj *et al.* (2013), how the S Group adaptively designs its strategic focuses of digital transformation under evolving institutional pressures exerted by the environment is summarize in Table 2.

4.2 Business transformation with technology-process integration

While strategically adapting to achieve a desirable match between the organization and the environment, a key dimension of the strategic transformation imperatives is to integration between new digital technologies and company's business process. As digital transformation is not achieved by a single corporate decision or action but rather is an ongoing process,

Period	Institutional pressures	Strategy themes
12th five-year plan (2011–2015)	Requirements from project clients; normative pressures from professionals	*Scope*: exploratory implementations of digital technologies, such as BIM, in traditional construction processes in pilot projects *Scale*: substantial investment in BIM-related technology infrastructure; company-wide training Speed: digital-project piloting *Value creation*: preliminary exploitation of social values such as reputations
13th five-year plan (2016–2020)	Requirements from project clients and government agencies; pressures from peers; normative pressures from professionals	*Scope*: integrated implementations of digital technologies in traditional construction processes within most projects and in operation and maintenance processes within complex projects *Scale*: substantial investment in emerging technologies such as IoT *Speed*: cross-project diffusion *Value creation*: deep exploitation of economic and social values in traditional business domains; initiation of new business processes in the domains of building services and industrialized construction
14th five-year plan (2021–2025)	Digital culture is collectively shaped by regulatory, cognitive and normative pressures; reputation pressures as industry leader	*Scope*: integrated and lifecycle implementations of digital technologies in lifecycle processes in most projects *Scale*: substantial investment in emerging technologies, such as AI and integrated platforms *Speed*: project-to-firm assimilation *Value creation*: comprehensive exploitation of economic and social values in traditional business domains; deep exploitation of economic and social values in new business domains, such as building services and industrialized construction

Source: Author's work

Table 2. Adaptation of digital transformation strategies under institutional pressures

decision-makers must proactively and incrementally transform organizational business orientations and processes and to embrace contemporary digital technologies and comprehensively reap their benefits (Terziovski, 2010). There is evidence of the impacts of technology-process integration on explicating improved business performance, including financial performance (Baier *et al.*, 2008), new product development (Acur *et al.*, 2012) and service innovation performance (Kitsios and Kamariotou, 2016). While traditional information technology strategies are typically viewed as functional-level strategies which primarily focus on the efficient management of technology infrastructure and application systems, they often lack a transformational and business-centric perspective that is needed to effectively manage the structural changes accompanying the process of leveraging digital technologies to enable business improvements (Hess *et al.*, 2016). Due to the great potential of digital technologies to fundamentally transform organizational products, processes, capabilities and key interorganizational relationships in extended business networks (Lucas *et al.*, 2013), it is critical to achieve the strategic alignment between organizational digital transformation strategies and organizational business strategies (Henderson and Venkatraman, 1999) and to substantially transform organizational business orientations and processes accordingly (Bharadwaj *et al.*, 2013; Hess *et al.*, 2016).

With regard to the S Group, to effectively exploit the great potential of digital technologies to optimize and reshape business processes for enhanced organizational performance, the firm has also substantially transformed its business processes, markets, services and product types. Such transformations include not only the use of digital technologies to optimize defined business processes but also the leverage of digitalization to create new business opportunities and foster new business models. The original business value chain of clients, designers, contractors and suppliers, which has been long and widely adopted in the "conservative" project-based construction industry, are disrupted and reengineered. The role of the S Group as a contractor in the business value chain is altered and expanded. Such transformations started with the changes in the attitudes and roles of the top management team in the S Group, as commented by the interviewees DD1 and GM1:

> We (the Engineering Research Institute) used to report to our chief information officer (CIO) but we will report to the group's chief engineer (CE), same as a chief executive officer of an organization, who would be in charge of the digital transformation and innovation strategy of the whole group. [. . .] We invest in BIM and other digital technologies about 20 to 30 million RMB per year and digital transformation strategy has gained great managerial-level support. [. . .] Now digital transformation is the first priority in our CE's agenda.

With such integrations and transformations, the way in which management and project tasks are carried out within the firm are changed, and the efficiency of traditional construction and management processes are improved, as commented by the interviewees GM1 and CE2:

> In the past, except major mega projects, few construction companies have digitized their management processes. [. . .] Similarly, we started by setting up pilot digital projects. [. . .] Gradually, it (digital technology) changed the way we work. For example, we now use an "ipad" with 3D models instead of paper drawings at site; I can sit in my office, or basically anywhere to check the situations around project sites; Work can be done through all access channels at any time with platform services and electronic devices.

