



Understanding mechanisms of digital transformation in state-owned enterprises in China

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**UNDERSTANDING MECHANISMS OF DIGITAL TRANSFORMATION IN
STATE-OWNED ENTERPRISES IN CHINA: AN INSTITUTIONAL
PERSPECTIVE**

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Abstract

In recent years, organizations across myriad industries have begun adopting novel digital technologies and, in doing so, fostered their digital transformation. This study examines the digital transformation in state-owned enterprises (SOEs) in China. We conducted comparative case studies on China Mobile and China Unicom, two typical and leading SOEs in China's telecommunications industry, to identify the company's transformation characteristics and how key factors impact the transformation process. This research also contributes to digital transformation literature and to the institutional theory. We develop a conceptual framework for analyzing enterprise digital transformation, and generate some theoretical prescriptions. The research findings conclude that, based on innovation in digital technology by generations, enterprise digital transformation on strategic positioning, value proposition (services and products), and value creation (assets and organizational structure) presents a process by stages; both institutional pressures and technological attraction impact how SOEs carry out digital transformation; different SOEs with different characteristics in value creation present different transformation process. Future research could use the framework as an analytical tool and draw upon the theoretical prescriptions to examine digital transformation in different kinds of organizations. At last, this research also offers practical insights for SOEs to carry out digital transformations and for governments to offer supportive institutional environment for this process.

Keywords: Digital Transformation, Institutional Perspective, Technological Attraction, Business Model, State-owned Enterprise (SOE).

1 Introduction

In recent years, a new generation of information and communications technologies (ICTs) such as artificial intelligence (AI), blockchain, cloud computing, and big data have emerged. These technologies share characteristics such as reprogrammability, data homogenization, and a self-referential nature (Hanelt *et al.*, 2021; Yoo, 2010). Alongside this emergence, we have witnessed many organizations across the world adopt innovative digital technologies, which has triggered their digital transformation. In China, the government has executed a series of plans to construct a digital society and develop a digital economy. In particular, it has implemented policy measures to encourage organizations to digitally transform their production modes and governance patterns. For instance, in May 2020, the National Development and Reform Commission (NDRC) launched the “Digital Transformation Partnership Action” to accelerate digital transformation in the nation’s pillar industries. In April 2021, the State-owned Assets Supervision and Administration Commission (SASAC) implemented industrial policies to encourage digital transformation in state-owned enterprises (SOEs), the backbone of the country’s national economy (Gao *et al.*, 2021). We focus on SOEs’ digital transformation in China in this study.

Digital transformation provides opportunities for organizations to transform its less competitive businesses in order to cope with the challenges in the marketplace. As Vial (2019), Hanelt *et al.* (2021), and Verhoef *et al.* (2021) concluded in their literature reviews, organizational digital transformation has attracted significant research attention in recent years. For example, thus far, scholars have considered the digital transformation process and its impact factors (Warner and Wäger, 2019), how organizations can improve their performance with digital transformation (Bouwman *et al.*, 2019; Zhai *et al.*, 2022), and business model innovation in the digital transformation context (Bohnsack *et al.*, 2021). Scholars have also examined digital transformation in different kinds of organizations and contexts, such as small and medium-sized enterprises (SMEs) (Bouwman, et al., 2019; Matarazzo *et al.*, 2021; Zhang *et al.*, 2021) and financial service providers (Chanias *et al.*, 2019). However, we note that the extant knowledge on enterprise digital transformation mainly concerns Western organizations that operate in a context different from Chinese ones. With that said, we found some limited research on Chinese organizations in Chinese academic outlets that has mostly focused on traditional manufacturing enterprises (Wang, 2021;

Xia *et al.*, 2022; Zhang and Zhang, 2020). However, these studies have mainly used quantitative methods to identify digital transformation impact factors and verify the static link between digital transformation and performance changes (e.g. Chi *et al.*, 2020; Qian and He, 2021; Wu *et al.*, 2021).

In China, SOEs form the backbone of every national industrial sector (Gao *et al.*, 2021). As such, they play an important role in the country's digital transformation. However, SOEs in China face multiple constraints due to their inherent special attributes (Shao, 2011). Specifically, compared with private or foreign organizations, SOEs normally bear a heavier policy responsibility. For instance, from an institutional theory perspective (DiMaggio and Powell, 1983; Oliver, 1991; Scott, 2001), SOEs bear higher pressure from the institutional environment (Huang and Yu, 2006). Specifically, regulatory arrangements such as the ownership and property rights system and the enterprise leader appointment system deeply influence the way in which SOEs develop (Huang *et al.*, 2018). SOEs in China also have higher social responsibilities and obligations, which means that normative pressures constrain them more than other organizations. SOEs should fulfill not only political responsibilities but also social responsibilities such as public welfare, environmental sustainability, and poverty alleviation (Chen *et al.*, 2022). Moreover, SOEs in China have stronger organizational inertia and path dependence for transformation. The deep-rooted ideology of serving the government and consistent behavior patterns result in more cognitive limitations and behavioral inertia in SOEs than other organizations, which impacts their development (Huang *et al.*, 2018; Xu *et al.*, 2017; Yang *et al.*, 2012) and digital transformation.

Due to these characteristics, the government often uses SOEs as means to control the national economy and intervene in the market (Huang and Yu, 2006; Shao, 2011). For instance, the Chinese Government has relied on SOEs to compensate for occasional market failures and to help efforts to support strategic industries (Liu *et al.*, 2011). Compared with other kinds of Chinese and Western enterprises, SOEs in China and their digital transformation have unique characteristics, and follow different paths. Thus, they warrant more research attention from the international ICT innovation research community. Research on their digital transformation can generate findings that

significantly extend the existing digital transformation literature, and more importantly, have prominent advancement to the theories in current studies.

Overall, given that we currently lack research and understanding on digital transformation's process and impact factors in China's SOEs, we advance knowledge on the phenomenon by conducting a comparative case study based on China Mobile and China Unicom, two typical and leading SOEs in China's telecommunications industry. In particular, we address the following research question (RQs):

RQ1: What key factors impact China's SOEs to undergo digital transformation, and how do these factors shape the digital transformation process?

RQ2: What are the characteristics of SOEs' digital transformation in China?

This paper proceeds as follows: in Section 2, we review the literature on digital transformation impact factors, and develop the conceptual framework for understanding digital transformation process in China's SOEs. In Section 3, we outline our research design and the method we used to collect and analyze data. In Section 4 and Section 5, we present two case studies and, in Section 6, discuss the findings. Finally, in Section 7, we discuss the study's limitations, and highlight opportunities future research, and conclude the paper.

2 Theoretical Backgrounds and Conceptual Framework

2.1 Enterprise digital transformation

Research in the literature has defined digital transformation from different perspectives. Vial (2019) views digital transformation as a process of adopting ICTs to trigger significant changes and improvements in an organization's attributes (i.e., strategic evolution in its structure, boundaries, and value-creation pathways). Verhoef *et al.* (2021) stress that, when an organization pursues digital transformation, it adopts digital technologies to change its business logic and value-creation process. Multiple authors have noted that digital transformation leads to changes in an organization's structure, product and service innovation, operation and management practices, and value-creation process (Baskerville *et al.*, 2020; Nambisan *et al.*, 2019). Matt *et al.* (2015) argue that digital transformation involves transformations of key business operations and affects products and processes, as well as organizational structures and

management concepts. Companies need to formulate a digital transformation strategy that goes beyond the process paradigm, and includes changes to and implications for products, services, and business models as a whole. A company's strategic vision for digital world and the business implications determine its digital transformation strategy (Gurbaxani and Dunkle, 2019). Warner and Wäger (2019) define digital transformation as strategic evolution in an organization's business model and business process. Hanelt et al. (2021) find that organizations undergo digital transformation to develop a digital business model to create more value and that whether digital transformation leads to business model innovation constitutes an important factor to consider when evaluating whether digital transformation has succeeded. Li *et al.* (2018) note that digital transformation digitalizes an organization's business processes, how it manages its assets, and its industrial relationships and can further promote evolutions in its business model. Gurbaxani and Dunkle (2019) understand enterprise digital transformation as an organization reinventing its organizational structure, processes, capabilities, and culture to match the evolving digital business context.

To conclude, enterprise digital transformation affects an enterprise in its entirety i.e., its management, operations, etc concerning how an enterprise does business and generates revenue. In other words, digital transformation entails innovating on one's business model (Bohnsack, et al., 2021; Gao and Li, 2020; Ricciardi *et al.*, 2016). A business model defines how an organization builds and uses its resources to offer its customers better value than its competitors and how it makes money doing so (Afuah and Tucci, 2003). Richardson (2008) defines a business model as comprising three dimensions: value proposition, value creation and delivery, and value capture. Value proposition refers to the products and services that an organization provides to customers in the target market. Value creation and delivery refers to the business processes that describe the activities an organization follows to produce, sell, and deliver products and services to customers. Value capture refers to the methods an organization uses to earn revenue. An organization needs to developing a proper business model to transform technology success into business success (Gao and Li, 2020; Teece, 2010).

