A latecomer’s strategy to promote a technology standard: The case of Datang and TD-SCDMA

Xudong Gao*
Tsinghua University Research Center for Technological Innovation, Beijing 100084, China

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ABSTRACT

This paper studied the key strategies used by Datang, a local Chinese firm, to promote TD-SCDMA in order to explore an under-researched topic: how could a latecomer promote a technology standard? The findings suggest that Datang faced formidable challenges because of latecomer disadvantage and transitional institutions. The development of innovation capabilities and new technologies is needed but far from sufficient. It is necessary to develop special capabilities to get support from the government and public stakeholders such as scholars. The experience of Datang offers new insights into the development and adoption of technology standards sponsored by latecomers in developing countries.

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1. Introduction

The literature on technology standard development and adoption has focused mainly on developed countries and multinational enterprises (MNEs) (Gandal, 2002), and the development and adoption of technology standards sponsored by developing country firms as latecomers is under researched. This paper tries to fill this gap by examining the promotion of TD-SCDMA (time division synchronous code division multiple access), one of the technology standards of 3G mobile communications, by Datang Telecom Technology and Industry Group (Datang), the company that developed the key technologies supporting this standard.

The phenomenon this paper tries to explore is: although many stakeholders recognized the potential benefits offered by TD-SCDMA, the development and adoption of this technology standard turned out to be a long and complex process (Li, 2006, 2010; Gao and Li, 2010). Specifically, the research questions this paper tried to answer include the following: (1) what are the strategies used by Datang to promote TD-SCDMA; (2) are these strategies similar or different from those used by MNEs; and (3) how to make sense of the similarities or differences.

In answering these questions we used a case study method and followed the grounded theory development principles (Eisenhardt, 1989; Yin, 1989). The findings suggest that there are major differences between the processes of developing and adopting technology standards sponsored by MNEs and that by latecomers: Neither strategic maneuvering nor government regulation was able to play as important a role in the case of TD-SCDMA as the literature suggests; Rather, the development and adoption of TD-SCDMA was a fragile and complicated social sociopolitical process heavily influenced by latecomer disadvantage and transitional institutions (Tushman and Rosenkopf, 1992).

The two concepts, latecomer disadvantage and transitional institutions, will be discussed in detail in Sections 4 and 5, but the basic meanings are explained here. First, based on reviewing the literature and coding the data collected, latecomer disadvantage is defined as the fundamental difficulties facing latecomers in promoting technological innovations such as the TD-SCDMA standard. Compared with MNEs, latecomers such as Datang usually have both resource disadvantage and reputation disadvantage, and
this makes it hard for innovations developed by latecomers to be adopted.

Second, the concept of transitional institutions is based on the study of Scott (2001, pp. 48–49). According to him, institutions are composed of regulative, normative, and cognitive elements that, together with associated activities and resources, provide stability and meaning to social life. However, during the development and adoption of TD-SCDMA, institutions in China were experiencing a lot of big changes. Accordingly, transitional institutions reflect two different kinds of institutions going through different processes: old institutions, which were related to the transfer of technologies from MNEs, were declining but still had strong negative impact on TD-SCDMA, and new institutions, which were related to the promotion of indigenous innovation, were growing but still not strong enough to provide effective support to TD-SCDMA.

The paper is organized as follows: we first review the related literature, followed by the description of the research methodology and data collection. We then report the key findings about the strategies used by Datang to promote TD-SCDMA. We conclude by discussing how to make sense of these findings and suggesting future research directions.

2. Theoretical background

The grounded theory development approach used in this study implies that it is inappropriate and impossible to specify ex ante any specific extant literature to guide the research. Rather, it is in the process of doing the research that the researchers find the relevant literature. In this study, in addition to the studies on TD-SCDMA, two more streams of literature turned out to be closely related: the literature on how standards or dominant designs emerge and the literature on what kinds of capabilities are needed in order for latecomers to catch up.

2.1. The emerging of technology standards

According to this stream of literature, when standards are defined broadly, a dominant design becomes the industry standard (Suarez and Utterback, 1995). Following this definition, there are three major perspectives on the development and adoption of dominant designs or technology standards.

The first perspective is about the role of dominant buyers or sellers (Besen and Farrell, 1994; Cusumano et al., 1992; Greenstain, 1992; Lint and Penningts, 2003; Schilling, 2003; Subramanian et al., 2011). Qualcomm was able to make its CDMA technology accepted as a leading technology standard in the US, although this technology came after TDMA, the then more accepted technology (Mock, 2005). In the VCR industry, it was primarily JVC’s strategy, not the technological advantages, made VHS the dominant design in the 1970s. JVC was very active in establishing alliances with other firms to support VHS, while Sony tried to rely mainly on itself to promote its Betamax technology. Microsoft, Intel, and Cisco also had effective strategies such as providing financial and technological assistance to their partners to promote their technologies as industry standard (Gawer and Cusumano, 2002).

The second perspective is about the role played by the government. Although standards development organizations (SDOs) such as ITU (the International Telecommunications Union) set most of the telecommunication technology standards (David and Shurmer, 1996), SDOs do not have legal authority to enforce a technology standard. In this regard, the government could play an important role in technology standard development and adoption (Baron, 1995, 1997; King and West, 2002; West, 2000; Zhang, 2000). One important factor contributing to the much bigger market share of GSM than CDMA, a technology that is at least as advanced, and the strong competitiveness of EU firms in GSM, is the stronger support from EU than that from the US government, which believes in a free market based standard setting approach (Funk, 1998; Funk and Methe, 2001). Similarly, with strong government support CDMA has been very successful in South Korea, and South Korea companies have also been very successful in penetrating the international CDMA market (Jho, 2007).

The third perspective is that technology standards emerge in a sociopolitical process (Fuertelsaz et al., 2008; Tushman and Rosenkopf, 1992). The more complex the technology, the more important the influence of sociopolitical factors is. According to Tushman and Rosenkopf (1992), dominant designs (standards) for simple products mainly emerge based on technical factors, while dominant designs of complex products and systems emerge based on not only technical factors but also social, political and cultural factors.

2.2. Strategies and capabilities for latecomers to catch up

According to this stream of literature, the key strategy for latecomers to catch up with MNEs is to transfer technologies from MNEs and develop strong manufacturing capabilities (Amsden, 2001; Kim, 1997; Lall, 1982; Lee and Lim, 2001; Liu, 2001; Westphal et al., 1985). In sharp contrast with the technology transfer perspective and more relevant to this study (which is about catching up through new technology development), some studies indicate that it is hard for local firms in developing countries to catch up by relying on the development of capabilities to transfer “mature” technologies but it is possible for them to catch up or even leapfrog through the development of innovation capabilities when new technologies are emerging during periods of “paradigm transitions” (Abernathy and Utterback, 1988; Clark, 1985; Henderson and Clark, 1990; Hobday, 1995).

