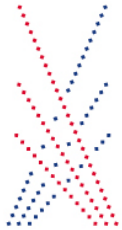

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Developing Innovation Strategies and Capabilities through Institutional Interactions: A Longitudinal Study of China's Telecommunications Industry

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Summary

How do firms develop innovation strategies and capabilities during fundamental institutional transitions? To answer this question, this paper develops a theoretical framework which combines both strategy-based and dynamic capability-based perspectives. A longitudinal multiple case study of China's telecommunications industry was conducted to verify the framework.

This study offers an integrated perspective to investigate the complex and dynamic institutional interactions through which firms develop their own strategies for innovation capabilities. The comparative setting of the study between different company ownership structures – in this case, Stated-Owned Enterprises (SOEs) and private companies – identifies the strategic importance of corporate governance structure and entrepreneurial decisions in shaping innovation strategies and capabilities of firms. The finding of the study also justify that firms' sustained competitive advantage in institutional transitions depends more on what we referred to as the dynamic alignment of their innovation capabilities.

Keywords: Innovation Capabilities, Innovation Strategies, Institutional Transition, Institutional Interactions

Track: Innovation

Word count: 6,992

1. Introduction

During the institutional transitions due to political structural change or major economic reform, a central question is how firms develop innovation strategies and capabilities to adapt to fast changing institutional and market environments (Boisot and Child; 1996; Peng and Heath, 1996; Peng *et al*., 2005; Yiu and Lau, 2008; Zhou and Li, 2010).

Existing studies address this question by focusing on the interaction between firms and dominant institutions, such as government or regulatory authorities. These studies mainly follow two contrasting perspectives. The strategy-based perspective attempts to explain how firms make specific strategic choices for innovation based on their relationships with dominant institutions (Peng and Heath, 1996; Peng *et al*., 2005; Peng and Zhou; 2005). The dynamic capability-based perspective focuses on developing innovation capabilities through the firm-specific use of external resources (Khanna and Palepu, 1997; 2000; Yiu and Lau, 2008).

More recently, there have been calls for an integration of these two theoretical perspectives (Yiu, *et al*., 2007; Yiu and Lau, 2008; Zhou and Li, 2010). The reasoning is twofold. First, dominant institutions greatly shape firms' strategic choices (Peng and Luo; 2000; Child and Tsai, 2005). Second, these strategic choices decide how firms transform the resources obtained from external institutions into internal specific uses (Yiu, *et al*., 2007; Yiu and Lau, 2008). Arguably, the interactions with dominant institutions not only benefit firms with valuable resources, but also constrain the way firms use them via intervening firm's strategic decisions (Xiao, *et al*., 2013). It is thus assumed that a more integrated view may contribute to a comprehensive understanding of the effect of the external institutional interactions on the development of firms' innovation strategies and capabilities.

This study explores such an integration. We firstly develop a theoretical framework to explicate the underlying managerial process through which firms interact with external institutions to develop innovation strategies and capabilities. This framework incorporates two theoretical perspectives. First, drawing on the strategy-based perspective (Peng and Luo; 2000; Peng *et al*., 2005), the framework explains how firms develop either network-centric or market-centric strategies based on their institutional relationship strength. Second, drawing on the dynamic capability-based perspective (Khanna and Palepu, 1997; 2000; Yiu and Lau, 2008; Zhou and Li, 2007; 2010), the framework explains how strategic choices, through interacting with external institutions, determine the way by which external resources are utilized by firms to develop three types of innovation capabilities, namely technology-oriented capability, market-oriented capability and organization-oriented capability. We then perform a longitudinal study of the evolution of China's telecom industry to verify this framework.

The structure of the paper is organized as follows. Section 2 develops the conceptual framework based on a review of extant literature. Section 3 explains the research method adopted in this paper. The longitudinal case study is presented in Section 4, which is followed by a discussion of relevant research findings in Section 5. Section 6 concludes both the contributions and limitations of the study.

2. Literature review and the theoretical framework

2.1 Firms' strategic choices: a strategy-based perspective

Strategic choice is conceptualized as "the process whereby power-holders within organizations decide upon courses of strategic action" (Child, 1997: 45). A firm's strategic choice is greatly determined by its institutional environment (Clark and Mueller, 1996; Beckert, 1999). Especially, in emerging economies where formal market structure and rules have yet to be fully established (Khanna and Palepu, 1997; 2000; Peng, 2000; 2002), the institutional conditions are largely shaped by the legal and administrative power of government and the related regulatory agencies (Boisot and Child, 1996; Peng and Heath, 1996; Hoskisson *et al*., 2000; Bruton and Lau, 2008). As a result, firms tend to make two contrasting strategic choices based on their relationship strength with dominant institutions (Peng and Luo; 2000; Peng, 2003). Firms with strong Business-to-Government (B2G) ties, such as SOEs, may focus on a network-centric strategy (Peng, 2003). On the other hand, firms with weak B2G ties, such as private firms, are more likely to adopt a market-centric strategy (Peng, 2003; Peng *et al*., 2005).

The network-centric strategy emphasizes cultivated trust, extensive social contact and informal agreements between managers and governmental officials (Peng and Heath, 1996; Xin and Pearce, 1996; Guillen, 2000; Peng and Luo; 2000; Peng *et al*., 2005), from which firms can take advantages. For instance, the scarce resources controlled by governments, such as licensing for business entry and financial funding or subsidiaries, can be obtained more easily (Child and Lu, 1996; Peng and Zhou, 2005; Li *et al*., 2012; Zeng and Glaister, 2016). Moreover, the fine-grained information exchange with dominant institutions reduces the regulatory policy uncertainties to firms during the institutional transitions (Peng and Luo; 2000; Doh and Pearce, 2004; Li *et al*., 2012). However, the network-centric strategy also bears constraints. Strong B2G ties often lead to direct governmental intervention in firms' operations (Peng and Luo, 2000; Ahlstrom *et al*., 2000), which restricts firms' independent decision making. In addition, the reliance on the benefits derived from close B2G relationships may prohibit firms from proactively identifying and adapting to new market opportunities (Peng and Zhou, 2005; Li *et al*., 2012).

The market-centric strategy concentrates more on the development of market-based resources and capabilities of the firm (Peng, 2003). Especially when firms lack direct financial and policy support from the government, they tend to adopt the market-centric strategy (Peng, 2003; Peng and Zhou, 2005). This strategy drives firms to quickly respond to market signals and explore new business opportunities (Rowley *et al*., 2000). Moreover, weak B2G ties means less administrative intervention in firms' independent entrepreneurial decisions. Firms can thus more effectively utilize the market-centric strategy to abandon old procedures, reconstruct existing organizational routines and develop new market-based capabilities (Peng, 2003; Luo *et al*., 2005; Xiao *et al*., 2013).