2.2 Impact factors of digital transformation

2.2.1 Technological attraction

Different factors affect the digital transformation process. These factors shape the strategy that an organization adopts when undergoing digital transformation and the path that the transformation follows (Verhoef *et al.*, 2021). For example, technological attraction measures an organization's overall evaluation or attitude toward a technology, which determines whether this organization will adopt this technology or not. In the information systems (IS) literature, technological attraction is a part of the multiphased IS adoption process; it is the predictor for IS adoption. The technological attraction concept has also been used to explain an organization's adoption of e-commerce (Campbell *et al.*, 2013; Zheng *et al.*, 2020). We can draw upon this concept to analyze an organization's digital transformation initiative.

Technological distance determines technological attraction in general and digital transformation in particular. Griliches (1979) first introduced the concept, and used technological distance between an enterprise and an industry to examine how an organization accumulates knowledge through not only its own research and development (R&D) efforts but also from the R&D efforts in the industry in which it operates and even others it does not operate in. Technological distance strongly influences innovation activities and technological distance can be categorized into horizontal technological distance and vertical technological distance. Horizontal technological distance refers to the extent to which the technologies that organizations use in different industries or regions differ, while vertical technological distance refers to the extent to which technologies that organizations in the same industry or region use differ (Zhang, 2012). Thus, for example, an organization that used the same or similar technologies to organizations in the same region would mean they had a small vertical technological distance between them. A bigger horizontal technological distance means that organizations will face more difficulty in acquiring and digesting expertise from external sources (Ge and Hu, 2008). Organizations are more likely to acquire and absorb external knowledge in similar technological fields to which they have invested. Since digital transformation necessitates that organizations integrate digital technologies into their organizational, management, and value-creation processes, whether their digital transformation succeeds or fails depends on whether they can

apply digital technologies in such a way that it helps them achieve improvements in their products, services, and operations (Gurbaxani and Dunkle, 2019).

2.2.2 Organizational Inertia

In addition to research on the technological factors affecting enterprise digital transformation, there are also studies focusing on the obstacles hindering the realization of digital transformation in organizations. Among the various factors, organizational inertia is widely recognized as the most representative obstacle. Organizational inertia refers to the inability of an enterprise to undergo internal changes to adapt to the significant environmental changes. Specifically, Gilbert decomposes the structure of organizational inertia into two categories: one resulting from resource rigidity, which means failing to change the investment pattern of resources; and the other resulting from process rigidity, which means failing to change the organizational processes used for these resources (Gilbert, 2005).

Resource dependence stemming from framework biases of established assets and re-investment incentives of incumbents are important reasons for resource rigidity. In the face of new technological changes, an enterprise's resource allocation mechanism may blindly cater to the requirements and preferences of resource providers such as capital markets and customer markets, leading to a refusal to invest in emerging technologies (Gilbert, 2005). Additionally, enterprises with fixed assets may tend to narrowly search for technologies and markets and limit their investments to innovations close to their existing asset base, while ignoring other high-potential innovations. Furthermore, incumbent enterprises often tend to heavily invest in deterministic technologies that maintain their market dominance in order to maintain market power, while constraining resource inputs for emerging technologies with uncertainties. These factors can all reduce the willingness of enterprises to invest in emerging technologies (Teece, 2007).

Moreover, process rigidity is also an important source of organizational inertia, and the general reason for process rigidity is usually the existence of organizational routines. Organizational routines are repetitive and identifiable behavioral patterns involving interdependent activities and multiple participants formed through structural embedding and repeated performance. Organizational routines are tools for organizations to efficiently complete work, but they can also become sources of process rigidity and

organizational inertia when they no longer fit the environment (Feldman and Pentland, 2003). In addition, the fundamental logic embedded in organizational routines deeply penetrates the cognitive level of the organization and forms cognitive limitations (Tripsas and Gavetti, 2000). This cognitive level of influence can lead managers to rely on a learned response mode that is reinforced structurally and cognitively to propose and solve problems, rather than being inclined to explore new approaches. The perspective of organizational inertia can help understand the internal mechanisms of resistance to change within enterprises when studying the factors affecting enterprise digital transformation, thereby understanding how it affects the planning and implementation of enterprise digital transformation strategies.

2.3 Institutional pressures

The environment in which an enterprise operates provides both opportunities and challenges to its development and any digital transformation process. An enterprise needs to adapt its strategies, structures, plans, and operations to its changing environment (Gao and Li, 2020). Researchers have used myriad theories to understand the interaction between an organization and its environment, such as stakeholder theory (Choudrie *et al.*, 2003), agency theory (Cohen and Kietzmann, 2014), socio-technical perspective (Borrás and Edler, 2020), collective action theory (Gao *et al.*, 2021), actor network theory (Gao, 2005; Lee and Oh, 2006), innovation system theory (Liu *et al.*, 2018), and theory of dynamic capabilities (Ricciardi *et al.*, 2016; Yeow *et al.*, 2018). Specifically, Hinings *et al.* (2018) suggested that the institutional perspective is a prolific lens to study digital transformation. Considering SOEs are subject to strong government influence in their business including digital transformation, we focus on institutional theory in this paper.

In general, the institutional environment profoundly impacts enterprises' digital transformation (Hinings *et al.*, 2018). Institutions include formal constraints such as rules, laws, and constitutions, and informal constraints such as social norms, conventions, and self-imposed codes (North, 1990). The institutional environment exerts coercive pressure, normative pressure, and mimetic pressures on organizations (DiMaggio and Powell, 1983). Specifically, coercive pressure comes from the legal environment and existing technical standards. Regulative pressure from government authorities is a typical coercive pressure (Lin, 2016). Normative pressure comes from

specialization, and mimetic pressure appears when organizations tend to imitate others that they consider more legitimate or successful in their field.

Different kinds of institutional pressures together confine a continuous organizational-change process (DiMaggio and Powell, 1983). Organizations seek to respond to institutional pressures and gain legitimacy in the environment in order to achieve acceptance and, thus, ensure their sustainable development (Oliver, 1991). Traditionally, legitimacy refers to the continuous adjustments that organizations make in their institutional environment to adapt to its rules and norms. To gain legitimacy, an organization needs to act in a desirable, correct, or appropriate manner in the socially constructed system of norms, values, beliefs, and definitions in which it operates. By doing so, organization can obtain social acceptance and recognition and obtain the resources they need for their operations (Hou *et al.*, 2018; Scott, 2008). Institutional theory helps one interpret how an organization's institutional environment affects how it plans and implements digital transformation. Specifically, an institutional perspective invites us to examine how new institutional arrangements gain social approval (i.e. legitimacy) in the eyes of critical stakeholders and their interplay with existing institutional arrangements (Hinings *et al.*, 2018).

2.4 Conceptual framework

Based on the reviewed literature, we have developed a conceptual framework (see Figure 1). The value-based business model perspective, the technological attraction and the organizational inertia concept, and the institutional theory serve as the framework's theoretical foundation. The framework is adopted to understand factors from both inside and outside organizations and their impacts on SOEs' digital transformation process and, thus, to answer the research questions.

(Figure 1 here)

Considering the technological environment, the technology attraction concept informs that enterprises tend to adopt and innovate on technologies with a relevant, familiar knowledge base when pursuing digital transformation. Considering the institutional environment, organizations undergo digital transformation to cope with institutional pressures and pursue legitimacy in the organizational field in which they operate.

Finally, under specific technological and institutional environment, organizations adopt digital technology to transform their business model and capture development opportunities (Bouwman, *et al.*, 2019). In other words, the transformation occurs throughout an organization in its entirety, and in all aspects of its digital business model. Specifically, organizations should have a strategic vision for handling the business implications that adopting new digital technologies and the requirements that the digital transformation and its implementation may have (Gurbaxani and Dunkle, 2019). Furthermore, they should re-consider their strategic positioning. In terms of business model, organizations need to redefine their value propositions (i.e., services and products) and reshape their value-creation system (i.e., adjust their assets and organizational structure) to offer proposed value (Gao and Li, 2020; Richardson, 2008).

3 Research Methodology

In designing research, this study follows the steps and guidelines of inductive embedded multiple case research (Eisenhardt, 1989; Yin, 2009). Firstly, the inductive case study method is suitable for exploratory research with new perspectives (Graebner and Eisenhardt, 2004). In this study, we adopt a new perspective by combining institutional theory with business model innovation, technological distance and organizational inertia concept, which is still in the exploratory stage. Secondly, this study adopted qualitative case study as method as it suits research that addresses “how” type research questions such as the ones we examine, and the embedded multiple case design can control certain contextual variations and enhance the robustness of conclusions (Yin, 2009). Qualitative allows one to analyze and interpret a social process in depth and to reveal its underlying complex mechanisms in a specific context, which makes it appropriate approach for our focus on understanding key factors and the way that they shape digital transformation process in China’s SOEs.