The study by Perez and Soete is illustrative (1988, pp. 475–477). They argued that in mature technology systems, “products build upon one another and are interconnected”. This means that “each new product benefits from the knowledge and experience developed for its predecessors and its producer benefits from the already generated externalities”. The situation is different for new technology systems for two reasons: “First of all, there is time for learning while everybody else is doing. Secondly, given a reasonable level of productive capacity and locational advantages and a sufficient endowment of qualified human resources in the new technologies, a temporary window of opportunity is open, with low thresholds of entry where it matters most’’.

Hobday (1990) also argues that there is opportunity for firms in developing countries to make technological leapfrog if certain kinds of technological change significantly lower the entry barriers. One example is the telecom equipment industry. According to him, the successful development of stored program controlled (SPC) switching systems in the 1970s significantly lowered the entry barriers for firms in developing countries. One reason is that the divisibility of the new telecom system increased the demand for PBX switches and small scale public switches, of which the software is far less complex than the traditional large scale public switches. The second reason is that the modularity of software design in digital switches made it possible for firms in developing countries to develop technology gradually.

A central issue in catching up through new technology development is about the advantages and disadvantages of followers or latecomers as a special group of followers because they are from developing countries (Liberman and Montgomery, 1998,1988). Some studies argue that latecomers as new entrants could be more likely to be successful in developing emerging technologies, because incumbent firms face a lot of constraints when new technologies are emerging. One constraint is related to the possibility
that emerging technologies could cannibalize incumbent firms’ existing businesses (Foster, 1986; Henderson, 1993).

Incumbent firms may also have disadvantages in perceiving and developing emerging technologies because they tend to develop the NIH (not invented here) syndrome, believing that they have a monopoly on knowledge in their field and fail to consider seriously the possibility that other organizations might produce important new ideas (Hamel et al., 1989; Katz and Allen, 1982). It is also possible that incumbent firms find it difficult to change their existing organizational structures and procedures, which have been developed to support existing strategies and operations, to facilitate the development and utilization of emerging technologies (Burgelman, 2002; Christensen and Bower, 1996; Christensen and Rosenbloom, 1995).

However, there are also studies which indicate that latecomers face many disadvantages (Choi et al., 1998). One is reputation disadvantage. According to Carpenter and Nakamoto (1994), the first mover enters the market, defines the ideal, and protects its position near the ideal point through its prototypicality. If a later entrant wants to challenge the first mover, it has to “restart” the customers’ learning process and shift buyer ideal points to its position. A lot of evidence shows that it is extremely difficult for latecomers to restart this new learning process. The second disadvantage facing latecomers is financial disadvantage. Specifically, financial resource constraint is more likely to be a bigger challenge for latecomers than for MNEs: latecomers are more likely to fail because of their lower “initial (financial) resources” (Bruderl and Schussler, 1990; Bhide, 2000).

2.3. Studies on TD-SCDMA

Because most literature regarding TD-SCDMA is written in Chinese, it is necessary to review this literature separately. First, some studies are about the technology of TD-SCDMA. In addition to Professor Li Shihui’s book analyzing the technical principles and features of TD-SCDMA (Li, 2009), Dr. Xu Guangan’s article described the technological origin and evolution of TD-SCDMA (2007). An important debate in this stream of literature was about the relative advantages and disadvantages between TD-SCDMA and other 3G standards such as WCDMA. There were many doubts as described in Professor Li Jinliang’s book (Li, 2006), but both Li and Xu (Li, 2009; Xu, 2007) came to the conclusion that TD-SCDMA was an advanced technology, and was superior in some areas. According to Xu (2007), during the collaboration between Datang and Siemens, the simulation result of TD-SCDMA was better than that of WCDMA.

Second, several studies described and examined the development and adoption process of TD-SCDMA. Among them, Professor Li Jinliang’s book focused on the early stage (before 2006), and Mr. Lou Qinjian’s book and the book by Gao and Li also covered the later stage (up to 2010) (Gao and Li, 2010; Lou, 2008). Among this stream of studies, the debate between Professor Hu Angang and other experts was of special importance. In early 2005, Professor Hu published a report, arguing that China was lagging behind in the development of 3G business and the government should issue 3G licenses as soon as possible. He also claimed that the government refused to issue 3G licenses because it was captured by special interest groups.

Although Professor Hu’s report got a lot of attention, several very famous telecommunications technology experts pointed out that the data he used were highly biased, his calculation was inaccurate, and his technological knowledge in making technical judgments was highly limited. These experts also suggested that the central government further delay the issuing of 3G licenses (Li, 2006).

Third, some studies examined the motivations of the Chinese government to promote TD-SCDMA (Chen et al., 2002; Ernst, 2009; Kshetri et al., 2011; Suttmeier and Yao, 2004; Suttmeier et al., 2006; Xia, 2011; Zhan and Tan, 2010). A basic conclusion was that, while there were considerations about national security, nationalisms and protectionism, China wanted to promote TD-SCDMA mainly because it intended to reduce its reliance on foreign technologies and pay less royalty, which was perceived to be very high in China.

2.4. The literature and the study

The above literature played important roles in this study: they facilitated the development of relevant concepts or categories, finding the relationships among these concepts, and integrating them into theoretical insights. For example, one of the core concepts in this paper, latecomer disadvantage, emerged in the interaction between data and literature: the data indicated the huge difficulties in promoting TD-SCDMA, the literature suggested preliminary explanations of these difficulties, and the iterations between data and literature led to a deeper understanding about this concept in the context of transitional institutions in China.

At the same time, the findings of this study suggest that the extant literature has obvious limitations in explaining the process of adopting a latecomer sponsored technology standard, and the strategies needed to promote a latecomer sponsored standard. For example, the extant literature identified three mechanisms for the emergence of technology standards (strategic maneuvering by dominant firms, government regulation, and interaction between sociopolitical factors), but it is not clear which mechanism could best explain the evolution of TD-SCDMA.

Similarly, the literature on the strategies and capabilities for latecomers to catch up also has difficulties in explaining the development and adoption of TD-SCDMA. According to this stream of literature, followers have both disadvantages and advantages compared with first movers. As will be discussed later on, the findings of this study suggest that latecomers as a special type of followers (they are from developing countries) might have advantages in developing some kinds of technologies supporting a new technology standard, but would have to face formidable difficulties in commercializing the standard.

Regarding the studies on TD-SCDMA, most of them focused on factors such as government policies, technology evolutions, and industry dynamics. Few of them examined local firms’ strategies. As will be discussed in the following, on the one hand, Datang’s strategies were influenced by these factors. On the other hand, these factors were also heavily influenced by Datang’s strategies. This paper provided a more complete picture about the development and adoption of TD-SCDMA through the detailed study about Datang’s strategies.

3. Research methodology

The grounded theory development approach (Glaser and Strauss, 1967; Glaser, 1978) was used in this study in order to develop insights into Datang’s strategies to promote TD-SCDMA. This methodology is appropriate because this paper is studying a new phenomenon and the purpose is not to test existing theories but generate new theoretical insights (Eisenhardt, 1989; Yin, 1989).