2.2 Firm's innovation capabilities: a dynamic capability-based perspective

Dynamic capabilities refer to firms' ability to sense opportunities and threats in changing circumstances, and maintain competitiveness through product and process innovations (Teece and Pisano, 1994; Teece *et al*., 1997; Teece, 2007). Facing the

rapidly evolving institutional and market conditions, firms should develop dynamic capabilities to survive the competition (Malik and Kotabe, 2009; Zhou and Li, 2010). The proponents of this dynamic capability-based perspective explore various capabilities that can facilitate domestic firms to innovate and adapt to the environmental changes during the institutional transition. For example, Malik and Kotabe (2009) argue that firms in emerging economies need dynamic capabilities to proactively update their technology base. Zhou and Li (2007; 2010) further suggest that firms should deploy dynamic capabilities for not only technology-oriented innovation, but also customer-oriented, competitor-oriented and entrepreneurship-oriented innovations. In a similar vein, Yiu and Lau (2008) argue that the dynamic capabilities possessed by firms can be utilized in their internal configuration processes for both product and organizational innovations. The findings of these studies can be further elaborated into three main types of innovation capabilities, namely technology-oriented capability, market-oriented capability and organization-oriented capability.

Technology-oriented capability refers to firms' capability to update their technology base through knowledge absorption, assimilation and utilization (Malik and Kotabe, 2009; Zhou and Li, 2010; Li *et al*., 2012). The typical organizational processes that underpin technology-oriented capability include acquiring new technologies from external sources, extensive in-house R&D activities, and using new technological know-how to innovate existing production processes (Yam *et al*., 2004; Malik and Kotabe, 2009; Zhou and Li, 2010).

Market-oriented capability represents firms' ability to understand and respond to emerging market preferences (Gatignon and Xuereb, 1997; Slater and Narver, 1998; Zhou *et al*., 2005). The deployment of market-oriented capability involves the organizational processes to collect up-to-date market information, and introduce differentiated products or services to the market (Slater and Narver, 1998; Zhou and Li, 2010).

Organization-oriented capability refers to firms' capability to renovate existing corporate structure, and introduce new management systems and human resources programs to promote innovation within the firm (Zhou *et al*., 2005; Yiu *et al*., 2007; Yiu and Lao, 2008). For example, old central planning system established in transitional economies such as China, often requires firms to accept a socialist bureaucratic logic in their business management (Yiu *et al*. 2007). The socialist bureaucracy emphasizes the essential role of government in economic planning and resource disposition, and uses firms only as the executers of governmental economic policies (Boist and Child, 1996). This socialist bureaucratic logic is no longer applicable when transitional economies continue to move towards a market-based system and participate in the global competition (Peng, 2003; Yiu *et al*., 2007). It is thus necessary for firms to undergo an entrepreneurial transformation to build up organization-oriented capabilities, so as to compete both locally and globally (Luo *et al*., 2005; Li *et al*., 2006; Yiu *et al*., 2007).

2.3 Developing innovation strategies and capabilities through institutional interactions

Drawing on existing literature, we develop a theoretical framework to illustrate how firms develop innovation strategies and capabilities through external institutional interactions during institutional transitions (see Figure 1).

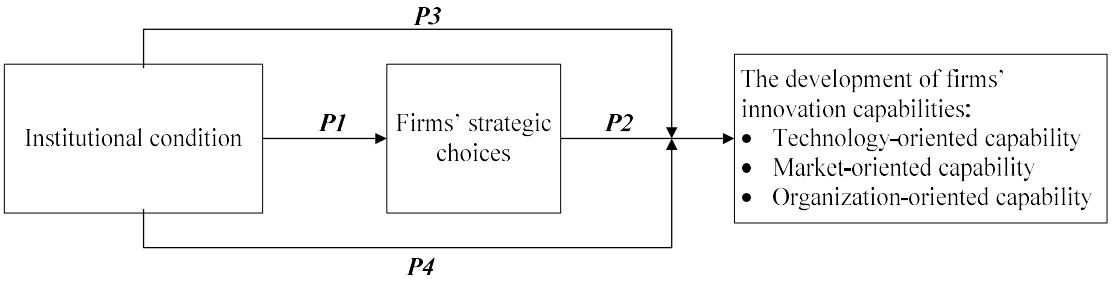

Figure 1 – Developing innovation strategies and capabilities through institutional interactions: a theoretical framework

During institutional transitions, regulative, financial and administrative measures are the three major tools adopted by dominant institutions, to mobilize various players to engage with innovations (King *et al*., 1994; Beerepoot and Beerepoot, 2007; Borrás and Edquist 2013). The regulative measure, in forms of regulations, rules and directives, can be used to define the institutional structure and market arrangement so as to either restrict or promote particular technology development (Borrás and Edquist 2013). The financial measure is normally in the form of financial support such as funding or subsidiaries from the government to stimulate domestic innovations (Georghiou *et al*., 2014). The administrative measures are various intervention instruments by which governmental agencies influence or even control the development trajectories of firms, especially SOEs (Borrás and Edquist 2013).

The interaction among the above three measures largely determines the institutional condition which can be viewed as an external source of both threats and opportunities faced by firms (Peng and Heath, 1996; Peng and Luo; 2000; Peng, 2003; Peng *et al*., 2005). To cope with and gain benefits from such an institutional condition, firms will have to emphasize either a network-centric or a market-centric strategy for innovation based on the strength of their ties with dominant institutions (i.e., Business-to-Government (B2G) ties) (Peng and Luo; 2000; Peng, 2003). We thus propose:

Proposition 1: *During institutional transitions, firms with strong ties with dominant institutions tend to adopt a network-centric strategy, and firms with weak ties with dominant institutions tend to adopt a market-centric strategy.*

At the interface between external environment and internal organizational configurations (Hofer and Schendel, 1978; Rajagopalan and Spreitzer, 1997), strategic choices drive the specific way firms interact with external institutions, so as to obtain legitimacy and resources (Hoskisson, *et al*., 2000; Peng, 2003; McDermott *et al*., 2013). Moreover, during institutional transitions, firms' strategic choices largely determine how external, generic resources are utilized to develop own innovation capabilities (Slater *et al*., 2007; Yiu and Lau, 2008; Zhou and Li, 2010). We thus propose:

Proposition 2: *During institutional transitions, the development of firms' innovation capabilities is mainly guided by their strategic choices.*