To examine digital transformation in China’s SOEs, we selected China Mobile Communications Group Co. Ltd. (which we refer to as China Mobile henceforth) and China United Network Communication Group Co. Ltd. (which we refer to as China Unicom henceforth) as case organizations based on two factors. First, China Mobile and China Unicom represent SOEs in China well. Furthermore, their digital transformation practices represent other SOEs well given that the SASAC selected its efforts to construct a digital ecological platform in 2020 as a typical SOE digital

transformation case. Second, we maintained close cooperation with China Mobile and China Unicom have taken as research samples for years. As thus, we could obtain data about the digital transformation process and results. In addition, as listed enterprises, China Mobile and China Unicom have reliable information disclosure channels and official documents such as annual reports. One can access abundant information about the company from channels such as industry reports, newspapers, and social media.

We draw on our conceptual framework (see Figure 1) that developed based on the literature to organize how we collected data. We collected data about two enterprises' digital transformation through four methods. First, we conducted semi-structured interviews during 2021-2023 with ten managers in China Mobile (CM1-CM10) and nine managers in China Unicom (CU1-CU9); four government officials (G1-G4); three researchers from the Chinese Academy of Sciences, a policy, natural sciences and high technology research institute (R1, R2, and R3); and three managers in downstream companies (S1, S2, and S3). Table 1 summarizes the interviews we conducted. Second, we collected data through participative observations. We used both companies' service platform and the third generation (3G), fourth generation (4G), and fifth generation (5G) mobile applications and, thus, directly experienced outcomes from their digital transformation. Third, we used internal data sources, such as the official websites, relevant meeting minutes and video records, annual reports, social responsibility reports, prospectus, and executives' speeches at important events (e.g., at the China Mobile Global Partner Conference, World Mobile Communications Conference, etc.). Fourth, we collected data from external sources such as relevant industry reports, reports in newspapers, and social media. Following Yin (2009), we validated data from different sources via triangulation to ensure its integrity, authenticity, and reliability.

(Table 1 here)

In analyzing the data, we focused on explaining events “by postulating (and identifying) mechanisms which are capable of producing them” (Sayer, 1992, p.107). Specifically, according to Hallen and Eisenhardt (2012), we applied the conceptual framework in Figure 1 to digital transformation in China Mobile and China Unicom to verify the framework and uncover new theoretical findings. We identified different development stages and key events in the companies' digital transformation. Through continuous

dialogue between literature and data, we coded their digital transformation process and the external and internal environments. We verified the conceptual framework in Figure 1 and further through the case studies expanded it with theoretical prescriptions on the factors and their impacts on SOEs' digital transformation (see Table 2).

(Table 2 here)

4 Case 1: China Mobile's Digital transformation

4.1 Digital transformation implementation

Digital transformation is enabled by innovation in digital technologies. In China's telecommunications industry, mobile technology has seen evolved from the 3G (2009 to 2013) to the 4G (2014 to 2018) and 5G eras (2019 onwards). Correspondingly, China Mobile's digital transformation moved in three stages, which are characterized by the start, exploration and acceleration of transformation, respectively. In each stage, China Mobile adopted specific mobile and digital technologies; the company adopted a specific business model i.e. specific strategic positioning in the market and specific value proposition, and specific logic of value creation and delivery (organizational change and asset re-configuration).

4.1.1 Adoption of digital technologies

The digital transformation is based on the digital infrastructure and technology system. As an illustration, Table 3 describes the core components of China Mobile's 5G technology system that incorporated technologies such as cloud computing, edge computing, and so on. Based on the 5G system, China Mobile operated a distributed cloud network. China Mobile developed a so called "technology + data + service" platform—an open Internet platform that integrated these three aspects. It allowed the company to gather massive data, develop data-mining applications, and provide output-reusable data services to other organizations. By performing these functions, China Mobile could transform data into a business asset, which enabled it to provide, for example, information and computing services and to strengthen cross-industry technology innovation. In an interview, a technical director in China Mobile said:

China Mobile has invested heavily to build the world's largest 5G network. To support the operation and commercialization of the 5G network, we have

optimized the cloud resource, and strengthened the deployment of cloud computing, big data, Internet of things, artificial intelligence and other new digital technologies. Consequently, China Mobile has built a platform offering centralized big data management, which enhanced its competence in the market in the digital era. (CM4)

(Table 3 here)

4.1.2 Strategic positioning and value proposition (service innovation)

Service innovation characterized China Mobile's digital transformation. The company started its digital transformation in the 3G era. At that time, it explored broader market segments. Consequently, the company began providing services beyond traditional basic communications services such as voice service and short message service (SMS) for the public market. That is, it started to provide value-added information services such as the short multimedia messaging service (MMS), color ring back tone (CRBT), and Internet services such as the "Over the Top TV" (OTT) service to family and group customer markets. Its business extended to the mobile Internet and Internet of things.

In the 4G era, China followed a strategy to become a global leading Internet network operator. In this stage, it extensively explored digital services. In particular, it explored the digital service market and changed its business focus from communications network operation to digital network operation. Its business focus further shifted to digital services for the public, the home, and emerging market like sharing economy. China Mobile offered digital content products such as mobile payment Hebao, Migu Video, Migu Reading, Migu Game, and "Migu Animation". It also set up the industry-leading Internet of things open platform OneNET.

In the 5G era, China Mobile's digital transformation entered the acceleration stage. China Mobile sought to specialize in information services. To do so, it followed a business model innovation strategy to upgrade itself from a communications pipeline operator to an information service provider. Its market scope gradually expanded from individuals to families and homes and from traditional organizations such as governments and manufacturing enterprises to emerging markets (e.g., the sharing economy and financial technology (fintech)). It offered myriad services, such as smart

transportation, smart education, smart healthcare, smart city, smart factories and smart mines, to target specific market segments. It integrated different terminals, networks, platforms, and scenario-based applications to provide one-stop solutions to different organizations and industries to support their digital transformation. It offered services for different market segments, provided dedicated network slices and customized services to users in key industries, and formed an ecological platform to provide overall solution for other organizations to carry out digital transformation. Two managers in charge of digital marketing in China Mobile said:

For the individual market, we launched 5G customer exclusive plans for offering features such as Harmony Cloud and Super SIM Card to the public market. For the family market, we built a smart home product system that integrates smart gateway, smart networking, home security, voice remote control and other smart home features. For the government and enterprise market, we developed the ‘Net + Cloud’ product system. Targeting on serving emerging market segments, we continued to invest in the R&D of 5G private network products, enriched the public cloud products, and made efforts to build a mobile cloud platform. (CM9)

China Mobile is transforming its operation and business strategy from scale-based to value-oriented. China Mobile has gradually moved from being a single communications pipeline operator to a digital service provider. Digital business models based on traffic, slicing and platform have emerged. (CM3)

4.1.3 Value creation and delivery: organizational structure and asset management

In its digital transformation process, according to the value proposition China Mobile reformed its value-creation and value-delivery logic. Digital transformation should raise an organization's operating efficiency and increase revenues (Gurbaxani and Dunkle, 2019). In a digital transformation process, an organization needs to make a series of organizational changes and restructure its digital assets (Li *et al.*, 2018). It also needs to restructure other assets, such as by creating subsidiaries for digital business, and adjust its organizational structure, such as by forming cross-functional teams (Feldman and Pentland, 2003; Teece, 2007). China Mobile modified its resource

framework and organizational management practices in various aspects as two officials said in interviews:

We have increased the investment in human resources with an aim to retain digital talents and to optimize the personnel structure to support implementing our digital transformation strategy. We offer regular trainings to employees to improve their digital skills, and promote them learning digital knowledge. (CM1)

China Mobile continues to promote asset restructuring, and shift the focus of investment gradually from communications network deployment to cloud infrastructure construction. The organizational structure is adjusted by measures, such as setting up a department responsible for organizational service market and a subsidiary body that focuses on providing new digital services, to abandon the traditional business model which solely relied on network operation. A flexible organization structure is formed to get rid of traditional business and operation procedure hindering the digital transformation of China Mobile. (CM4)

4.2 Environmental challenges

4.2.1 Technological attraction

As discussed, technological attraction affects an organization's digital transformation. In the 5G era, we found evidence that showed technological attraction strongly impacted China Mobile's digital transformation. 5G infrastructure transformed the Internet market from consumers to industry. 5G system supports emerging digital ICTs such cloud computing, artificial intelligence, big data, edge computing, blockchain, and the Internet of things, which enabled the provision of a broad range of digital services that suit the requirements of not only individual users for traditional communications services, but also organizations for information services.