3.1. Research setting

The research setting of this paper is the development and adoption of TD-SCDMA in China. In 1997 the ITU called for proposals of 3G wireless communications standards. In 1998 TD-SCDMA was proposed to the ITU by the China Wireless Telecommunication Standard Group (CWTS) as a candidate for 3G mobile communications standards, and accepted as one of the standards by the ITU in May 2000 and 3GPP in March 2001.
After TD-SCDMA was accepted as a 3G technology standard, Datang, the focal company, took proactive actions to promote TD-SCDMA. Datang came from the Post and Telecommunications Institute of the former Ministry of Posts and Telecommunications (MPT). The institute was established in 1957 to conduct R&D for state-owned telecom firms, and experienced a lot of reforms in the 1980s and 1990s with the goal of making the institute’s R&D more responsive to the market. In this process, the institute was able to develop advanced technologies and products such as SCDMA, which was the basis for TD-SCDMA, and SP30, one of the leading large scale digital switches in China in the 1990s. In 1999 this institute was converted into a for-profit firm (Datang Telecom Technology and Industry Group). Now Datang is one of the biggest telecom equipment firms in China with assets of about 50 billion RMB and subsidiaries such as Datang Mobile, the subsidiary established in 2002 and dedicated to the development and commercialization of TD-SCDMA, and Datang Telecom Technology Co. Ltd., the subsidiary listed on the Shanghai Stock Exchange.

Datang was very active in promoting TD-SCDMA mainly for two reasons. First, Datang believed that TD-SCDMA could be an opportunity for it to improve its competitive position. When Datang was established in 1999, it was less competitive than ZTE and Huawei in the telecom equipment industry in China. TD-SCDMA seemed to be a good opportunity for Datang, because it was leading the development of TD-SCDMA.

Second, Datang’s top management believed that technology transfer from MNEs was not an effective strategy after China joined the WTO, and internal technology development was a better choice. One example is Mr. Zhou Huan. He was the Director General of the Department of Science and Technology of the former MPT before he became the Chairman of the Board and CEO of Datang. Mr. Zhou strongly believed in the importance of indigenous innovation and created a favorable environment within Datang to support the development of TD-SCDMA, although he was clear that his performance evaluation by the State Owned Assets Supervision and Administration Commission (SASAC) of the State Council could not be high with this kind of decision, because the return of promoting TD-SCDMA must be risky, slow, and uncertain when few people believed in the success of TD-SCDMA.

Datang was very active in promoting TD-SCDMA, but it encountered a lot of difficulties. Many people argue that the Chinese government has been active in supporting TD-SCDMA (Kshetri et al., 2011), the reality is that the Chinese government never made it clear that the TD-SCDMA standard must be adopted in China, and it was never clear which service provider(s) would be the key adopter(s), before the issuing of 3G licenses in 2009 (Li, 2010; Yang and Lu, 2010). Datang took a lot of actions to deal with the challenges, and these actions finally led to the adoption of TD-SCDMA by China Mobile in 2009. A chronology reflecting this process is reported in Table 1.

### Table 1: Chronology of TD-SCDMA development.

<table>
<thead>
<tr>
<th>Timing</th>
<th>Key events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-1990s</td>
<td>Datang developed SCDMA, the basis for TD-SCDMA</td>
</tr>
<tr>
<td>April 1997</td>
<td>ITU called for 3G proposals</td>
</tr>
<tr>
<td>January 1998</td>
<td>Xiangshan Mountain Meeting to discuss on how to respond to ITU’s call for proposals</td>
</tr>
<tr>
<td>June 1998</td>
<td>TD-SCDMA submitted to ITU</td>
</tr>
<tr>
<td>May 2000</td>
<td>TD-SCDMA approved by ITU as one of the 3G mobile communications standards</td>
</tr>
<tr>
<td>December 2000</td>
<td>TD-SCDMA Technology Forum established</td>
</tr>
<tr>
<td>March 2001</td>
<td>TD-SCDMA accepted by the 3rd Generation Partnership Project (3GPP)</td>
</tr>
<tr>
<td>November 2001</td>
<td>Agreement signed between Datang and Siemens to collaborate on TD-SCDMA</td>
</tr>
<tr>
<td>February 2002</td>
<td>Datang Mobile established by Datang to speed up TD-SCDMA development and adoption</td>
</tr>
<tr>
<td>October 2002</td>
<td>TD-SCAMA Industry Alliance established</td>
</tr>
<tr>
<td>April 2004</td>
<td>MTNet test to verify the capability of TD-SCDMA system to be deployed as a standalone network</td>
</tr>
<tr>
<td>March 2005</td>
<td>TD-SCDMA Industrialization Special Test to verify the commercial readiness of TD-SCDMA equipment</td>
</tr>
<tr>
<td>February 2006</td>
<td>Large-scale TD-SCDMA Network Application Trial project in five Chinese cities, and extended to ten Chinese cities including Beijing, Shanghai and Guangzhou in 2007</td>
</tr>
<tr>
<td>April 2008</td>
<td>TD-SCDMA pre-commercialization test project initiated in 10 cities such as Beijing, Shanghai, Tianjin, Shenzhen, and Qingdao</td>
</tr>
<tr>
<td>August 2008</td>
<td>3G services offered to Olympic Games through TD-SCDMA</td>
</tr>
<tr>
<td>January 2009</td>
<td>TD-SCDMA license awarded to China Mobile</td>
</tr>
<tr>
<td>December 2011</td>
<td>TD-SCDMA users reached more than 48 million, 40% of 3G users in China</td>
</tr>
<tr>
<td>January 2012</td>
<td>TD-LTE ADVANCED approved by ITU as one of the 4G mobile communications standards</td>
</tr>
</tbody>
</table>

Source: Composed by authors.

We also interviewed people from other organizations, including key equipment firms, handset makers, IC suppliers, service providers, the TD-SCDMA Industry Alliance (TD Alliance), the TD-SCDMA Technology Forum (TD Forum), the Ministry of Industry and Technology.