During institutional transitions, close ties with dominant institutions, such as government authorities, means easier access to abundant resources (Child and Lu, 1996; Peng and Zhou, 2005; Li *et al*., 2012; Zeng and Glaister, 2016). These resources can be the foundation for firms to quickly build up their organizational capabilities (Khanna and Palepu, 1997; 2000; Fan, 2006; Yiu and Lau, 2008). Stated alternatively, extensive institutional interactions may benefit the development of firms' innovation capabilities. We thus propose:

Proposition 3: *During institutional transitions, firms with strong ties with dominant institutions tend to receive more external resources for the development of their innovation capabilities.*

Meanwhile, firms' internal decisions may not be completely independent, but impacted by the institutional conditions they face (Peng and Luo, 2000; Ahlstrom *et al*., 2000; Li *et al*., 2012; Zeng and Glaister, 2016). For example, compared with private companies, the SOEs with strong B2G ties often receive more direct administrative intervention in their strategies and operations (Peng and Luo, 2000; Ahlstrom *et al*., 2000; Li *et al*., 2012; Xiao *et al*., 2013). As such, the development of innovation capabilities within firms, especially SOEs, is not only guided by corporate strategic choices, but also restricted by governmental policies and decisions. We thus propose:

Proposition 4: *During institutional transitions, firms with strong ties with dominant institutions tend to receive more administrative intervention in the development of their innovation capabilities.*

3. Research Method

Based on the theoretical framework, we conduct an archival-based, longitudinal case study (Eisenhardt, 1989) of the development of China's telecommunications industry from early 1980s to the present. The reasons for studying China's telecommunications industry are twofold. First, telecommunications industry is one of the most R&D-intensive industries (Fan, 2006; Wu *et al*., 2012). These industries are driven by the development of dynamic capabilities and continuous innovations (Macher and Mowery, 2009). Second, governmental inputs have played a key role in the reform of China's telecommunications industry (Fan 2010; He and Mu, 2012). Thus in this specific industry, the development of corporate innovation strategies and capabilities can be seen as the result of the co-evolutionary interactions between institutional systems and firms.

This case study focuses on three major Chinese telecom-equipment manufacturers, Great Dragon Information Technology Group Co., Ltd. (GDT), Zhongxing Telecommunication Equipment Corporation (ZTE), and Huawei Technologies Co., Ltd. (Huawei). Because firms with different ownership structures will be under different institutional pressures, and thus may have varied strategic focuses and patterns of capabilities development (Peng, 2003; Peng *et al*., 2005; Peng and Luo, 2000), two different types of enterprises are included (GDT and ZTE as SOEs and Huawei as private company). The longitudinal case study allows us to examine and compare (1) how firms of different types use their entrepreneurial actions to interact with dominant institutions, and develop and renew distinctive innovation strategies

and capabilities over time; (2) how these strategies and capabilities lead to varied innovation outcomes of firms at different stages of the institutional transition.

According to the theoretical framework above, firstly, two key factors are identified to represent the institutional condition, namely the administrative intervention and the resources received by firms from dominant institutions (Peng and Zhou, 2005; Peng and Luo, 2000; Ahlstrom *et al*., 2000; Li *et al*., 2012). Secondly, firm's strategic choices are classified against the strength of their ties with dominant institutions (in this case B2G ties) (Peng and Luo; 2000; Peng, 2003; Peng *et al*., 2005). Thirdly, based on existing literature, we identify the following underlying processes to reflect the development of firm's innovation capabilities (see Table 1).

Table 1 – Underlying processes of the development of innovation capabilities

Types of Innovations	Underlying processes
• Technology-oriented innovation (Yam *et al*., 2004; Malik and Kotabe, 2009; Zhou and Li, 2010).	1. Acquisition of new technologies from external sources; 2. In-house R&D activities; 3. Renovation of existing R&D process
• Market-oriented innovation (Slater and Narver, 1998; Zhou *et al*., 2005; Zhou and Li, 2010)	1. Collection of up-to-date market information; 2. Understanding of emerging market preferences; 3. Introduction of differentiated products or services to the market; 4. The delivery of superior values to customers
• Organization-oriented innovation (Zhou *et al*., 2005; Yiu *et al*., 2007; Yiu and Lao, 2008)	1. Establishment of new management systems and human resources programs; 2. Renovation of existing organizational procedures and structure; 3. Building of corporate culture for innovation; 4. Renovation of existing corporate governance structure

The collection of archival data is based on an extensive and thorough review of the extant academic and non-academic literatures regarding China's telecommunications industry. The non-academic literature include the official reports of Chinese regulatory agencies, the statistical reports from third-party organizations, and the annual reports, CSR reports and newsletters of the case companies. In addition, three major indicators are used to measure and compare the innovation outcomes of the case companies: (1) in the early transitional stages of China's telecommunications industry, "sales revenue" and "products to market" are used as the indicators (Slater and Narver, 1998; Zhou and Li, 2010); (2) in the later transitional stages when ZTE and Huawei began to join the international patent system, the Patent Cooperation Treaty (PCT)[1] ranking is used as a new indicator, because patents have always been treated as a reliable measure of firm's innovation performance (Brouwer and Kleinknecht, 1999; Ma, *et al*., 2009; Nelson, 2009).

4. Evidence from China's telecommunications industry

[1] Under the regulation of the World Intellectual Property Organization (WIPO), PCT is the United Nation's official international patent application system.

4.1 Evolution of the institutional and market conditions of China's telecommunications industry

This study breaks down the development of China's telecommunications industry from early 1980s to the present into four stages according to the major milestones of profound institutional and market transitions led by the government (see Figure 2). These stages will serve the basis of longitudinal analysis of the three case companies.