China Mobile owns a 5G network that leads the world in technology and scale. Its 5G system had strong technological attraction both horizontally and vertically for China Mobile to carry out digital transformation. Specifically, as for horizontal technological distance, the fact that organizations and individuals across the world used 5G

technology pushed China Mobile to adopt it. As for vertical technological distance, 5G system enabled a broader range of services for individuals, industry, and society than previous system generations. A marketing manager of China Mobile said:

5G system could offer many digital services for individuals and different of organizations based on integration of artificial intelligence, cloud computing, industrial Internet and other emerging digital technologies. China Mobile's 5G network constantly upgrades and innovates, keeps enabling the provision of new services, supporting new business models, and serving the development of the digital economy. (CM2)

4.2.2 Institutional pressures

Coercive pressures: top national authorities such as the Central Committee of Communist Party of China (CPC), the State Council, and National People's Congress (NPC) attached great importance to the digital economy, and set promoting digital development as a part of national development strategy. Other national authorities overseeing ICT industry and development, such as the Ministry of Industry and Information Technology (MIIT), followed and enacted decrees to support digital transformation in China. For example, in 2015, the State Council declared a decree on "raising internet speed and lowering tariffs". China Mobile actively responded to this requirement and engaged in transforming its digital infrastructure and services. In recent years, as digital ICT innovations appeared quickly and the digital economy started to take shape, the government took even stronger policy measures to support SOEs as national economy backbone to carry out digital transformation. As an illustration, Table 4 summarizes important policies that Chinese governmental organizations have promulgated since 2020. For example, both "The 14th Five-Year Plan for National Economic and Social Development" and "The Outline of Long-term Goals for 2035" that the NPC issued in 2021 declared to support digital economy; in August 2020, the SASAC issued the "Notice of Accelerating SOEs' Digital Transformation", which local governments endorsed. Under coercive pressures, China Mobile pushed hard on digital transformation. One manager of China Mobile said:

As a SOE, China Mobile solidly fulfils its political responsibilities, supports the national digital transformation strategy, and helps the construction of

digital China. On the other hand, the national policies and regulations on ICT industry offer a supportive environment for China Mobile's initiative of digital transformation. (CM1)

(Table 4 here)

Normative pressures: before the 3G era in particular, mobile telecommunications operators relied on new subscribers to traditional communications services such as voice service, SMS, and MMS to achieve growth in their revenue and profit. In recent years since the 4G and the 5G mobile systems were launched, in general in China's mobile telecommunications market mobile user number and the network penetration rate increased to the saturated level. The traditional communications service market started to shrink, but the market saw increasing demand for information services. Accordingly, the government had new expectations and applied new regulative pressures on China's telecommunications industry to fulfill them. Against this background, China Mobile transformed its focus from providing traditional customer services to providing information services. Two managers at China Mobile added:

China Mobile invested hugely in indigenous mobile systems which were treated as an iconic achievement of the country's independent innovation capability. In developing and deploying the Chinese versions of 3G, 4G, and 5G mobile communications standards, China Mobile has also gained global influence and recognition. China won the reputation of a leader in global mobile communications. (CM3)

A better digital life has become the universal demand, which puts forward higher requirements from the market, and expectations from the government for telecommunication operators to provide useful but affordable digital services. Meanwhile, China Mobile as an owner of national mobile infrastructure and communications and information service providers is expected by the society and government to enable transformation of other traditional industries, which requires China Mobile first realizing its own digital transformation. (CM1)

Mimetic pressures: China Mobile has two main competitors in the Chinese communication market: China Unicom and China Telecom (Gao *et al.*, 2021). From the 3G era, in network coverage and services, the market exhibited high homogeneity, i.e. competition in similar services based on prices increasingly intensified. Internet organizations, equipment manufacturers, and terminal manufacturers fiercely competed with one another to strengthen their position, gain competitiveness in the industrial value chain, build platform advantages, and lead the industrial ecology. Being in a disadvantaged position to China Mobile in the 3G and the 4G eras, China Unicom and China Telecom expected to catch up with China Mobile. In order to win the competition in the 5G era, China Mobile actively engaged in digital transformation.

5 Case 2: China Unicom's Digital transformation

5.1 Digital transformation implementation

Similar as China Mobile, China Unicom's digital transformation also moved in three stages. In each stage, China Unicom adopted specific mobile and digital technologies with specific business model. An important event in the process of its digital transformation is the reform of mixed ownership at the group level of China Unicom. China Unicom initiated the reform in 2017 by introducing 14 strategic investors including internet companies such as Baidu, Tencent, Alibaba, and JD. As a result, China Unicom's shareholding ratio decreased from 62.7% to 36.7%. By closely aligning with its own resource endowments, China Unicom with its strategic partners highly enhanced its ability to innovate and transform.

5.1.1 Adoption of digital technologies

By establishing multiple strategic cooperation centers and joint laboratories with its mixed ownership partners, China Unicom has explored the business application scenarios of 5G technology in varied fields. By leveraging the advantages of its mixed ownership partners, China Unicom has created differentiated technological competitive advantages. For the past three years, the core technologies that China Unicom has focused on include the 5G technology, cloud computing technology, big data technology and artificial intelligence technology. Through the integration of digital technologies, China Unicom has nurtured a number of digital applications in industries

such as industrial internet, vertical industries and government affairs. One manager of China Unicom said:

The company recognizes that enhancing the independent innovation ability of digital technologies and maintaining the advanced nature of information services are crucial for enhancing the competitiveness of operators. (CU2)

5.1.2 Strategic positioning and value proposition

Similarly, service innovation also characterized China Unicom's digital transformation. The company also started its digital transformation since the 3G era. At that time, it explored broader market segments as competed fiercely with other operators like China Mobile and China Telecom. During the technological evolution process from 3G to 5G, the strategic position and value proposition in domestic telecommunication operators are quite similar. For example, in the area of consumer internet, China Unicom also innovated 5G products from multiple levels such as content, applications, platforms, and terminals to provide customers with more disruptive and diversified information consumption experiences. Moreover, China Unicom attaches greater importance to the rapidly growing opportunities brought about by the industrial internet, and launches a wide range of independent innovative products and services for cloud computing, big data, the Internet of Things, digital empowerment, and other business areas. One manager of China Unicom said:

The "Unicom Chain" has been connected to the national blockchain facility "Spark Net", which is also a recognition of our product quality and innovation capabilities. (CU6)

During the accelerated phase of digital transformation, China Unicom shifted its operational focus from serving the consumer internet (for individual and household users) to serving the industrial internet (for government and enterprise clients). With an advanced digital service as its value proposition, it shifted from market competition in the stock market to expanding into the digital increment market. Leaving behind traditional communication services, China Unicom has transitioned towards providing higher-value information services. It has constructed a diversified digital business model, based on the foundation of digital infrastructure and supported by digital

platforms, which provides intelligent applications and capability services to external stakeholders.

5.1.3 Value creation and delivery: organizational structure and asset management

Different with China Mobile, the central policy of the 2015 Guiding Opinions on Deepening the Reform of State-Owned Enterprises directly promoted the mixed ownership reform of China Unicom, facilitating the change in the equity and governance structure at the group level, resulting in a significant asset restructuring and organizational adjustment. China Unicom introduced senior managers from strategic investment enterprises to its board of directors, allowing strategic investors to participate in management through various channels. The management philosophy and organizational culture of internet companies began to influence China Unicom's investment direction and decision-making management model, breaking down the inherent rigidities in resources and processes and injecting new vitality into the transformation and development of the enterprise. One manager of China Unicom said:

Optimizing the structure and quantity of management departments at the company headquarters and significantly streamlining provincial company institutions, which is conducive to shortening the decision-making chain, better adapting to digital consumption, and improving transformation efficiency. (CU3)

After the reform, China Unicom has established several joint ventures with industry partners in the field of digital services to deepen capital cooperation and further restructure digital assets with traditional assets. The specific details of these joint ventures are summarized in Table 5. For example, since 2019, China Unicom and China Telecom have taken the lead in implementing 5G network co-construction and sharing, achieving significant innovations in technology, operation, and management. By the end of 2022, the two companies jointly invested in building the world's first and largest 5G shared network, achieving intensive development with higher network performance and lower energy consumption.

(Table 5 here)

Furthermore, China Unicom has supported the effective transformation of the company through digital adjustments to its organizational structure. It has flattened and matrixed the organizational structure, like in 2021, China Unicom integrated its original digital business sectors into Unicom Digital Technology Co., Ltd. as an independent organization to promote digital transformation. One manager of China Unicom said:

At the beginning of the mixed ownership reform, the company deeply realized that digital transformation was the basis for deepening cooperation with strategic investment from the internet, which also facilitated improving internal operational efficiency and external empowerment. (CU7)

5.2 Environmental challenges

5.2.1 Technological attraction

Under the rapid development of the digital economy and the drastic changes in the external environment, the technological attraction and institutional pressures generated gradually led to China Unicom's perception of the enormous value hidden behind digital technology. China Unicom has repositioned itself as a science and technology innovation company that provides digital services, focusing on innovative cooperation strategies, and initiated a new process of comprehensive digital transformation through a series of transformation and development initiatives, shifting from traditional business competition to digital value creation.

Different with the case of China Mobile, China Unicom's mixed ownership reform introduces Tencent, Baidu, Alibaba, and JD.com as investors with strategic synergies, resulting in greater technical attractions. These famous Internet companies have technological advantages in different emerging digital technologies, such as Alibaba's strong technical strength in cloud computing and blockchain, which ranks first in global market revenue in cloud computing; Baidu, as the leader in China's artificial intelligence field, leads in patent applications in dialogue-based AI operating systems, autonomous driving, deep learning, etc. The technology fields and technological advantages deeply cultivated by the shareholders of the mixed ownership reform also indirectly shortened the horizontal technical distance between China Unicom and various digital technologies, therefore generating strong technical attractions for China Unicom's digital transformation.