### Table 2: People interviewed at Datang.

<table>
<thead>
<tr>
<th>People</th>
<th>Position at Datang</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li Shihie</td>
<td>Senior vice president, Datang Mobile, in charge of technology, father of TD-SCDMA</td>
</tr>
<tr>
<td>Tang Ruan</td>
<td>Former CEO of Datang Mobile</td>
</tr>
<tr>
<td>Xie Yongbin</td>
<td>Senior vice president, Datang Mobile</td>
</tr>
<tr>
<td>Li Meng</td>
<td>Director, Division of Government and Enterprises</td>
</tr>
<tr>
<td>Yingjian Zhu</td>
<td>Director, Marketing Management Department</td>
</tr>
<tr>
<td>Duan Weilun</td>
<td>VP, Human resources</td>
</tr>
<tr>
<td>Cai Yuelin</td>
<td>Chief engineer for TD-LTE, Project Management Department</td>
</tr>
<tr>
<td>Ma Weiguo</td>
<td>Deputy general manager, state Key Lab of Wireless Mobile Communications</td>
</tr>
<tr>
<td>Ma Chao</td>
<td>Director, Telecom Technology Instrument Research Institute, Datang</td>
</tr>
<tr>
<td>Yuan Yong</td>
<td>Deputy general manager, Marketing Management Department, Datang Mobile</td>
</tr>
<tr>
<td>Zhou Yong</td>
<td>Senior Technology Manager, Marketing Management Department, Datang Mobile</td>
</tr>
<tr>
<td>Chen Zhanjun</td>
<td>Manager, Marketing Management Department, Datang Mobile</td>
</tr>
<tr>
<td>Liu Jie</td>
<td>Manager, Marketing Management Department, Datang Mobile</td>
</tr>
<tr>
<td>Zhang Yan</td>
<td>Manager, Marketing Management Department, Datang Mobile</td>
</tr>
<tr>
<td>Hua Yang</td>
<td>Former VP, Datang Mobile; General secretary of TD Alliance</td>
</tr>
<tr>
<td>Lu Yu</td>
<td>Senior manager, TD Alliance</td>
</tr>
<tr>
<td>Yang Yuanxi</td>
<td>Former manager, Marketing Management Department, Datang Mobile</td>
</tr>
<tr>
<td>Xiong Bingqin</td>
<td>Former CEO of Datang</td>
</tr>
<tr>
<td>Chen Shanzhi</td>
<td>Chief Engineer of Datang</td>
</tr>
<tr>
<td>Duan Chenhui</td>
<td>Manager, CEO’s Office, Datang</td>
</tr>
</tbody>
</table>

Source: Composed by authors.

3.2. Data collection

We are trying to identify Datang’s strategies from many decisions and activities related to TD-SCDMA, so this study is not a single case study design (Yin, 1989). We collected data mainly through interviewing people from Datang (Table 2), including Dr. Li Shihie, who is the former vice president of Datang and also is called the “father of TD-SCDMA” in China; Mr. Tang Ruan, former CEO of Datang Mobile; Mr. Chen Shanzhi, Chief Engineer of Datang; and other managers and engineers such as Mr. Li Ming, Mr. Zhu Yingjian, and Mr. Duan Weilun. The interviews were semi-structured and occurred between 2000 and 2010, mainly after 2003. During the interviews, we took intensive notes, because most of the interviewees preferred not to have the interviews taped. Interviews typically lasted 90–120 min.
Information Technology (MIIT), the former Ministry of Information Industry (MII), the Ministry of Science and Technology (MOST), and the National Development and Reform Commission (NDRC). People interviewed include the following, who have played major roles in the development of TD-SCDMA in China: Mr. Zhang Xinsheng, vice director general of the Division of Science and Technology, MIIT; Ms. Cao Shumin, vice president of the China Academy of Telecommunication Research (CATR); Professors Li Jiniang, Ding Shouqian, and Mr. Jin Luzhong, who wrote many letters to the top leaders (people above the Minister level) of the Chinese Central Government to promote TD-SCDMA; Mr. Wang Jianzhou, CEO of China Mobile; Dr. Wang jing, the former general secretary of TD Forum.

3.3. Data analysis

Following the principles of the grounded theory development approach, we conducted data analysis simultaneously with data collection (Glaser and Strauss, 1967; Glaser, 1978). Throughout the whole research process, the theoretical sampling principle and data saturation principle were followed. Commentaries were written on each interview and whenever a new theoretical concept emerged. At the early stages of the research, opening coding techniques were used. After core concepts such as latecomer disadvantage emerged, selective coding was followed. The research iterated between raw data, emerging theoretical concepts, related literature, and inter-relationships among the theoretical concepts.

What emerged from the data analysis process are two major findings. First, huge negative impact of latecomer disadvantage led to high market uncertainties and made the development and adoption of TD-SCDMA in China a complex, fragile, and arduous process. Second, Datang relied mainly on 3 strategies to promote the development and adoption of TD-SCDMA to overcome the negative impact of latecomer disadvantage: proactively getting government support; leading the development of the whole TD-SCDMA value chain; and working closely with public stakeholders. In the following we present these findings.

4. Key findings

4.1. A complicated process of developing and adopting TD-SCDMA

Compared with MNEs sponsored technology standards, TD-SCDMA encountered huge negative impact of latecomer disadvantage. Specifically, because TD-SCDMA was sponsored mainly by Datang, a latecomer that has insufficient resources and low reputation, people had deep doubts about this technology and were reluctant to adopt this technology. Even after TD-SCDMA was accepted by ITU as a 3G standard, many people believed that TD-SCDMA was a closed standard like Japan’s PDC system in 2G and would not be able to survive in the era of globalization (Li, 2006). In fact, before the founding of the TD Alliance in 2002, no company was willing to make strong commitment to TD-SCDMA except for Siemens.

A direct result of latecomer disadvantage was high market uncertainty, which was reflected in the difficulty of getting support from important stakeholders such as the government and telecom service providers. First, the Chinese government never publicly announced that TD-SCDMA would be used in China before issuing the TD-SCDMA license in January 2009, although it did offer other forms of support (government support would be discussed in detail in the following).

Accordingly to Mr. Zhou Huan, former CEO and Chairman of Datang, “I am not expecting that the Chinese government would choose TD-SCDMA as the only national standard for 3G mobile communications. What I am expecting is that the government could say that TD would be used even with 10 preconditions: TD is mature, TD is reliable, TD is low cost, TD is of high quality, …but now the government is not giving enough support” (interview with Zhou Huan: The only thing the government need to do is saying that TD-SCDMA will be used, retrieved from http://www.yesky.com/NetCom/2184245819274689056/20020325/1603907.shtml).

Dr. Li Shihe also commented: “TD-SCDMA will die soon, because government agencies have not developed a clear plan about this standard. No one has made it clear whether TD-SCDMA will be used in China, and no one knows which service provider will use this technology” (Li Shihe, Father of TD: TD is suffering a euthanasia. Retrieved from http://tech.sina.com.cn/t/2008-04-21/11532151035.shtml).

In December 2008 the TD Alliance and the Tsinghua University Research Center for Technological Innovation (RCTI) invited the key handset makers and the key IC makers along the TD-SCDMA value chain to have a workshop. The majority of these firms felt that they would have to cut their investment in TD-SCDMA, because they did not feel that the Chinese government was really supporting TD-SCDMA; although China Mobile was asked to build up the pre-commercialization TD-SCDMA network, it was fulfilling the task half-heartedly, and the government was not taking effective actions to change the situation.

Second, the major telecom service providers were not interested in adopting TD-SCDMA. Among the 6 telecom service providers before the restructuring of the telecom service industry in China in 2008, only two small firms, China Tietong and China Netcom, once showed some interest in adopting the TD-SCDMA standard.

The fact that there was huge market uncertainty in the development and adoption of TD-SCDMA is very different from technology standard adoption in developed countries. In Europe, both GSM and WCDMA, the 2G and 3G technology standards, got strong support from the government and service providers (Funk, 1998; Funk and Methe, 2001). Even in the US, although Qualcomm’s CDMA came late than TDMA, the 2G technology once supported by the majority of US telecom firms, CDMA was able to get support from service providers including PacTel, AT&T, NYNEX Mobile, etc. (Mock, 2005).