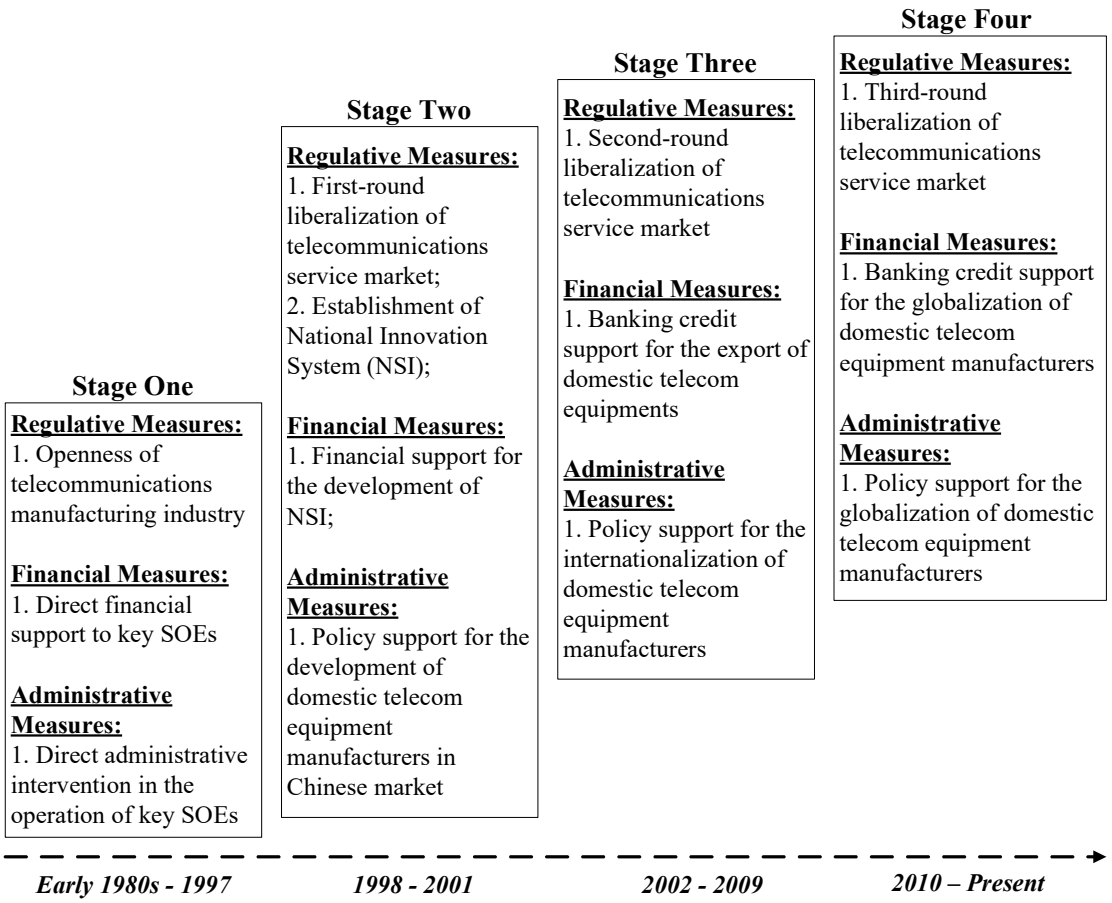

Figure 2 - Evolution of the institutional and market conditions of China's telecommunications industry

Stage 1 (early 1980s-1997): The Chinese government opened its telecommunications manufacturing industry to foreign companies and began to access latest technologies through joint ventures and technology transfer (Fan, 2006). Meanwhile, financial subsidiaries and policy guidance were provided to key SOEs, with the aim to encourage domestic telecommunications innovation through direct administrative intervention (Mu and Lee, 2005).

Stage 2 (1998-2001): The state's monopolized telecom service market was initially broken down into three main service providers, namely China Telecom, China Mobile and China Unicom (Xia, 2012). Meanwhile, the Chinese government began to invest in the National Systems of Innovation (NSI) for telecommunications technologies development (Zhang and Igel, 2001; Fan, 2010). In addition, direct governmental intervention in SOEs' operations was largely avoided. The policy focus of the government turned into how to ensure the continuous development of both SOEs and private firms.

Stage 3 (2002-2009): In 2002, to stop its monopoly in Public Switched Telephone Network (PSTN) service, China Telecom was divided into two companies, China Telecom and China Netcom (Xia, 2012). In 2009, overall competition in China's telecommunications service market was established, when China Telecom, China Mobile, and new China Unicom (after merging with China Netcom) all became comprehensive service providers (Xia, 2012; Gao, 2014). At the same time, new industry policies and financial arrangements were created to accelerate the expansion of domestic telecom equipment manufacturers in foreign markets.

Stage 4 (2010-present): Since 2010, guided by the central government, China's telecommunications network, public broadcasting network and broadband network began to converge (Gao, 2014). This tri-networks integration created a new market arrangement by which various service providers can compete with each other on a uniform platform. Meanwhile, since 2014 the innovation and globalization of domestic telecom equipment manufacturers were fully supported by the state's "Belt and Road Initiative" (BRI) and "China Manufacturing 2025" plan (Huawei, 2017; ZTE. 2017).

4.2 Establishment backgrounds of the case companies

The predecessor of GDT was a R&D consortium established in 1987 and controlled by the Ministry of Posts and Telecommunications (MPT) (Mu and Lee, 2005). In 1995, GDT was established as one of the state's 520 key enterprises (Zhang, 2000).

ZTE was founded in 1985 in Shenzhen (Fan, 2010), which was one of the first four special economic zones in China. As a local SOE, ZTE's B2G ties were not as strong as GDT's. However, the flexible business and trade laws, and governmental administration implemented in Shenzhen meant that ZTE was more likely to make its strategic decisions independently.

Huawei was set up in Shenzhen in 1987 as a private company (Wu *et al*., 2012). Unlike the above two SOEs, Huawei lacked governmental support in the beginning. But as a private company, Huawei could decide its own development trajectory without the interference of external institutions. Table 2 summarizes the backgrounds of the case companies.

Table 2 – Establishment background of case companies

Company Name	Company Type	B2G Ties	Location of Headquarter	Year of Foundation	Founder
GDT	Key SOE	Strong	Beijing	1995	Professor Jiangxing Wu
ZTE	Local SOE	Moderate	Shenzhen, Guangdong Province	1985	Mr Weigui Hou
Huawei	Private	Weak	Shenzhen, Guangdong Province	1987	Mr Zhengfei Ren

Source: Huawei (2002; 2008), ZTE (2002; 2008) and MII (2001)

4.3 Transitional stage one (early 1980s – 1997)

Since early 1980s, foreign telecom equipment providers quickly dominated Chinese urban digital switch system market (Fan, 2010). However, the rural markets were largely neglected because of their low profit contribution (Mu and Lee, 2005). This segmented sector thus became a potential business opportunity for domestic firms, provided that they could develop own digital switch technologies first.

4.3.1 The development of GDT in the transitional stage one

Benefitting from its strong B2G ties, GDT followed a network-centric strategy and focused on the breakthrough in technology-oriented innovation. Through technology assimilation, in-house R&D, and the collaboration with external research institutes, the R&D consortium (the predecessor of GDT) produced Chinese first large-scale digital switch system (HJD-04) in 1991 (Liu, 2006). This technology development received extensive governmental support. For example, the technical experts of MPT directly joined GDT's digital switch development program. The experience they gained from their former research collaboration with foreign telecom companies provided a good knowledge base (Mu and Lee, 2005).