5.2.2 Institutional pressures

China Unicom shares similar coercive pressures as China Mobile. However, in terms of normative pressures, China Unicom is the only SOE among the first batch of mixed ownership reform pilots in China to carry out comprehensive mixed reform at the entire group level. Therefore, the leading departments and the society pay more attention to its transformation and development performance after the reform. One manager of China Unicom said:

Digital transformation cannot only change others but not oneself, it must start from within and undergo self-revolution. It should begin with oneself and start from the corporate headquarters. (CU1)

In terms of mimetic pressures, competition among operators is fierce. Compared to China Mobile, China Unicom has long been at a disadvantage position in the 4G and 5G period. In the face of new opportunities in the digital service industry, China Unicom also faces challenges from Internet companies, cloud service providers, and industry system integrators. Therefore, China Unicom needs to draw close to the advantages of strategic investors such as Baidu and Alibaba, cooperate in cloud computing, big data, and artificial intelligence, and combine its own technology, brand, and customer advantages with the technological advantages of Internet companies to create differentiated competitive advantages.

6 Discussion

6.1 Characteristics of SOEs' digital transformation in China

Comparative case analysis of China Mobile and China Unicom's digital transformation demonstrated some characteristics. In the 3G era, China Mobile and China Unicom's digital transformation had only just begun and remained in an embryonic stage. They lacked a clear vision on digital transformation, and the development strategy did not include digital transformation. They started to innovate on its products and business, but did not carry out overall transformation in major aspects of the business and operation. In the 4G era, two enterprises' digital transformation entered the exploration stage when they had clear plan to pursue the transformation but still did not form a major part of the overall organizational strategy. China Mobile and China Unicom

increasingly used emerging digital technologies to transform their business. New business digital services emerged, but traditional business field still dominate the operation. In the 5G era, China Mobile's digital transformation accelerated. China Mobile pursued digital transformation in all aspects of business model covering strategic positioning, value proposition i.e. service innovation, and value creation logic i.e. organizational structure change and asset reconfiguration. However, different from other operators, China Unicom had completed its own reform of mixed ownership during the transitional stage of 4G and 5G, thus showed greater initiative and higher efficiency in the process of comprehensive digital transformation.

Digital transformation took place in a specific environment. National policies from relevant authorities and technological attraction from innovating mobile systems and emerging ICTs shaped China Mobile and China Unicom's digital transformation strategy. In the 3G era when both enterprises started digital transformation, ICTs at that time allowed mobile phone users to surf the Internet, browse webpages, and enjoy multimedia applications. China Mobile prioritized maintaining the dominant position in mobile market and constructing its communications network. It positioned itself as a network operator and communications service provider. It focused on traditional communications services but started to offer value-added services based on Internet traffic management. Nevertheless, national authorities that oversaw the national ICT industry such as NDRC and MIIT did not include SOEs' digital transformation and the digital economy as a part of China's national development strategy. As such, even though China Mobile had both technology and market advantages, it lagged behind private enterprises that faced less institutional pressures and could exploit useful technology innovations to innovate their business and operation.

In the 4G era, ICTs innovations appeared rapidly and enabled higher network transmission capacity and various digital services. Both China Mobile and China Unicom's revenue from traditional voice and SMS services declined significantly. Against the external environment that contained increasing institutional pressure and increasing digital technology attraction, two operators' digital transformation entered an exploration stage in which they provided a broad range of digital services but still had not adopted digital transformation as its main business and operational direction. They focused on deploying digital infrastructure and building a centralized big data

platform to promote digital assets and basic network resources. At this stage, operators made profit from both communications services and digital content products. Later, in the 5G era, China Mobile and China Unicom accelerated their digital transformation all-round on organizational structure and services. At that point, two operators adopted fully digitally oriented business models. The digital strategy changes of China Mobile and China Unicom from 2G to 5G are summarized in Table 6.

(Table 6 here)

Therefore, by comparing the performance of the two state-owned enterprise operators in the embryonic, exploratory and accelerated periods of digital strategic transformation, the relevant characteristics of the comprehensive digital strategic transformation of state-owned enterprises in China can be summarized. For state-owned enterprises in China, the impact of institutional pressure is much more greater than that of technological attraction, and the compulsory pressure and normative pressure in institutional pressure, such as the policy guidance from higher authorities, the formulation of assessment indicators and personnel scheduling, are particularly important. Furthermore, many state-owned enterprises are large-scale heavy assets enterprises, which are prone to fall into the framework bias derived from the established assets and the reinvestment incentives of incumbents, resulting in resource rigidity, weakening the willingness of enterprises to invest in digital technology and new products, and reducing the internal power of enterprises to carry out digital transformation. Long-term historical accumulation and deep-rooted ideas tend to make state-owned enterprises form procedural rigidity in the process of development, which makes it difficult for enterprises to change the existing business model and organizational process of production and operation, and hinders the realization of digital strategic transformation. Therefore, technologies adoption and strategic position of digital transformation within China's state-owned enterprises needs to be driven by external institutional pressure, the pulling power from market itself is not sufficient.

6.2 Key factors impacting digital transformation in China's SOEs

We found evidence to support our proposed framework (Figure 1) in analyzing both cases. Specifically, we found that institutional pressure, technological attraction and organizational inertia influenced the organization to carry out digital transformation.

Moreover, the results of comparative case analysis are sorted out through two frameworks (see figure 2 and figure 3), which not only clearly shows the similarities and differences between China Mobile and China Unicom in the process of digital transformation, but also enables us to clarify the mechanism of how different impact factors shape the enterprises with different characteristics.

(Figure 2 here)

In China, authorities supported the digital economy. As the leading SOEs in ICT industry in the country, China Mobile and China Unicom faced substantial institutional pressure to explore and accelerate their digital transformation. Institutional pressure from both the national and local levels promoted two enterprises' digital transformation. In addition, the technological attraction measured by the technological distance to the operators' technological base was appealing for them to carry out digital transformation. Emerging digital technologies provided an opportunity to explore and accelerate digital transformation. Meanwhile, market competition based on technologies become more and more fierce, which pulled SOEs to take advantage of digital technologies to transform their business model in order to offer market-demanded services and survive in the market (Gao *et al.*, 2021).

Inside SOEs (typically big and old companies), organizational inertia arising from resource rigidity and procedural rigidity hinders their digital transformation. According to the organizational behavior and management literature, organizations tend to adhere to the incumbent procedures and the organizational processes, which would produce procedural rigidity. Organizations tend to depend on established assets and incumbent incentive to reinvest, which produces resource rigidity (Feldman and Pentland, 2003; Gilbert, 2005). Due to organizational inertia, an organization's digital transformation has path dependence on the incumbent one (Bohnsack, et al., 2021). External resource providers can influence the choices on the transformation path that organizations make (Bouwman *et al.*, 2019; Miller and Friesen, 1980). In order to reduce organizational inertia in digital transformation, in the 5G era, China Mobile implemented digital transformation into its organizational development strategy, and could break resource rigidity constraints. The company improved its network and digital assets, adjusted its organizational structure, and guaranteed talent support for its digital transformation.

Through integrating digital technology applications, China Mobile strengthened its product and service innovation to meet different market segments' diversified demands for information to consume. Thus, it changed from a communications service provider and network operator with a traditional business model to an information service provider with a digital business model that relied on emerging ICTs such as big data, the Internet of things and cloud computing.

(Figure 3 here)

In contrast, although China Unicom shows similar characteristics in its strategic transformation, its transformation path and mechanism show obvious differences (see Figure 3). The institutional pressure is the core driving force of organizational transformation, and the pulling effect of technology attraction on the start of organizational transformation of China Unicom lags behind the institutional pressure. China Unicom was the first to try the reform of mixed ownership, and contributed to the reform of ownership structure and governance structure at the group level, thus realizing a major asset restructuring and organizational restructuring. Unicom has introduced senior managers of strategic investment enterprises into its board of directors, and strategic investors can also participate in management through various channels, and has established many joint ventures in related fields. The core external impact of the mixed ownership reform of state-owned enterprises mainly comes from the regulatory pressure in the institutional pressure, that is, the policy formulation of the higher authorities such as the Development and Reform Commission and the Ministry of Industry and Information Technology.

In addition, in the case of China Mobile, the process of digital transformation first started from technologies adoption and strategic positioning, and the organizational inertia caused by internal resource rigidity and procedural rigidity hinders the organization's opportunity identification, value creation and value proposition. In the case of China Unicom, the obvious difference is that because the reform of mixed ownership is completed before the formulation of digital strategy, the process of digital transformation started from the change of value creation. The difference in this order has produced at least three favorable changes in strategic transformation: first, the "mixed capital" and "reform mechanism" carried out in the reform of mixed ownership

have rapidly promoted organizational change, which is conducive to the smooth formation of organizational structure and organizational culture to promote strategic transformation; In addition, the obvious obstacles to change in state-owned enterprises, such as resource rigidity and procedural rigidity, have been successfully broken by the reform of mixed ownership; Finally, after the reform of mixed ownership, China Unicom's "mixed capital" and "reform mechanism" make the relationship between enterprises and the market closer, and the organization's perception of opportunities in the subsequent transformation process is more spontaneous, active and sustained.