The potential opportunities from TD-SCDMA were widely recognized: this technology could help local firms to change their market positions. A senior manager from a well known local firm pointed out: “We are able to produce as high quality handsets as Samsung but are not able to charge as high price and capture as big market share. The direct reason is that our brand name is not as strong as that of Samsung, and the indirect reason is that Samsung started to make handsets earlier than us in using CDMA technology. TD-SCDMA is a local technology, and we have much higher probability to be a leader in this technology if we adopt it earlier than other firms, including MNEs”.

Despite the potential opportunities, local firms were cautious to invest in TD-SCDMA and this resulted in slow development and adoption of this technology. For example, one of the leading equipment firms could not offer qualified base stations for the trial organized by the government in the city of Baoding, Hebei Province, in 2006, because of its cautious investment. Similarly, the development of TD-SCDMA based handsets and measurement equipment also encountered a lot of delays. In fact, because of cautious investment, a lot of technical problems were not solved when China Mobile adopted TD-SCDMA in 2009, and the company had to publish a handbook to help solve these problems (China Mobile, 2010).

The huge negative impact of latecomer disadvantage made the development and adoption of TD-SCDMA in China a complex, fragile, and arduous process which lasted 11 years (from 1998 to 2009). During this period, it was necessary to coordinate many stakeholders, including different government agencies, which had different understandings and policies toward TD-SCDMA. This proved to be
a challenging task (Yang and Lu, 2010). In some cases, it was necessary to rely on top leaders' support and intervention to move on, but it was hard to get this kind of support and intervention (Li, 2006, 2010).

4.2. Getting support from the government

To deal with the challenges of latecomer disadvantage in promoting TD-SCDMA, Datang developed 3 strategies: (1) proactively getting support from the government. In this part, we discuss the first strategy; (2) taking the lead in developing the TD-SCDMA value chain; and (3) working closely with the public stakeholders. In this part, we discuss the first strategy.

Datang had a deep understanding about the importance of government support: (1) the telecom industry, especially the service sector, was heavily influenced by government policies; (2) when the major service providers were not interested in adopting TD-SCDMA, it was almost impossible to overcome the negative impact of latecomer disadvantage without government support. Accordingly, Datang was very active in getting support from the government in the whole process of TD-SCDMA's development and adoption. This strategy helped to reduce the negative impact of high market uncertainty and increase participation of firms along the TD-SCDMA value chain.

Datang was able to get government support by convincing some government officials, especially those from NDRC and MOST, that TD-SCDMA could play a crucial role in improving local firms' technological capabilities and changing the situation of relying too heavily on foreign technology. These government officials had a strong belief that indigenous innovation was becoming more and more important. After China joined the WTO in 2001, MNEs became very reluctant to transfer technology, worrying that local firms might become their strong competitors, or finding it more attractive to use their technology by themselves in an open market in China. Local firms relying mainly on transferring technology began to lose competitiveness because of increased competition from MNEs. This forced the Chinese government, especially MOST and NDRC, to begin to rethink the technology policy from the late 1990s, and finally made the decision in 2006 to make indigenous innovation a national strategy and build an innovative country (Chen and Liu, 2008; Gao, 2007).

Taking advantage of the changed policy, Datang convinced some government officials in related government agencies that TD-SCDMA provided an opportunity to implement the new policy of promoting indigenous innovation. Specifically, the government provided the following three kinds of support: signaling the willingness to support TD-SCDMA, offering financial support, and asking service providers to help with testing TD-SCDMA. Although these supports did not clearly create a market for TD-SCDMA, they did signal a government reputation based market.

First, signaling the willingness to support TD-SCDMA. A specific example was the allocation of frequency spectrum for TD-SCDMA. In 2002 the former MI announced the allocation of frequency spectrum for third generation mobile telecommunication. In this allocation, 180 MHz was allocated to FDD, while 155 MHz was allocated to TDD. This meant that if both WCDMA and CDMA2000 were put into use, each had 90 MHz, while TD-SCDMA could have 155 MHz. This was a strong signal to support TD-SCDMA.

Another example was the establishment of the TD Alliance in 2002. The process of creating this alliance was very difficult. According to Mr. Yang Hua, General Secretary of the TD Alliance and VP of Datang Mobile at that time, “It was very difficult at the beginning, and no one believed that TD-SCDMA would be successful. We visited a lot of companies, trying to persuade them to join the TD Alliance, and many firms refused even to meet us”. In fact, TCL, a well known company in China, agreed to be a founding member but withdrew at the last moment.

NDRC, together with MOST and the former MI, offered strong support to the creation of the TD Alliance. They not only pushed leading firms such as ZTE and Huawei to join the Alliance, but also offered financial support (about 700 million RMB) to help these firms get access to Datang’s technology. This kind of government support was of critical importance. As mentioned earlier, when TD-SCDMA was first accepted as a 3G technology standard, few people believed that TD-SCDMA would be successfully adopted, and few companies were willing to join the TD Alliance. Direct signal of government support helped to improve the credibility of TD-SCDMA, and indicated possible market opportunity.

Second, offering financial support. This was extremely important given Datang’s financial situation. Datang’s financial resources for R&D came mainly from four sources. (1) Internal money, especially at the early stage of TD-SCDMA’s development. In fact, before the setting up of Datang Mobile, the subsidiary set up by Datang to speed up the development and commercialization of TD-SCDMA in March, 2002, R&D for TD-SCDMA was done at Xinwei, another subsidiary of Datang, which was set up in 1995 and developed the key technology, SCDMA, for TD-SCDMA. (2) Bank loans. In the development of TD-SCDMA, Datang borrowed heavily from banks. In fact, Datang put its headquarters building in pledge in order to obtain bank loans to support the development of TD-SCDMA. (3) Government money used to support the TD Alliance. A big portion of the 700 million RMB supporting the alliance members went to Datang, paying Datang for sharing its TD-SCDMA technology with other members of the Alliance. Datang did not charge royalty for sharing its technology. (4) Government money used to support science and technology programs at different government agencies such as NDRC, MOST, and the former MI. Datang, as other firms, applied this kind of money.

In 2006 the telecom service providers were asked to support TD-SCDMA commercialization trials in “3+2” cities. (2) In 2007 the commercialization trials were expanded to 10 cities, including Beijing and Shanghai. (3) In April 2008 China Mobile was asked to offer TD-SCDMA service based on its pre-commercialization network in Beijing and other cities during the Olympic Games.
4.3. Taking the lead in the development of the whole TD-SCDMA value chain

Different from technology standards sponsored by MNEs, which were supported by many firms, including service providers (Gandal et al., 2003; King and West, 2002), TD-SCDMA was mainly sponsored by one firm (Datang) in the early days of its development. Datang quickly realized that it could not rely on itself and had to attract many companies to build up a complete value chain in order for TD-SCDMA to become a commercial success. Based on this understanding, Datang took a lot of measures, including some seemingly very strange measures, to build up the TD-SCDMA value chain.