Nevertheless, direct governmental intervention also seriously hindered the development of GDT's market-oriented and organization-oriented capabilities. Because the sale of its HJD-04 machine was fully supported by MPT (Liu, 2006), there was no motive for GDT to develop its market-oriented capability to understand and respond to emerging users' preferences. On the other hand, the formation of GDT was guided by MPT, which was essentially a loose business group lacking clear corporate governance structure and close collaboration among R&D, manufacturing and marketing functions (Zhang, 2000).

4.3.2 The development of ZTE in the transitional stage one

ZTE, as a local SOE, received less support but also weaker administrative intervention from regulatory authorities. It thus adopted a mixed strategic choice. ZTE actively sought external research and financial support for its technology innovation. Meanwhile, it also focused on the development of its market-based resources and capabilities.

One direct benefit of ZTE's SOE background was its secured collaboration opportunities with stated-controlled research institutes. For example, through working with Nanjing University of Posts and Telecommunications (NUPT), ZTE developed its large-scale digital switch system (ZXJ10) in 1993 (Fan, 2010).

Since its establishment, ZTE entered a competitive market joined by Multinational Corporations (MNCs), Joint Ventures and domestic firms. Initially, ZTE's digital switch system lacked technical advantages compared with the foreign models. To compensate that, ZTE established a country-wide network for 24/7 market and technical support. Through this network ZTE was able to build up its long-term collaborative customer relationship and gain deep understanding of China's telecommunications market.

As a SOE, inevitably ZTE received direct administrative intervention in its business management. To mitigate this intervention, in 1993 ZTE carried out the first-round organization-oriented innovation regarding its ownership structure and corporate governance. Through Management Buyout (MBO), the founder of ZTE, Mr Weigui

Hou and his executive management team obtained 49% share in the company ownership and the two state-owned enterprises occupied the remaining share of 51% (ZTE, 2001). In addition, ZTE's executive team was authorized to be fully responsible for the company's daily management and long-term development. This organization-oriented innovation was proved to be so successful that it was called the "ZTE model" by the Chinese government and implemented in many other similar reforms of SOEs (ZTE, 2001).

4.3.3 The development of Huawei in the transitional stage one

As a small private company, Huawei followed its market-centric strategy and focused on the development of its market-oriented innovation. Initially, through its early sales experience of imported Private Branch Exchange (PBX) machines, Huawei formed its unique understanding of the complex nature of China's telecommunications market. Then from 1989 to 1994, Huawei established its nationwide sales and after-service network (Mu, 2003). Finally, Huawei's long-term market-orientation led to its "market first, technology follows" principle, which means its technology development should always be guided by real market opportunities (Wu *et al*., 2012).

Huawei's weak B2G ties meant that it lacked external support to develop large-scale digital switch system. It thus concentrated on the development of PBX machine instead. Since then Huawei's initial R&D team was expended through hiring young engineers with backgrounds in the inland research institutes. These engineers brought in substantial knowledge in telecommunications technologies to accelerate Huawei's R&D process (Mu and Lee, 2005). As a result, Huawei's digital switch machine (C&C08) was developed in 1993 (Pyramid, 1996).

To facilitate its market-oriented and technology-oriented innovations, Huawei actively engaged in its organization-oriented innovation. First, back in 1990, Huawei established a modern corporate structure composed of R&D, manufacturing, sales, finance and human resources departments (Mu 2003). Second, in 1994 Huawei began to implement ISO 9000 system to ensure its manufacturing quality control (Mu, 2003). Third, in 1995 Huawei created its core value of "becoming a world-leading company in telecommunications industry through realizing customers' expectations" (Gao, 2018). The employees' acceptance of this core value greatly improved Huawei's capability to quickly mobilize company-wide resources once new marketing opportunities arise.

Table 3 summarizes the development of case companies' innovation strategies and capabilities in the transitional stage one. During this period, all three case companies developed their large-scale digital switch systems and began to compete with foreign firms, first in rural markets and gradually in urban markets. Based on its technology advantage, the market share of GDT's HJD-04 machine reached 10.6% in 1992 and increased to 14% in 1997 (Mi and Yi, 2005). In the same year, the digital switch market share of ZTE and Huawei was 10% and 7% respectively (Tan, 2002; Mu and Lee, 2005).

Table 3 - The development of case companies' innovation strategies and capabilities in the transitional stage one

Company	Business-to-Government (B2G) ties	Strategic Choices	Development of Innovation Capabilities	External Administrative Intervention	External Resources
GDT (key SOE)	Strong	Network-Centric	*Technology-oriented capability:* 1. External knowledge acquisition; 2. In-house R&D and external research collaboration *Market-oriented capability:* N/A *Organization-oriented capability:* N/A	1. Intervention in marketing and sales activities; 2. Intervention in corporate governance	1. External human resources; 2. External knowledge source; 3. External financial support; 4. External policy support
ZTE (Local SOE)	Moderate	Mixed	*Technology-oriented capability:* 1. In-house R&D and external research collaboration *Market-oriented capability:* 1. Understanding of China's telecommunications market; 2. Establishment of marketing and service network *Organization-oriented capability:* 1. Establishment of new corporate governance structure	1. Intervention in corporate governance	1. External research support; 2. External financial support
Huawei (Private firm)	Weak	Market-Centric	*Technology-oriented capability:* 1. R&D team building; 2. Knowledge accumulation *Market-oriented capability:* 1. Understanding of China's telecommunications market; 2. Establishment of marketing and service network; 3. Formation of "market first, technology follows" principle *Organization-oriented capability* 1. Establishment of modern corporate structure; 2. Establishment of quality control system; 3. Building of corporate culture	N/A	2. External knowledge spill over

4.4 Transitional stage two (1998 – 2001)

In this period, along with the liberalization of China's telecommunications service market, its digital switch sector was quickly saturated (Mu and Lee, 2005, Fan, 2010). Moreover, the Chinese government began to introduce a NSI platform to replace its former direct administrative intervention in the development of indigenous telecommunications technologies (Zhang and Igel, 2001; Fan, 2010). Therefore, domestic firms, especially SOEs, had the challenge of not only finding new market opportunities, but also obtaining continuous governmental support for further innovations and organizational transformation.

4.4.1 The failure of GDT in the transitional stage two

During the transitional stage two, GDT's network-centric strategy encountered great challenges in technology development, market expansion and organizational transformation. Particularly, GDT's strategic reinvention was restricted by its over-dependence on B2G ties.

Since 1998, the market focus turned from digital switch system to other technologies, such as access network. Although GDT's access network equipment was developed in 1997 (MII, 1997), this machine eventually failed in the market because of two reasons. First, GDT's marketing and sales lost direct administrative support in 1998 when the Chinese government began to liberalize its telecommunications service market. Second, without sufficient investment in market-oriented capability before, GDT lacked knowledge and experience of building up a professional marketing and service network quickly.