In analyzing China Mobile and China Unicom's digital transformation processes, we extend our proposed framework and answer proposed research questions by developing the following prescriptions on the factors and their impact on digital transformation in China's SOEs:

Prescription 1: *Innovation in digital technology by generations is fundamental for SOEs' digital transformation on strategic positioning and business model by stages.*

Prescription 2: *Institutional pressure, specifically coercive pressure such as policies and regulations and normative pressure such as social responsibility, plays a significant role in promoting SOEs' digital transformation. Through organizational structure reform and asset reorganization, the hindrance of organizational inertia to transformation can be effectively reduced.*

Prescription 3: *Technological attraction has a driving effect on an SOE's digital transformation. The less closely emerging digital technologies match a SOE's business and technological field, the more support to the SOE's digital transformation from the government is needed.*

6.3 Theoretical contributions

This research both contributes to digital transformation literature and theories. In terms of literature contribution, in this study we advance knowledge on the phenomenon by conducting a comparative case study between China Mobile and China Unicom to advance the understanding on digital transformation's process and impact factors in

China's SOEs, which contributes to current digital transformation research by extending the research context to China's SOEs and building an operational conceptual frame to uncover digital transformation mechanisms.

In addition, and more importantly, this research has contributions to advance the institutional theory from three aspects: Firstly, in this study, by constructing an operational analytical framework, the long-standing criticism of institutional theory, which has a high explanatory power but lacks specific tools for analyzing problems, is addressed. Based on institutional theory, the conceptual framework we have developed not only has the ability to explain mechanisms, but also can delve into the actual analysis of organizations involved, their interactions, and the impacts they produce. Different with traditional institutional theory adoptions, the organizations that analyzed are no-longer "black-box" under the institutional perspective.

Secondly, in general, institutional theory is good at explaining how institutional pressure shapes the external environment to achieve influence on organizations. However, in the phenomenon of China Mobile and China Unicom exhibited that, under the same institutional environment but had different organizational behaviors and generated different transformation paths and performance during digital transformation process. This phenomenon cannot be fully explained by traditional institutional theory alone. At the same time, China Mobile and China Unicom, which have high technological attractiveness, did not start digital transformation early due to their close technological distance, but lagged behind other companies in the market. This phenomenon also cannot be fully explained by technological distance theory alone.

Through comparative case analysis, we found that the key issue lies in the state-owned nature of these two organizations. This special characteristic leads to excessive organizational inertia, resulting in the observed unique phenomenon. In addition, by comparing the differences between the two cases, it can be found that the relatively smooth digital transformation of China Unicom is due to the different leadership personal preferences caused by shareholding reform, while the acceleration of digital transformation of China Mobile in the later stage is also because of the direct personnel assessment pressure faced by its leaders from the Organization Department.

Therefore, we found that institutional pressure in institutional theory can not only manifest as traditional external pressure in the special situation of state-owned enterprises, but can also directly act on key individuals within organizations. This influence mechanism, usually combined with external institutional pressure on organizations, can play a significant role. To sum up, constructing a multi-theoretical framework together with technological distance theory can help expand the explanatory power of institutional theory. Applying institutional pressure on key individuals in organizations helps expand the scope of action of traditional institutional theory. This is an important theoretical contribution of this research.

6.4 Practical implications

The research findings offer valuable insights for enterprises especially Chinese SOEs to implement digital transformation. To carry out digital transformation, an organization needs to overcome organizational inertia that arises from procedural rigidity and resource rigidity. Reliance on established assets and incumbents' routines and conventions are important reasons for organizational inertia to hinder organizational changes like digital transformation (Feldman and Pentland, 2003). SOEs are normally big in size, for example China Mobile owned the largest communications network in the country. Due to their complex organizational structure and huge established assets, SOEs need to overcome greater organizational inertia than other organizational types (e.g., SMEs and private enterprises) when attempting to use emerging ICTs to change existing business model and production and management processes. The basic logic in organizational routes permeates deeply through organizational cognition and forms cognitive limitations (Tripsas and Gavetti, 2000). Facing technological innovations, organizations sometimes may cater to their resource providers' requirements and preferences in allocating resources (Bouwman et al., 2019; Gilbert, 2005). For SOEs, the government obviously represents an important resource provider. As such, governments should form a supportive environment for SOEs to carry out digital transformation. It should take policy measures to provide guidance for SOEs to do so and to reduce the impact that organizational inertia has on impeding SOEs from transforming resource rigidity. Inside a SOE, its digital transformation needs strong leadership since, without the strategic positioning on digital transformation that senior staff provides, an SOE cannot break through organizational inertia and promote

towards digital business models. SOEs also need strong institutional support to overcome organizational inertia when carrying out digital transformation.

Both technological attraction theory and innovation literature argue that organizations tend to narrowly search for technologies and markets and to limit their investments to innovations close to their existing asset base while ignoring other high-potential innovations (Campbell *et al.*, 2013; Teece, 2007). In order to maintain their market power, incumbent organizations usually invest heavily in the deterministic technology that could help them gain the dominant position in their market while constraining resource input to uncertain emerging technologies (Gilbert and Newbery, 1982). The case enterprise China Mobile is an ICT enterprise, which does not repel to emerging ICTs and is prepared to face challenges for change from technological innovation. For other types of enterprises, technological attraction is appealing for them to initiate digital transformation. The government should take specific measures to support these types of SOEs to adopt digital technologies and implement digital transformation.

Organizations need to transform its conventional capabilities and continuously integrate, restructure, update, and recreate its resources and capabilities, especially its core capabilities, to adapt to environmental changes especially ICT innovation (Wang and Ahmed, 2007; Teece, 2007). By doing so, when faced with external pressures, they can cope with innovation activities (Liao *et al.*, 2009), such as selecting a digital transformation strategy (Yeow *et al.*, 2018) and adaptively innovating on enterprise business model (Ricciardi *et al.*, 2016). The government should support SOEs to develop digital transformation capabilities.

6.5 Limitations and further research

Our work has several limitations but opens opportunities for future research. We can identify several opportunities for researchers to expand on our work on enterprise digital transformation. First, since in general SOEs in different industries differ in some aspects and may have different paths in digital transformation, researchers could explore digital transformation of SOEs in other industries to verify our research findings from China Mobile and China Unicom. Second, we focus on SOEs subjecting to heavy institutional pressures. The case enterprises locate in ICT industry. Technological attraction is appealing to China Mobile and China Unicom, and

encourages companies to carry out digital transformation. Such SOEs also have high perceptive capability to the business opportunity raised by emerging ICTs. Future research could expand other types of organizations than ICT companies, including other types of SOEs, to test and improve our developed framework and our theoretical prescriptions. In addition, scholars could use quantitative methods to analyze factors and impacts as our framework (Figure 1) on SOEs' digital transformation describes. Researchers could expand our developed framework to include internal factors and address questions such as how organizations can build dynamic capability under dynamic external environment, to break resource rigidity and routine dependence to pursue digital transformation.

7 Conclusions

This comparative case analysis advances our knowledge on digital transformation of China's SOEs. We found that institutional pressures, specifically coercive pressure such as policies and regulations and normative pressure such as social responsibility, shaped China Mobile and China Unicom's digital transformation path. Moreover, we found that technological attraction had a driving effect on their digital transformation. We call on governments to provide a supportive institutional environment for enterprise digital transformation. Especially the government should take special measures to support companies not in the ICT industry, which normally do not have a strong ICT base and are not familiar with ICT innovation.

This paper develops a conceptual framework for analyzing enterprise digital transformation, and generates some theoretical prescriptions. We conclude that, based on innovation in digital technology by generations, enterprise digital transformation on strategic positioning, value proposition (services and products), and value creation (assets and organizational structure) presents a process by stages; institutional pressures, technological attraction and organizational inertia together impact how SOEs carry out digital transformation. Future research could use our framework as an analytical tool and draw upon our theoretical prescriptions to examine digital transformation in different kinds of organizations, particularly organizations under close government control and sensitive to institutional pressures.