First, sharing proprietary technology within the TD Alliance. The creation of the TD Alliance did not automatically lead to member firms’ strong support and investment in TD-SCDMA. In order to solve this challenge, Datang decided to share its proprietary technology, including source code, up to November 2003, with member firms of the TD Alliance. Some of the member firms such as ZTE and Potevio are Datang’s direct competitors. This was a very tough decision, because Datang’s overall industry position was (and still is) far behind ZTE and Huawei, especially in marketing capabilities.

Second, organizing competing firms to develop TD-SCDMA based handset IC (Zhao, 2009). The importance of IC is obvious for the development of the TD-SCDMA value chain. Datang leveraged its core technology to speed up the development of TD-SCDMA based IC. In 2000, Datang shared its TD-SCDMA technology with Chongqing Chongyou Information Technology (Group) Co. Ltd. (CYIT) in order for CYIT to develop TD-SCDMA based IC. For the same purpose, in 2002 Datang persuaded 16 MNEs and local firms to form COMMIT; in 2003 Datang set up T3G with Philips and Samsung. It also licensed its TD-SCDMA technology to STMicroelectronics, and formed close partnerships with ADI in 2003.

This practice was also very strange: these firms would ultimately compete with each other. In fact, the partners frequently asked Datang this question: If you chose to work with us, why do you also work with other firms in the same business? Datang knew that this was not the ideal choice, but there was no better choice to speed up the development of the TD-SCDMA value chain.

Third, coordinating activities of firms along the TD-SCDMA value chain. The development and adoption of the TD-SCDMA system was an extremely complex process, and involved the coordination of not only a lot of activities but also different interests. As the key technology sponsor, Datang had to play the coordinating role.

One channel for Datang to play the coordinating was the TD Alliance. Because many trials (MTNet trials, industrialization trails, and commercialization trials), which involved a lot of firms, were needed before large scale deployment of TD-SCDMA, the TD Alliance worked very closely with the firms along the TD-SCDMA value chain, and related government agencies such as the former MII and the current MIIT and successfully conducted these trials. In many cases, this was very difficult, especially when the service providers were involved. As mentioned earlier, these firms were basically not interested in adopting TD-SCDMA. In fact, in some cases these service providers were not cooperative, trying to use biased data from the trials to “prove” that TD-SCDMA is not a good technology.

4.4. Working closely with the public stakeholders

Datang’s third strategy was to build up an informal social network including public stakeholders (in addition to primary stakeholders such as shareholders, investors, employees, customers, and suppliers) such as noted scholars, government officials (including retired ones), and people in the media (Clarkson, 1995). The development and adoption process of TD-SCDMA indicated that the essence of latecomer disadvantage is that people have deep doubt about a technology from a latecomer, even if this technology is advanced. One role played by the public stakeholders and the informal social network was to inform government officials, especially top leaders, of the importance of TD-SCDMA.

A specific example was related to the previously mentioned three noted scientists’ writing the letter to the top leaders and requesting that the government support TD-SCDMA in 2005. These three scientists are not Datang’s shareholders, and their affiliated institutions have no direct relationships with Datang. They agreed to write this letter because Datang used the informal social network it built up to reach these scientists and convinced them that TD-SCDMA was important and the central government should support it. In fact, in the whole process of developing and adopting TD-SCDMA, Datang convinced many noted people to support TD-SCDMA through their writing letters to government officials, including top leaders.

The public stakeholders and the informal social network also played an important role in explaining the advantages and progress of TD-SCDMA to the public. As discussed earlier, most people believed that WCDMA and CDMA2000 were more advanced than TD-SCDMA, and this created huge negative impact on the development of TD-SCDMA in China. To address this problem, Datang asked some noted scholars to help. Professor Li Jiniang at the 7th Research Institute of the China Electronics Technology Group Corporation is a typical example.

One of Professor Li’s key research conclusions is that TD-SCDMA enjoys big technology advantages over WCDMA and CDMA2000. Professor Li also argues that the obvious technology advantage of TD-SCDMA would lead to low cost advantage (Li, 2006). Because Professor Li is a highly respected expert in wireless telecommunications in China, his study and publications directly helped the government build up confidence in supporting TD-SCDMA. In fact, Professor Li and his friends wrote many letters to the top leaders of the central government to share their understandings about TD-SCDMA and to request support of this standard.

Some public stakeholders were interested in helping TD-SCDMA for several reasons. First, public stakeholders believed they had the social responsibilities to do so. Many scholars felt they had the responsibility to tell the public “the truth” (their research results and their understanding) about the relative advantages and disadvantage of different technologies. For example, Professor Li Jiniang is a very famous professor and does not need to make himself known by supporting TD-SCDMA. However, he believes he has his responsibility. This could be partially understood from his book published in 2006 (Li, 2006). Second, public stakeholders have their own interests. The decision of adopting a specific 3G technology standard would have important impact on a lot of scholars’ career, because different people have expertise in different technological areas.

4.5. Effectiveness of Datang’s strategies

Judged from the following facts, Datang’s three strategies to promote TD-SCDMA were reasonably successful: (1) it gradually attracted a good number of firms, mainly local firms, to join the TD Alliance; (2) the Chinese government issued three 3G licenses, including TD-SCDMA, CDMA2000 and WCDMA in 2009; (3) Datang improved its industry position; and (4) TD-SCDMA provided a good foundation for TD-LTE and TD-LTE Advanced, new generations of mobile communications technology standards.

In more detail, Datang was able to gradually attract more and more firms to join the TD Alliance. Table 3 showed the number of firms which joined this alliance. When the alliance was first established in 2002, it was hard to persuade firms to support TD-SCDMA, and it only had 8 members. By January 2011, 84 organizations had
become members of the TD Alliance. The 84 members included equipment firms such as Datang, ZTE, Huawei, and Potevio; handset makers such as Lenovo, Hisense, TCL, and ZTE; IC suppliers such as T3G, Spreadtrum Communications, and CVIF; and service providers such as China Mobile and SK Telecom. These firms formed a complete TD-SCDMA value chain.

According to data from MIIT, by the end of January 2011, China Mobile’s TD-SCDMA users reached 22.6 million, China Unicom’s WCDMA users were 15.5 million, and China Telecom’s CDMA2000 users were 13.6 million. China Mobile had about 43.7% of the 3G market in China. By the end of Oct. 2012, China Mobile’s TD-SCDMA users reached 79.3 million. With the development of TD-SCDMA, Datang also improved its industry position. Datang is among the top three equipment suppliers for China Mobile’s TD-SCDMA network development (the other two top suppliers are ZTE and Huawei). Datang is also the leader in supplying ICs for TD-SCDMA handsets through its subsidiary, Leadcore Technology Co. Ltd.

In addition, new generations of technology based on TD-SCDMA (TD-LTE and TD-LTE Advanced) are attracting more and more firms from the world. By the end of September, 2012, 11 telecom service providers in the world had deployed 12 TD-LTE networks, and 24 telecom service providers had signed 31 contracts to deploy TD-LTE technology.