As the transformation process proceeds, the integration of digital technologies with organizational processes does not only optimizes defined business processes but also results in new business opportunities and new business models in which the firm operates in different markets, producing different products, providing different services and ultimately gaining considerable advantages. As a consequence, now the business scope of the firm does

not only covers traditional construction activities but also expands to several new domains such as digitally-enabled building services and industrialized construction. In recent years, while the revenues of traditional construction businesses in the S Group generally increase 10%–15% annually, the annual increase rates of its new business revenues are generally above 20%. Such expansions are also specifically depicted by the interviewees DCE1 and CE3:

> By digitizing traditional construction processes and products, we discovered the great values of digital data and information for lifecycle facility management. [. . .] Our business scope has now expanded to several new domains including urban renewal, facility management, historical building restoration, interior decoration and etc. [. . .] When it comes to large complex projects or the clients (such as overseas developers) with relatively high requirements, our ability of using digital technologies like BIM is definitely an advantage. [. . .] Currently, the ultimate goal of the company, inspired by our digital transformation efforts, is to become a leading service provider for the entire life cycle of building facilities.

4.3 Organizational transformation for project-firm integration

Chandler (1969) claims that business strategy determines the organizational structure. Recent studies suggest that flexible organizational structures that constantly adapt to market competitions and customer needs would support the implementation of innovation strategies and help enterprises respond rapidly to the drastic changes in the external environment and maintain their competitive advantages (Marion *et al.*, 2012). New technology plays a crucial role in achieving higher degree of integration by improving the efficiency of information flows and facilitating cooperation across organizations (Rothwell and Whiston, 1990) and digital ability, in turn, requires high degree of interaction and integration across different subsystems at different levels. Our result is consistent with previous findings on the significance of organizational integration. While leveraging digital technologies to reshape organizational business processes and to strategically adapt to achieve a desirable match between the organization and the environment, the S Group has experienced substantial organizational transformations to integrate temporary project-level operation processes with ongoing firm-level business processes and to facilitate both the firm-to-project diffusion and the project-to-firm assimilation of knowledge resources.

Similar to other project-based firms, which generally organize most of their work around temporary projects in discontinuous and fragmented business contexts, a major disadvantage of the S Group was the poor integration between functionally separated projects and subsidiaries for two reasons. First, the continually changing nature of project-based firms impedes the process of project-firm integration due to the uniqueness, differentiation and specialization of varied construction projects (Kwak *et al.*, 2015). Project-based data and knowledge generated from discrete and temporary projects have not been well integrated and used by construction companies for a long time, and the discontinuity of information between projects have been relatively striking. Second, the S Group is a large-scale conglomerate consisting of a series of subsidiary companies, which are both cooperative and competitive, and each subsidiary is engaged with different operational processes and functional units. A prominent reason for the underperformance of large-scale conglomerates across segments is the lack of effective internal coordination and organizational governance of different operational and functional units (Maksimovic and Phillips, 2002).

A key organizational transformation endeavor for the S Group to integrate temporary project-level operation processes with ongoing firm-level business processes is to set up new organizational units with different types of integration functions. The primary

organizational changes as an integral part of the complex digital transformation imperative in the S Group during the past decade are summarized in Table 3. While digital technologies hold great potential to reshape the whole data processing lifecycle, including the stages of data collection, data modeling, data storage and sharing and data analysis and application (Cao, 2023), such organizational changes for project- and firm-level process integration have substantially facilitated both the firm-to-project diffusion and the project-to-firm assimilation of related data and knowledge resources and thus enabled the S Group to more effectively leverage emerging digital technologies to create and capture values.

5. Conclusions

While emerging digital technologies have brought and will continue to bring remarkable changes to our society, how to appropriately formulate and implement digital transformation strategies to comprehensively manage diversified factors of their complex organizational and environmental contexts for systemic organizational changes has become a critical but challenging endeavor for organizations in many industries. This study aims to explore how project-based firms, which generally organize most of their work around temporary projects in discontinuous and fragmented types of business contexts, comprehensively balance their internal needs and external institutional demands to proactively formulate and implement digital transformation strategies for organizational success in their specific business contexts. Based on the exploratory case study with a large-scale construction company in China, an integrated framework is developed to conceptualize three key dimensions of digital transformation strategies of project-based firms: strategic adaptation for organization-environment fit through balancing the internal efficiency needs with the external legitimacy pressures; proactive business transformation through comprehensively managing the roles of digital technologies in optimizing defined business processes and fostering new business models; and delicate organizational transformation to integrate temporary project-level operation processes with ongoing firm-level business processes. This study represents an exploratory effort to empirically investigate how project-based firms strategically organize complex digital transformation imperatives in their discontinuous and fragmented business contexts. The findings contribute to deepened

Table 3. Organizational changes in the S group

New organizational units	Establishment time (year)	Main functions
Central Engineering Research Institute	2012	To organize R&D activities and provide digital workplace; to facilitate the integration of digital technologies with organizational business and project processes
Engineering Research Institutes of Subsidiary Groups	2014	To manage and digitize construction projects; to train digital skills and foster digital culture
High-tech Subsidiary Company	2019	To integrate data and knowledge resources from different projects and subsidiary units within the group; to provide digital services to internal and external projects
Top Management Team for Digital Transformation	2021	To comprehensively manage the digital transformation imperative of the group; to coordinate the transformation endeavors of different subsidiary units

Source: Author's work

understandings of how complex organizational and environmental contexts can be comprehensively managed for systemic business and organizational transformations to leverage the value of emerging digital technologies for project-based organizations.

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