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Table 1. Interviews

Organization	Interviewee	Interview duration	Code
China Mobile Headquarter	Deputy general manager of development strategy department	About 80 minutes	CM1
	Deputy general manager of marketing department	About 60 minutes	CM2
	Director of technology department	About 60 minutes	CM3
China Mobile Cloud Capability Center	General manager of product department	About 50 minutes	CM4
	Deputy general manager of planning and construction department	About 50 minutes	CM5
China Mobile Internet of Things	Deputy general manager	About 60 minutes	CM6
	Deputy general manager of development strategy department	About 50 minutes	CM7
China Mobile Design Institute Zhejiang Branch	General manager	About 60 minutes	CM8
China Mobile Digital Intelligence Technology	Deputy general manager	About 80 minutes	CM9
	Consulting director	About 50 minutes	CM10
China Unicom Ltd.	Senior Manager, Corporate Development	About 90 minutes	CU1
	Senior Manager, Science and Technology Innovation	About 90 minutes	CU2
	Senior Manager, Digital Department	About 90 minutes	CU3
	Director, Marketing Department	About 60 minutes	CU4
China Unicom Digital Technology Co., Ltd.	Director, Cloud Computing Business Department	About 60 minutes	CU5
	Director, Data Intelligence Business Department	About 60 minutes	CU6
China Unicom Research Institute	Director, Research Department	About 60 minutes	CU7
	Researcher A, Research Department	About 60 minutes	CU8
	Researcher B, Research Department	About 60 minutes	CU9
MIIT	Officers in Bureau of Telecommunications	About 60 minutes	G1, G2
SASAC	Officers in Bureau of Scientific and Technological Innovation	About 60 minutes	G3, G4
China Academy of Sciences	Scholars in telecommunications field	About 90 minutes	R1, R2, R3
Datang Telecommunications Group	Deputy general manager of development strategy department and market department	About 50 minutes	S1, S2
Huawei Technologies Co., Ltd	Deputy general manager of development strategy department	About 90 minutes	S3

Table 2. Encoding structure and semantic entries

Principal Categories	Sub categories	Typical quotations and evidence	Keywords	Coding Results
External Environment	Technological Attraction	"5G technology is in the accelerated maturity stage, moving towards large-scale application." (CM3)	Technology Matured	Vertical Technological Attraction
		"5G has strong permeability and significant driving effects. Through integration and innovation with new information and communication technologies such as artificial intelligence, the Internet of Things, cloud computing, big data, edge computing, etc., it will trigger chain reactions and produce multiplier effects." (CU3)	Converging Technology Innovation	Horizontal Technological Attraction
External Environment	Institutional Pressure	"Users now place more emphasis on the quality of information consumption, with diversified needs. On one hand, we need to lower the barriers to information services, while on the other hand, we need to enrich new products and formats to meet new consumption needs." (CM2)	Customer Demand	Coercive Institutional Pressure
		"Internet companies, professional cloud service providers, and some industry system integrators are all joining the market competition of digital service industry. In addition to strengthening our own innovation capabilities, we also need to form a competitive advantage through innovative cooperation." (CU3)	Market Competition	Mimetic Institutional Pressure
		"We will firmly implement major national strategies, play the role of the main force of network power, digital China, and smart society... effectively supporting and promoting the digital transformation of the economy and society." (CM4)	National Strategy	Normative Institutional Pressure
Enterprise Digital Transformation	Strategic Positioning	"In the era of 5G, only by relying on the leading role of new information and communication technologies, continuously enhancing our core capabilities, accelerating digital transformation, and improving total factor productivity can we gain the initiative and advantages in future business competition." (CM1)	Develop Opportunity	Opportunity Recognition
		"The traditional business market of domestic telecommunications industry is gradually becoming saturated, and homogeneous competition is becoming increasingly fierce. The growth of operators'	Traditional Operational Elements	Resource Rigidity

	revenue is affected by factors such as the rapid release of traffic dividends and mismatch between volume and revenue growth..." (CU5)		
	In the past, we mainly operated based on voice and then shifted to traffic-based operation. Profits heavily rely on the growth of users. (CM1)	Traditional Operation Strategies	Program Rigidity
Value Creation	"The Group attaches great importance to the development of network cloudification, investing heavily in cloud infrastructure and data center construction." (CU5)	Resource Distribution	Assets Reorganization
	"In 2021, the Group established China Mobile Digital Technology Co., Ltd. Main function is to provide digital transformation services to the Group internally, while also providing digital consulting products and services externally to empower other industries to transform." (CM10)	New Business Units	Organizational Restructuring
Technologies Adoption	"The company is accelerating the promotion of technological integration and innovation between 5G and artificial intelligence, the Internet of Things, cloud computing, big data, edge computing, etc., leading and meeting customer needs, and continuously catalyzing the 'chemical reaction' between information technology and the real economy and the virtual economy." (CM8)	Information Technology	Adopt Digital Technologies
Value Proposition	On the basis of current business, the company actively explores new blue ocean of digital economy, continuously introduces personal digital content and applications such as ultra-high definition video, video ring back tone, mobile certification, rights supermarket, expands diversified smart home operation services such as entertainment, education, pension, security and so on, leads the implementation of DICT solutions demonstration projects for industry, transportation, medical care and other industries. (CM6)	Digitalized Business Process	Provide Digital Products and Services
	In 2020, we took the lead in proposing the BAF business model for the government and enterprise market, successfully realized the productization of 5G private network, and landed nearly 500 private network projects that year. (CM2)	Business Model Innovation	Build Digitalized Business Model

Table 3. Core components of China Mobile’s 5G technology system

Technological field	Core technology
5G backbone	<ul style="list-style-type: none"> - TDD (time division duplex) technology - Large scale antenna technology - Standalone network - Private network
Cloud computing	<ul style="list-style-type: none"> - Dayun Tianquan Extra Byte level storage engine technology - Cloud network integration platform - Cloud database
Artificial intelligence	<ul style="list-style-type: none"> - Jiutian artificial intelligence technology and intelligent interaction technology - Jiutian intelligent data analysis and intelligent recommendation technology
Smart family	<ul style="list-style-type: none"> - Ad hoc intelligent connection technology and UHD (ultra high definition) audio and video communications technology - Ad hoc home network security protection technology
Industry platform	<ul style="list-style-type: none"> - Photovoltaic quality inspection based on deep learning algorithm - Traffic MOLAP (multidimensional online analytical processing) technology - Medical artificial intelligence assisted diagnosis technology - Multi-source heterogeneous data integration, fusion and analysis technology - Agricultural machinery working area - Tourism - UAV (unmanned aerial vehicle) based on 5G network - Park scene data aggregation and intelligent analysis and governance technology
Internet of things	<ul style="list-style-type: none"> - Internet of things operating system and chip technology - OneNET integration management and data processing technology
Digital contents	<ul style="list-style-type: none"> - 4K/8K UHD video end-to-end technology - Video ring back tone end-to-end technology - Intelligent video production technology and cloud extended reality technology - Cloud game codec and rendering technology

Table 4. Policies for promoting digital transformation in 5G era

Policy level	Time	Issue authorities	File name	Relevant contents
National	2020.04	NDRC; Central Office of Internet Information Technology	Implementation Plan on using Digital Cloud Intelligence to Cultivate New Economy Development	Foster digital economy, further promote enterprise digital transformation, form a cross-industries digital ecosystem and integrate the industrial chain. Support exploring new generation of digital ICTs and integrating 5G, big data, artificial intelligence, cloud computing, digital twin, Internet of things, and blockchain to develop services and applications.
	2020.07	13 authorities including NDRC, MIIT, Cyberspace Administration of China etc.	Opinions on Supporting the Development of New Economy and New Business Models	Promote the digital transformation in various industries and enterprises, improve platform empowerment level, promote the inclusive cloud digital intelligence service, cultivate a new digital ecology, and improve digital transformation capability and efficiency. Accelerate the digital transformation in traditional enterprises. Help reduce the transformation difficulty.
	2020.08	SASAC	Notice on Accelerating SOEs' Digital Transformation	Promote the digitalization of SOEs, enhance their competitiveness, innovation, and risk resistance, and improve the industrial value chain modernization.
	2021.03	NPC	The 14 th Five-Year Plan for National Economic and Social Development; The Outline of Long-Term Development Goals for 2035	Realize the potential of data elements, promote the use of the Internet, accelerate the construction of digital economy, digital society and digital government, and drive the digital transformation in production mode, life style and governance.
	2021.12	State Council	Notice on Accelerating Digital Economy Development in the 14 th Five-Year Plan	Strengthen the construction of digital infrastructure, improve the digital economic governance system, promote digital industrialization and industrial digitization, accelerate the transformation and upgrading of traditional industries, and cultivate new industries and new business models. Guide enterprises to have digital thinking, improve employees' digital skills and data management capabilities, and promote enterprise digital transformation in R&D, design, production, operation, management, sales services etc.
Local	2021.03	Zhejiang CPC Comprehensive Deepening Reform Commission	Overall Plan for Digital Reform in Zhejiang Province	Focus on digital economy, digital industrialization and industrial digitization, promote the integration and application of public data, production data, scientific and technological innovation data, trade data, service consumption data, supply chain data.
	2021.07	Shanghai Development and Reform Commission	Policies and Measures to Promote Urban Digital Transformation	Stimulate digital transformation in SOEs. Implement the "one enterprise one strategy" policy, and include the digital transformation objectives into the responsibility statement of SOE leaders.
	2021.07	General Office of CPC Beijing Municipal Committee; General Office of Beijing Municipal Government	Implementation Plan on Accelerating the Construction of a Global Digital Economy Benchmark City	Promote the integration of digital ICT innovation chain and industrial value chain, support the digital transformation in traditional enterprises and the development of digital ICT enterprises, and foster different types of benchmark enterprises in their technology innovation, digital empowerment, and platform service and applications.
	2021.07	Guangdong Provincial People's Congress	Regulations on Promoting Digital Economy	Guide enterprises to conduct digital transformation Guide Internet enterprises, industry leading enterprises and traditional telecommunications enterprises to open data resources and platform computing capacity.