5. Discussion and conclusion

5.1. A sociopolitical process under transitional institutions

The above analysis indicates that, because of the huge negative impact of latecomer disadvantage, neither strategic maneuvering nor government regulation was able to play as important a role in the development and adoption of technology standards sponsored by latecomers as in developing and adopting technology standards sponsored by MNEs.

For example, Datang, the focal company, was extremely proactive in promoting TD-SCDMA. However, Datang had limited influence and was not able to play a dominant role in its strategic maneuvering. In many cases, it was not able to attract strong support, and had to rely on public stakeholders such as scholars to promote this technology. This was very different from the experience of Qualcomm when it was promoting CDMA: it was also a small firm but was able to gain strong support from stakeholders such as telecom service providers and equipment makers (Mock, 2005).

The Chinese government offered important support to TD-SCDMA as discussed earlier, but many policies were inconsistent. For example, the government was very supportive in making TD-SCDMA a 3G standard, but it failed to follow up. This is why Mr. Yang Hua claimed that 2002 was the dimmest year for TD-SCDMA, which was at the edge of death (Li, 2010; Yang and Lu, 2010). This was different from the strong support EU and South Korea offered to GSM, WCDMA, and CDMA (Funk, 1998; Funk and Methe, 2001; Jho, 2007).

The TD-SCDMA story did indicate that the development and adoption of technology standards sponsored by latecomers could be better understood from a sociopolitical process perspective as the extant literature suggests, but this process has two important features, which significantly enlarged the negative impact of latecomer disadvantage: (1) it was a complicated sociopolitical process without strong leading players; and (2) this process was heavily influenced by the transitional nature of the institutions (Scott, 2001).

The first feature of the sociopolitical process of adopting TD-SCDMA was obvious: When neither strategic maneuvering nor government regulation was effective, the many stakeholders, including public stakeholders, could not find a dominant player to lead them to move in the same direction. When the government failed to be a dominant leader, both China Mobile and China Telecom, the two leading service providers in China, declared many times that they preferred not to adopt TD-SCDMA, although Mr. Wang Xudong, the Minister of the former MII, pointed out at the end of 2005 and early 2006 that it was time to make a decision on TD-SCDMA’s commercialization, and the commercialization would be led by a strong enough service provider.

The lack of strong leading players is very different from the extant literature (Tushman and Rosenkopf, 1992; Carlson, 1991), and the public stakeholders had to play much more important roles in the development and adoption of technology standards sponsored by latecomers as discussed earlier. Similarly, Datang, the focal firm, had to take much more responsibility in developing the whole TD-SCDMA value chain in order for it to be successful. This was the key reason that Datang had a lot of seemingly strange behaviors such as sharing its proprietary technologies with its direct competitors. This was different from the situation of WCDMA or to a lesser extent, CDMA2000.

We now turn to the analysis on how the transitional nature of the institutions in China made the development and adoption of TD-SCDMA a difficult and complicated sociopolitical process. As briefly mentioned in the introduction section, the negative impact of transitional institutions came from the fact that new institutions could not offer strong enough support to TD-SCDMA and old institutions were still able to exert negative impact.

From the regulatory perspective, moving away from technology transfer to encouraging indigenous innovation was a big institutional change after China joined the WTO in 2001. However, the Chinese government did not have a clear understanding about how to make the transition. According to Mr. Zhang Xinsheng, vice director general of the Division of Science and Technology, MIIT: “at the early days we did not know how to support TD-SCDMA and indigenous innovation. We were used to technology transfer, which had been very successful in the telecom industry. We gradually recognized that there were big differences between technology transfer from MNEs and indigenous innovation”.

The transitional nature of the policy of moving away from technology transfer to indigenous innovation also made it difficult for different government agencies to develop consensus on how to make this transition. For example, how fast should this transition be? NDRC and MOST wanted to make this transition faster, while the former MII believed this should be a gradual process. Specifically, the telecom sector realized rapid development based on transferring technology from MNEs rather than developing technology internally (Zhang, 2000). Accordingly, many people at the former MII did not feel strong urgency to change from buying technology to internal development of technology. This was a major reason that government support from the former MII became much more ambiguous and uncertain after TD-SCDMA was accepted as a 3G technology standard, although it was very supportive in making TD-SCDMA a 3G technology standard in 1998.

Table 3

<table>
<thead>
<tr>
<th>Timing</th>
<th>Number of member firms</th>
</tr>
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<tbody>
<tr>
<td>October 2002</td>
<td>8</td>
</tr>
<tr>
<td>December 2003</td>
<td>14</td>
</tr>
<tr>
<td>November 2005</td>
<td>25</td>
</tr>
<tr>
<td>May 2006</td>
<td>29</td>
</tr>
<tr>
<td>June 2007</td>
<td>48</td>
</tr>
<tr>
<td>July 2008</td>
<td>58</td>
</tr>
<tr>
<td>June 2009</td>
<td>66</td>
</tr>
</tbody>
</table>

Source: Composed by authors.
From the normative perspective, the transitional nature of institutions also had big negative impact on the development and adoption of TD-SCDMA. Specifically, market protection could be helpful for reducing the negative impact of latecomer disadvantage (Cusumano, 1983; Kim, 1997). However, the situation of the local Chinese telecom equipment market was different. The Chinese government has chosen not to protect but to open the telecom equipment market in China since the early 1980s, and the Chinese wireless equipment market was dominated by MNEs when TD-SCDMA was accepted as a technology standard of 3G mobile communications. After many years’ dominance of MNEs as technology providers and market leaders in the Chinese telecom sector, local firms, including local telecom service providers, had developed the habits and routines to choose MNEs as the key business partners (Nelson and Winter, 1982).

MNEs’ dominant position implied that choosing TD-SCDMA was not the only choice. Because the service providers had been using GSM and CDMA for their 2G networks, it is understandable that they preferred to adopt WCDMA and CDMA2000, believing that choosing WCDMA and CDMA2000 was a natural upgrading of the existing technology, even though this was an incorrect understanding. This implied that there existed a lot of barriers to build up new habits and routines to work with local firms as technology leaders, and it would take time to choose local firms such as ZTE and Datang as the key business partners.

Of course, the fact that TD-SCDMA was behind in commercialization compared with WCDMA and CDMA2000 also contributed to Datang’s facing huge latecomer disadvantage. When TD-SCDMA was accepted as a 3G standard, leading local firms such as Huawei and ZTE had made significant investment in WCDMA and CDMA2000. When there were a lot of technology, market, and policy uncertainties facing TD-SCDMA, it was understandable that local firms chose to keep investment in TD-SCDMA at a limited level.

From the cognitive perspective, the transitional nature of institutions also had big negative impact on the development and adoption of TD-SCDMA. For example, theoretically, TD-SCDMA is an advanced technology and has obvious advantages in areas such as intelligent antennae, which makes it possible for service providers to optimize their TD-SCDMA network through software, and higher spectrum usage efficiency (Li, 2009, pp. 110–111; Xu, 2007). In fact, according to Dr. Szabo, chief scientist of the wireless product division, Alcatel-Lucent, compared with FDD technology, “In bottom line, using TDD the ‘Efficiency’ of the System in the same Frequency Band and Bandwidth, can be up to 2 times higher with 8 Transmit/Receive Antennas” (email with Dr. Szabo, September 18, 2012).