GDT's endeavour in its organization-oriented innovation was not successful as well. From 1996 to 2001, GDT experienced three-round corporate restructurings (Liu, 2006). Based on a number of external administrative arrangements, this restructuring process provided GDT with necessary financial support through introducing new investors. However, such an external intervention could not resolve the internal misalignment of GDT's R&D, manufacturing and marketing functions.

4.4.2 The development of ZTE in the transitional stage two

Guided by a mixed strategic choice, ZTE evenly developed its technology-oriented, market-oriented and organization-oriented capabilities in the transitional stage one. In the transitional stage two, ZTE further improved and applied these capabilities to turn emerging market challenges into business opportunities.

For technology innovation, by 2000, 9 R&D centres were set up in China, United States and Korea (ZTE, 2001). Meanwhile, ZTE actively searched for external funding and research alliance opportunities through the NSI platform created by the state. For example, in the Chinese government's "863 plan" for high technology development, more than 30 research projects were taken by ZTE (ZTE, 2006).

For market innovation, ZTE started its international exploration. From 1996 to 2000, sales representative offices were set up in more than 50 countries (ZTE, 2001). They then became the backbone of ZTE's later international marketing and service network. More importantly, the knowledge and experience gained in foreign markets helped ZTE to form its future internationalization strategy.

For organization innovation, in 1998, to support its fast market growth, ZTE established four independent product business units (ZTE, 2002). Its unitary corporate structure was thus transformed into a multidivisional one. Then after the implementation of ISO9001, Six-Sigma quality management system was introduced to ZTE in 2001. In the same year, ZTE launched its EPR system after re-engineering its existing organizational functions (ZTE, 2002).

4.4.3 The development of Huawei in the transitional stage two

From 1998 to 2001, Huawei established its overseas research centres in India, Sweden and United States (Liu, 2006). In addition, Integrated Product Design (IPD) approach was applied to Huawei's R&D process (Mi and Yi, 2005). This approach greatly reduced Huawei's R&D cycle time. More importantly, it ensured that Huawei's following technology innovations could be guided by sufficient early-stage market analysis.

The success in domestic market drove Huawei's adventure in international market. From 1997 to 2001, Huawei's representative offices were established in Russia, Middle East, Southern Asia, Southern America and Africa (Huawei, 2006). In Huawei's early overseas exploration, long-term customer relationship and sales team building were its focus, so as to develop the capability to quickly sense and satisfy emerging market requirements.

Huawei's organization-oriented innovation was mainly manifested in both the establishment of modern human resources management system, and organizational process re-engineering. First, since 1997, through working with Hay Group, Huawei established its qualification system, compensation system, and performance management system (Huawei, 2002). Second, from 1999 to 2003 Huawei carried out its Integrated Supply Chain (ISC) program under the guidance of IBM (Liu, 2006). This program re-engineered and optimized Huawei's six major business functions, namely sales and order processing, planning and scheduling, procurement, logistics, manufacturing and customer relationship.

Table 4 summarizes the development of case companies' innovation strategies and capabilities in the transitional stage two. In this period, GDT's advanced position in digital switch sector was quickly eroded by the structural change in the market. Even though GDT tried to diversify its product lines through new technology innovation, this attempt lacked the support of corresponding market-oriented and organization-oriented innovations. As a result, the sales revenue of GDT in 1999 halved than the previous year. Since 2010 GDT disappeared from the main sectors of China's telecommunications market. On the contrary, the balanced development of ZTE's and Huawei's technology-oriented, market-oriented and organization-oriented capabilities greatly contributed to their fast market growth and product proliferation (see Table 5).

Table 4 - The development of case companies' innovation strategies and capabilities in the transitional stage two

Company	Business-to-Government (B2G) ties	Strategic Choices	Development of Innovation Capabilities	External Administrative Intervention	External Resources
GDT (key SOE)	Strong	Network-Centric	*Technology-oriented capability:* 1. R&D in new technologies *Market-oriented capability:* N/A *Organization-oriented capability:* N/A	1. Intervention in corporate restructuring	1. External financial support
ZTE (From local SOE to public listed SOE)	From moderate to strong	Mixed	*Technology-oriented capability:* 1. Establishment of domestic and overseas research centres; 2. External research collaboration *Market-oriented capability:* 1. Understanding of overseas markets; 2. Overseas sales team building *Organization-oriented capability:* 1. Establishment of new corporate structure; 2. Establishment of quality control and improvement system; 3. Re-engineering of existing organizational functions	N/A	1. External research support; 2. External policy support; 3. External financial resource
Huawei (Private firm)	From weak to moderate	Market-Centric	*Technology-oriented capability:* 1. International R&D team building; 2. R&D process re-engineering *Market-oriented capability:* 1. Overseas sales team building; 2. Establishment of long-term customer relationship in overseas market *Organization-oriented capability* 1. Establishment of modern human resources management system; 2. Re-engineering of existing business functions and process	N/A	1, External policy support; 2. External financial resource

Table 5 - Comparison of the market performance and product proliferation of case companies in the transitional stage two

Company Name	Sales Revenue (RMB)				Products to Market
	1998	1999	2000	2001	
GDT	2.6 Billion	1.2 Billion	N/A	N/A	Digital Switch
ZTE	4.1 Billion	5.2 Billion	10.2 Billion	14.0 Billion	Digital Switch, Access network, Optical Transmission, PHS, GSM and CDMA
Huawei	8.9 Billion	12.0 Billion	22.0 Billion	22.5 Billion	Digital Switch, Access network, Optical Transmission, GSM and CDMA

Source: Huawei (2002; 2008), ZTE (2002; 2008) and MII (2001)

4.5 Transitional stage three (2002 – 2009)

In this period, intensified competition continuously lowered the average profit margin in China's telecom equipment industry. ZTE and Huawei thus turned their attention to overseas markets for new business opportunities.

4.5.1 The development of ZTE in the transitional stage three

From 2002 to 2009, the development of ZTE's technology-oriented capability was mainly reflected in two aspects. First, by 2009 ZTE completed its international R&D platform composed of 16 research centres in China, Korea, United States, Sweden, France, Pakistan and India (ZTE, 2009). Second, ZTE's external research collaboration became internationalized. The major overseas participants in ZTE's joint research programs included IBM, Intel, Microsoft, Ericsson, Texas Instrument and Qualcomm (ZTE, 2009).