Table 5. China Unicom's joint venture in the field of digital services

Year Founded	Company Name	Key Shareholders	Percentage of Shares	Business Direction
2015	Intelligent Footprint Data Technology Co., Ltd.	Unicom Big Data Co., Ltd	41.25%	Professional Big Data Services
		JD Xin Dong Teng Business Service Co., Ltd.	15%	
2018	Yunlu Intelligence Technology Co., Ltd.	Unicom Digital Technology Co., Ltd.	43.22%	Smart City Services
		Alibaba (China) Network Technology Co., Ltd.	28.81%	
2019	Yunke Vision Culture & Travel Technology Co., Ltd.	Unicom Big Data Co., Ltd.	60%	Smart Tourism Services
		Shenzhen Tencent Industry Investment Fund Limited	40%	
2019	Yundi Wisdom Technology Co., Ltd.	Unicom Innovation and Entrepreneurship Investment Co., Ltd.	45%	Industrial Internet Platform
		Shenzhen Cangqiongzhihang Investment Co., Ltd	45%	
2019	Yundun Wisdom Security Technology Co., Ltd.	Unicom Wisdom Security Technology Co., Ltd.	51%	Cybersecurity
		Qi'an Xin Information Technology Co., Ltd.	49%	

Table 6. Digital strategy evolution of China Mobile and China Unicom

Period	Digital Transformation Stage	Strategic Positioning	Customer	Value Proposition	Value Creation
2G	Pre-Transition	Providing good communication services	Mobile market	Mainly based on voice operation. Provide value-added services such as short messages, Color Ring Back Tone, etc.	Charging network connection fees
3G	Emergence	Providing good communication services	Expanding from mobile to home and enterprise customers	Mainly based on voice operation. Provide data traffic as value-added services, provide fixed broadband Internet and mobile office applications.	Mainly charging network connection fees
4G	Exploration	Transition and leapfrog from communication services to digital services	Mobile and home markets, expanding to group customer markets	Shifting from mainly voice operation to mainly traffic operation. Bundling traffic fee with content applications of Internet companies. Providing cloud computing, data centers, etc. for industrial Internet fields.	Charging network connection fees, starting to profit from digital services.
5G	Acceleration	Providing advanced digital services	Personal market, home market, government and enterprise markets, emerging markets all-round development, focusing on the government and enterprise markets	Shifting from mainly traffic operation to digital ecological operation. (1) Providing different speeds of network for individual and household users, with additional value-added content such as ultra-high-definition video, cloud gaming, etc. (2) Providing customized network slices for industry customers, with enhanced functions such as edge computing. (3) Building own ecological platform, providing digital applications or overall digital solutions for subdivisional industries customers.	(1) Merging traffic value with rate value and content value to achieve differentiated traffic fee models. (2) Charging service fees for using and function of network slices. (3) Charging platform service fees and solution service fees.

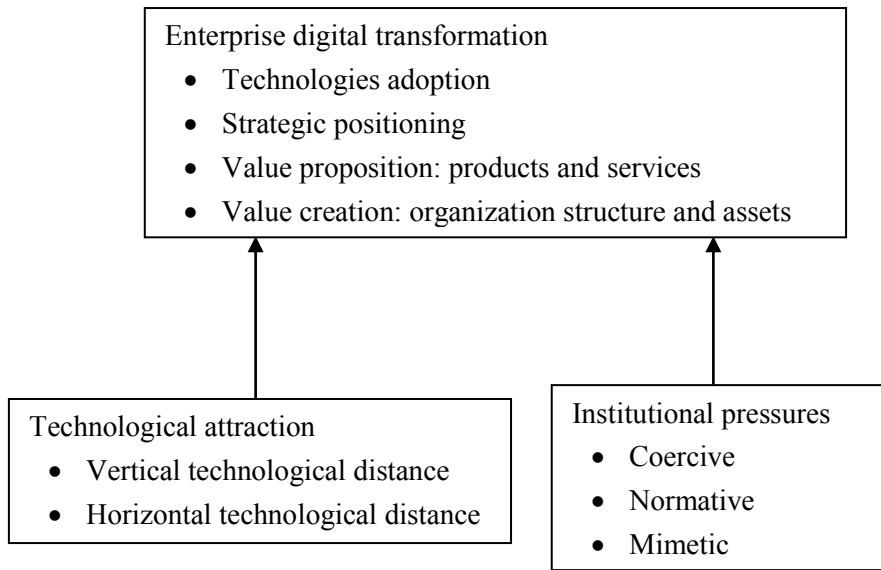


Figure 1. Conceptual framework of enterprise digital transformation

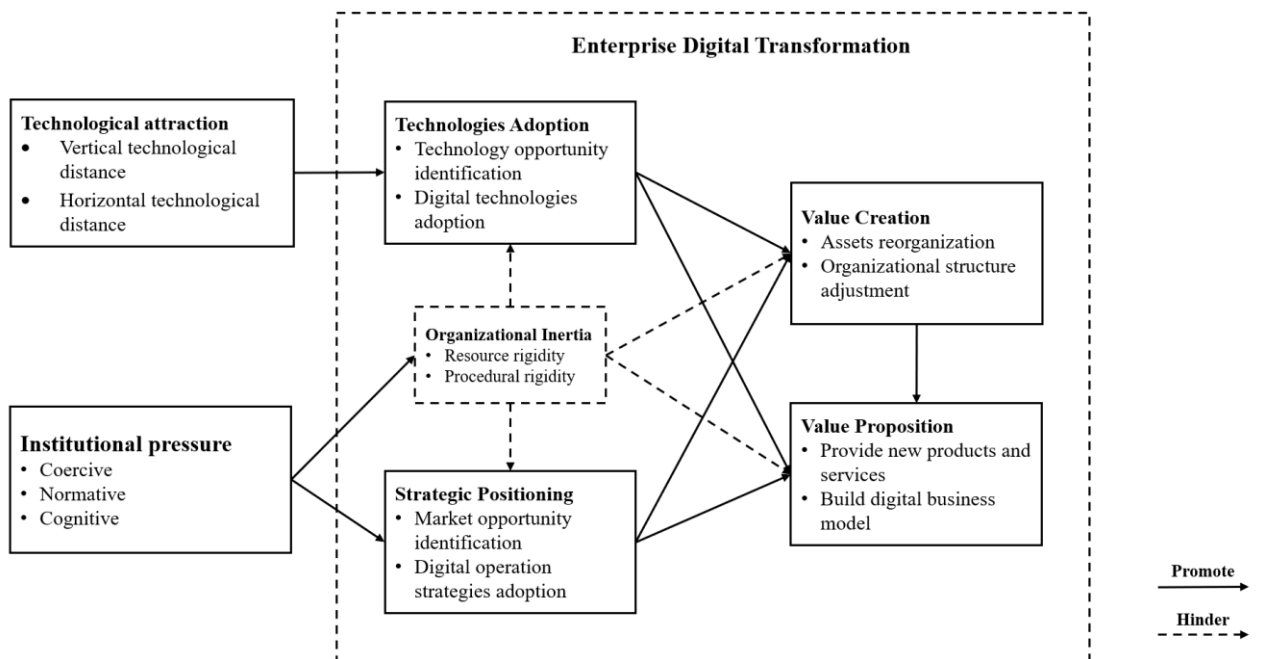


Figure 2. China Mobile's Digital Transformation

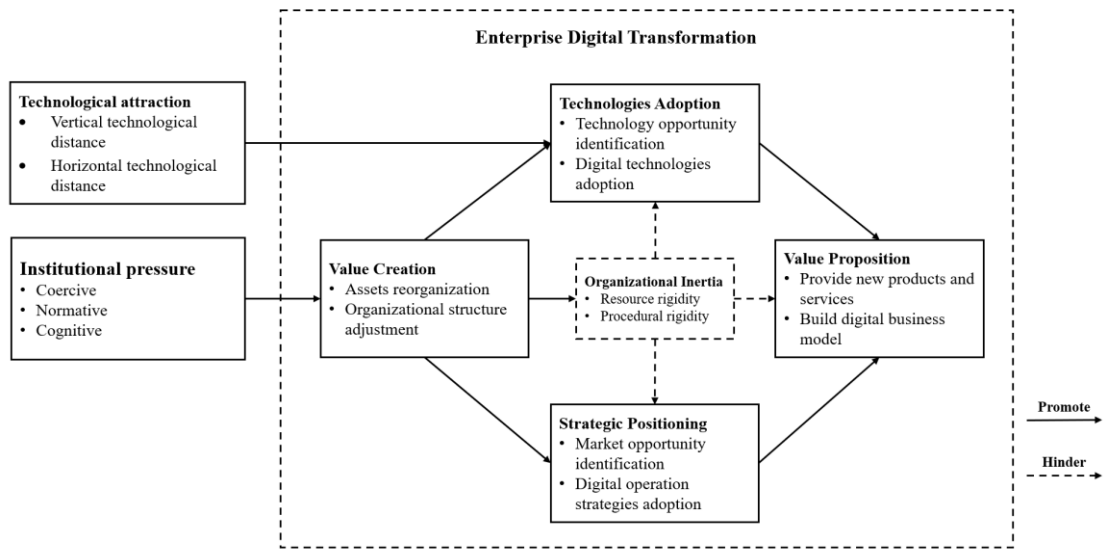


Figure 3. China Unicom's Digital Transformation