However, because the key sponsor of TD-SCDMA was Datang, people had deep doubts about this technology. Some even argued that Datang was just cheating in order to get support from the government (Li, 2010). A report by Nuosheng published in 2006 said that Datang only held 12.2% of patents regarding TDD and 15.2% regarding SCDMA, while Siemens held 21.6% and 21.2%, respectively (http://news.ccidnet.com/art/1032/20060120/931123_1.html).

Datang did not agree with this report and argued that this report failed to make a distinction between ‘essential patents’ and ‘non-essential patents’. Our interview with people from Datang (especially Professor Li Shihe) indicates that Datang holds most of the ‘essential patents’. Professor Li Shihe also pointed out: “IP issue should not be a barrier for the commercialization of TD-SCDMA. Even if other firms such as Qualcomm hold some ‘essential patents’, we could negotiate with them. I met the CEO of Qualcomm, and we have consensus on this, because business is business” (interview with Li Shihe, Beijing, April 2, 2008).

5.2. The importance of developing special capabilities

The extant literature emphasizes the importance of developing innovation capabilities and new technologies in catching up (Fan, 2006; Gao et al., 2007; Perez and Soete, 1988; Shen, 1999), in addition to the capability to transfer and absorb mature technologies from MNEs (Amsden, 2001; Kim, 1997; Lall, 1982; Lee and Lim, 2001; Westphal et al., 1985). The findings of this study suggest that innovation capabilities and the development of new technologies are needed but far from sufficient for a latecomer to promote a technology standard such as TD-SCDMA. It is necessary to develop special capabilities such as getting support from the government and working closely with public stakeholders.

The development of capabilities to get government support could be a very difficult task. Datang had to work with various government agencies, which might have different understandings about and attitudes toward TD-SCDMA and Datang, especially when there were contrasting views about TD-SCDMA (is TD-SCDMA an advanced technology, are Datang and its partners able to survive in the competition with WCDMA and CDMA2000, is it appropriate for the government to get involved in the promotion of a specific standard, etc.). Datang had to do a lot of explanation work, and learn how to figure out who were truly willing to support TD-SCDMA and who were not.

The importance and difficulty of getting government support also explains the necessity of developing the capability to work with various groups of public stakeholders such as scholars, and get their support. Similar to the situation of government agencies and government officials, in the process of developing this kind of capability Datang had to do a lot of explanation work, and learn how to figure out who were truly willing to support TD-SCDMA and who were not.

To some extent, allocating resources to the development of non-technology capabilities implies that resources that could be spent on technological capability development would be reduced. However, because of the huge impact of latecomer disadvantage, Datang had to invest in the development of non-technology capabilities. Put differently, without the development of capabilities to get support from the government and public stakeholders, a latecomer like Datang would not be able to get its technology standard commercialized.

5.3. Conclusion, limitations and future studies

As pointed out at the beginning of the paper, we intended to answer three questions in this study: (1) what are the strategies used by Datang to promote TD-SCDMA; (2) are these strategies similar or different from those used by MNEs; and (3) how to make sense of the similarities or differences. We found that Datang used three strategies (proactively getting support from the government, taking the lead in developing the TD-SCDMA value chain, and working closely with the public stakeholders) to promote TD-SCDMA.

We also found that these strategies are very different from those used by MNEs, and the differences mainly came from the fact that the development and adoption of TD-SCDMA was a complicated sociopolitical process, which was heavily influenced by the transitional nature of the Chinese institutions. Specifically, the transitional nature of the Chinese institutions significantly enlarged negative impact of latecomer disadvantage and made the development and adoption of TD-SCDMA a sociopolitical process without strong leading players that could play a dominant role. The complicated sociopolitical process also means that special capabilities such as getting support from the government and working closely with public stakeholders, in addition to the development of strong technological capabilities, are crucial in promoting a latecomer developed technology standard.
The highly complicated process of developing and adopting TD-SCDMA involved a lot of interesting theoretical and practical questions. In this paper we only focused on the strategies taken by Datang and how to make sense of these strategies. This means that our understanding of this process was very limited. In order to broaden and deepen our understanding, future research could explore in directions such as the following.

First, is it possible to generalize Datang’s strategies to other settings? For example, is Datang’s strategy of working closely with public stakeholders (such as persuading some top scientists to write a letter to the top leaders, requesting that the government support TD-SCDMA) a common strategy for latecomers in all developing countries, or is it just a unique strategy for China, as it is a transitional economy where government officials have great power in the development and promotion of a technology standard?

The extant literature seems to suggest that Datang’s above strategy could be applied in more settings, because this strategy, in essence, belongs to nonmarket strategies, which are important for firms in industries involving government regulations in any county (Baron, 1995, p. 50; Baron, 1997). In the US, 3M worked very closely with FDA (Food and Drug Administration) during the development of its cochlear implant products (Van de Ven et al., 1999). Firms in Asian countries seem to have to rely more on nonmarket strategies because governments in these countries have strong influences over their economies (Evans, 1995; Linden, 2004). The findings of this study also suggest that nonmarket strategies could be more important for latecomers, especially when they are operating in the contexts of transitional institutions.

Second, what are the costs and benefits of having TD-SCDMA from a social welfare perspective? Specifically, was it worthwhile for China to have an indigenous standard? Was it a pursuit by the Chinese government to satisfy its techno-nationalism (Lee and Oh, 2006; Suttmeier and Yao, 2004; Suttmeier et al., 2006), regardless of its cost on the government budget and national welfare? Or was it an important means to facilitate technological innovation capability development (Zhan and Tan, 2010), which is similar to the Korean experience, which suggests that a nation should not be discouraged by slow progress in standard setting during early stages, because this could be a good learning opportunity (Choung et al., 2011).

The calculation of social welfare is always a challenging task, especially because of “the impossibility of knowing what the outcome would have been in the absence of the policy, from which the true opportunity cost of the resources can be calculated” (Linden, 2004, p. 22). However, the extant literature does find that it is possible for government intervention to result in inefficient standard as the case of HDTV illustrates (Jordan, 1994; Pelkmans and Beuter, 1987). In China, consumers had to wait until 2009 to enjoy 3G service, while in other countries telecom operators started to provide 3G service in 2002. The loss of consumer welfare by not having high-speed telecommunication service during the 7-8-year delay plus the cost for R&D is the cost which China paid for having TD-SCDMA. If we could have a better understanding about this cost, we would be able to develop a better understanding about promoting a latecomer-developed technology standard.

Third, what are the impact of the strategies used by MNEs in developing and adopting TD-SCDMA on their business in China? For various reasons, most MNEs were not active in developing TD-SCDMA, and the result is that they are marginalized in the TD-SCDMA market, capturing less than 20% of the market share. However, in TD-LTE, MNEs have been much more active, and are more likely to capture higher market share. This raises the question of what are the appropriate strategies MNEs need to have when host countries such as China have policies similar to the promotion of TD-SCDMA and indigenous innovation.

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