In terms of market-oriented innovation, in 2004 ZTE established a new department dedicated to overseas marketing (ZTE, 2004). This indicated that ZTE began to equally weight its domestic and overseas markets through adjusting its existing marketing function. By 2008, ZTE's overseas marketing and service network already covered 135 countries. As a milestone of its internationalization progress, ZTE's overseas revenue increased to 20.09 billion RMB in 2007 and for the first time exceeded its domestic earning (ZTE, 2007).

Meanwhile, the changes in market preference drove ZTE's organization-oriented innovation. During its international expansion, ZTE quickly realized that the technical advancement of individual telecom product was no longer the priority of its customers. Instead, what needed was an overall customized solution to support both their current business models and future development. In response, in 2007 ZTE's existing business units were regrouped into six telecommunications solution platforms targeting at different market segments (ZTE, 2007). This organizational change eliminated departmental silos and reduced response time to the market.

4.5.2 The development of Huawei in the transitional stage three

In the transitional stage three, Huawei's international expansion was greatly supported by its improved technology-oriented, market-oriented and organization-oriented capabilities.

In terms of technology innovation, by 2009 Huawei established its international R&D network across China, United States, Germany, Sweden, Russia and India (Huawei, 2008). Both Integrated Product Design (IPD) approach and Capability Maturity Model (CMM) were also applied. Therefore, Huawei's world-wide research centres could be coordinated through a standardized, platform-specific management process (Huawei, 2008).

In terms of market-oriented innovation, by 2007 Huawei completed its overseas marketing and service network composed of more than 90 sales and service centres in 9 major international regions (Huawei, 2007). Huawei closely aligned its market innovation with its technology innovation. Based on the deep understanding of the customers' needs in developing countries, Huawei's mature R&D platform developed various low-cost, high value-added technology solutions which ensured the commercial success of these local telecommunications operators (Wu *et al*., 2012).

In terms of organization-oriented innovation, from 2002 to 2009 Huawei established a matrix organizational structure (Huawei, 2009). Its horizontal axis was Huawei's regional market and service platforms, and its vertical axis was Huawei's product line-based business groups. The communication routines were pre-defined at each interface point between these two axes. Based on this matrix structure, when new business opportunities were identified, Huawei could build up a cross-functional project team to respond almost instantly.

It is worth noting that, in this period, the backup of regulatory authorities to the overseas market expansions of ZTE and Huawei was equally strong. For example, since 2001, under the Chinese government's "export of technology" policy (Lu *et al*., 2011), ZTE and Huawei were all listed as key enterprises and received sufficient export credit support. Therefore, Huawei's initial market-centric strategy was changed into a mixed one in the transitional stage three when its interactions with dominant institutions became further strengthened.

Table 6 - The development of ZTE's and Huawei's innovation strategies and capabilities in the transitional stage three

Company	Business-to-Government (B2G) ties	Strategic Choices	Development of Innovation Capabilities	External Administrative Intervention	External Resources
ZTE (Public listed SOE)	Strong	Mixed	*Technology-oriented capability:* 1. Establishment of international R&D platform; 2. International research collaboration *Market-oriented capability:* 1. Establishment of international marketing department; 2. Establishment of overseas marketing and service network *Organization-oriented capability:*	N/A	1. External policy support; 2. External financial support

			1. Re-engineering of corporate structure		
Huawei (Private firm)	From moderate to strong	From Market-Centric to Mixed	*Technology-oriented capability:* 1. Establishment of international R&D network; 2. Introduction of IPD-CMM approach *Market-oriented capability:* 1. Establishment of overseas marketing and service network; 2. Providing low-cost, high value-added technology solutions to market *Organization-oriented capability* 1. Establishment of a matrix organizational structure	N/A	1, External policy support; 2. External financial support

Table 6 compares the development of ZTE's and Huawei's innovation strategies and capabilities in the transitional stage three. Based on a further development of their innovation strategies and capabilities, ZTE and Huawei continued their market success. In 2002 the revenues of both companies were below 20 billion RMB (Huawei, 2006; ZTE, 2006). By 2009 their sales increased to 60.3 billion RMB and 149.1 billion RMB respectively (Huawei, 2009; ZTE, 2009).

Meanwhile, the enhanced capabilities of ZTE and Huawei in technology innovation were reflected in their PCT rankings. In 2005, ZTE firstly appeared in the PCT table and the ranking was 209. By 2009 its ranking rose to 22. As a comparison, Huawei's PCT ranking was 37 in 2005 and 2 in 2009 (WIPO Statistics Database, 2018).

4.6 Transitional stage four (2010 – Present)

In the transitional stage four, the advancement of ZTE and Huawei's innovation capabilities was driven by the competition in both domestic and international markets. In addition, the globalization of ZTE and Huawei was greatly supported by the Chinese government's Belt and Road Initiative (BRI) and "China Manufacturing 2025" plan.

4.6.1 The development of ZTE in the transitional stage four

ZTE's technology-oriented innovation was led by its market-driven investment in new technologies. Through collaborating with European major telecommunications service providers, ZTE concentrated on the R&D for the next-generation network. Its Long-Term Evolution (LTE) solution (the precursor of 4G technology) was developed in 2011.

To develop market-oriented innovation, ZTE firstly extended its business range from traditional telecommunications sector to consumer business and government and corporate business. In 2017 these two new business sectors contributed 41.38% of ZTE's annual revenue (ZTE, 2017). Secondly, based on its technology advancement in LTE and 4G, ZTE's customized solutions began to serve in the backbone networks of all major telecommunications operators in Europe, North America and Oceania (ZTE, 2017).

To support its market expansion in consumer business and government and corporate business, ZTE rebuilt its existing corporate structure. In 2014 its six telecommunications solution platforms were reconstructed into three business groups, namely carriers' networks group, government and corporate business group, and consumer business group (ZTE, 2014).

4.6.2 The development of Huawei in the transitional stage four

In the transitional stage four, Huawei's globalization process was greatly driven by its updated innovation capabilities. Huawei's disruptive innovation was especially reflected in the fields of R&D and corporate governance.

In 2011 Huawei reconstructed its R&D system by separating its "Research" and "Development" functions. The development function was taken by Huawei's existing R&D centres which concentrated on the current telecom technologies. The research function was carried out by its newly established "2012 Lab[2]" focusing on next-generation technologies such as 5G and All-Optical Networking (Huawei, 2011). Under this ambidextrous arrangement, the development function of Huawei's R&D system aimed at transforming its current technology investment into foreseeable business success. On the contrary, the responsibility of its research function was to explore the future technology evolution direction of the global ICT industry. This drastic technology-oriented innovation both satisfied Huawei's current business need and developed its capability to cope with potential disruptive innovations in the future. As a result, Huawei quickly grew from a technology follower to a technology leader.

In the field of corporate governance, in 2011 Huawei created a unique CEO rotation system for corporate governance and strategic management (Huawei, 2011). In this system three deputy chairmen took turns to be acting CEO for a period of every six months. Facing the increasing market uncertainties in global telecommunications industry, Huawei tried to minimize the risk in the development of its future strategy. It thus introduced this shared leadership design to balance democracy and centralisation in strategic decision making. Although this disruptive innovation in corporate leadership still needs time to be fully justified, its initial success was proved by Huawei's exponential growth from 2012 to 2017.

In market-oriented innovation, in 2010 Huawei's business range was extended from carrier business to consumer and enterprise businesses. In addition, during its global expansion, Huawei practiced a "Glocalization" strategy to attract local talents. In 2017 the localization rate of Huawei's international marketing team was over 70% (Huawei, 2017).

Table 7 - The development of ZTE's and Huawei's innovation strategies and capabilities in the transitional stage four

Company	Business-to-Government (B2G) ties	Strategic Choices	Development of Innovation Capabilities	External Administrative Intervention	External Resources
ZTE (Public listed SOE)	Strong	Mixed	<u>*Technology-oriented capability:*</u> 1. Market-driven innovation in 4G and 5G technologies	N/A	1. External policy support

[2] The "2012 Lab" is Huawei's research platform towards next-generation ICT technology, which is composed of 16 research institutes worldwide.

			Market-oriented capability: 1. Extension of business ranges; 2. Providing high value-added technology solutions to market *Organization-oriented capability:* 1. Renovation of corporate structure		
Huawei (Private firm)	Strong	Mixed	*Technology-oriented capability:* 1. Reconstruction of R&D system *Market-oriented capability:* 1. Extension of business ranges; 2. "Glocalization" strategy *Organization-oriented capability* 1. Creation of CEO rotation system	N/A	1, External policy support

Table 7 compares the development of ZTE's and Huawei's innovation strategies and capabilities in the transitional stage four. In this period ZTE and Huawei renovated their innovation capabilities through a globalization process. In 2013 Huawei surpassed Ericsson to become the largest telecom equipment manufacturer in the world (Huawei, 2013). In the same year, ZTE became one of the top 5 global telecom equipment providers. Meanwhile, the PCT rankings of ZTE and Huawei also reflected their leading innovation positions in emerging telecommunications technologies. From 2010 to 2017 the PCT rankings of ZTE and Huawei always remained in the top 4 (WIPO Statistics Database, 2018).

5. Discussion

This study extends the strategy-based perspective (Peng and Luo; 2000; Peng, 2003; Peng *et al*., 2005; Li *et al*., 2012) by showing that, during a transitional period, both a relationship-based institutional structure and a rule-based market arrangement may coexist for a long time. They intermingle to influence the formation and evolution of firm's innovation strategies. Under such a complex and dynamic phenomenon, in the early transitional stage, firms with strong B2G ties tend to adopt a network-centric strategy, and firms with weak B2G ties tend to adopt a market-centric strategy. However, when firms face both a favourable institutional condition and a competitive market, they may adopt a mixed strategic choice to emphasize both network relationship and the development of market-based resources and capabilities. Moreover, in the later transitional stages, firms with strong market positions may also transform their original market-centric strategy into a mixed one, if their interactions with dominant institutions become strengthened.

During institutional transition, especially in emerging economies, the strong B2G ties of SOEs often lead more institutional support and interventions to the development of their innovation capabilities (e.g. Peng and Luo, 2000; Ahlstrom *et al*., 2000; Li *et al*., 2012). Therefore, how to utilize the necessary external resources and avoid unnecessary administrative interference at the same time becomes a strategic trade off. In this regard the cases of GDT and ZTE provide two contrasting examples. When dominant institutions began to intervene in organizations' management and operations, GDT's board level managers passively accepted such an administrative intervention. To the contrary, ZTE designed a proper corporate governance structure to both

reconstruct the company's ownership and align the strategic objective between the senior management team and the shareholders. As a result, unnecessary institutional interference was largely avoided.

In terms of the development of innovation capabilities, in stage one and two, while GDT only concentrated on technology innovation, both ZTE and Huawei invested in all three types of innovation capabilities. In stage three, ZTE and Huawei showed both similarity and difference in terms of the co-evolvement of innovation capabilities. On the one hand, based on their low-cost, customized technology solutions, both ZTE and Huawei quickly increased their market shares in developing countries. On the other hand, driven by the customers' emerging preference for tailored telecommunications solutions, ZTE's product-based business units were reconstructed into six telecommunications solution platforms. In stage four, the cases of ZTE and Huawei showed that the interactions between their innovation capabilities became further intensified. Through working with major telecommunications service providers, ZTE's technology innovation became even more market-driven. On the other hand, Huawei reconstructed its R&D system and created a CEO rotation system with the aim of minimizing uncertainties and risks in future market.

Three implications are drawn from the above findings. First, firms during institutional transitions need to develop all three types (technology-oriented, market-oriented and organization-oriented) of innovation capabilities. More importantly, the development of any one type of these capabilities is not independent. Firms need to emphasize more on the co-evolvement of different innovation capabilities. This is what we referred to as the "*dynamic alignment*" of firms' innovation capabilities for long term development. Second, based on the various market conditions, corporate strategic focuses and entrepreneurial decisions, the dynamic alignment of firms' innovation capabilities may follow different evolution routines. Third, in the later stage of development, the dynamic alignment of firms' innovation capabilities may also demonstrate a convergent pattern, which is reflected in the extensive interactions among the three innovation capabilities.

6. Conclusion

This study develops an integrated framework to illustrate how firm's strategic choices, through the long-term, complex interactions with dominant institutions, lead the way by which organizational innovation capabilities are developed. Based on the longitudinal study of China's telecommunications industry from early 1980s to the present, our study extends the literature by identifying the strategic importance of the dynamic alignment of firm's innovation capabilities for the sustained competitive advantage.

This study contributes to the research on corporate transformation for innovation by examining the institutional interactions through which firms develop their own strategies for the innovation capabilities. The comparative study between different company ownerships – in this case, Stated-Owned Enterprises and private companies – identifies the importance of corporate governance structure and entrepreneurial decisions in shaping innovation strategies and capabilities of firms during institutional transitions.

Few limitations of this study are worth pointing out. First, this study focuses on China's telecommunications industry. Future research could extend the work into other countries or other industries, where institutional context may vary. Second, this study is largely archival based. Future research could conduct more empirical works through interviews and surveys to verify the theoretical framework developed in this paper.

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