Subtheme: Transferring technology and knowledge to SMEs: the role of government and Higher Education Institutions, financial instruments creating a culture of knowledge-based SMEs

Title: Transferring technology to industrialising countries: the role of government

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1. Introduction

To compete in the global economy, firms in industrialising countries need to acquire and develop their technological capabilities. An important channel for firms to develop their technological capabilities is international technology transfer (Dahlman and Westphal, 1982; Lall, 1987; Kim, 1999). The scope of technology transfer is not only about appropriating and using transferred technologies but also about assimilating and creating local technologies (Bell, 1996; Kim, 1991; 1999). However, domestic firms in industrialising countries, even in more advanced countries such as Korea required a certain degree of intervention and facilitation from government to achieve the target of technology transfer. In particular, for mega infrastructure projects such as high-speed rail in which government is a buyer and owner but not a recipient or 'learner' of the bought technologies. It is domestic firms and industries who are technology recipients and learners. In this case, it is required that government intervenes in technology transfer process which includes organising, facilitating the process, and generating a tripartite cooperation of technology development. That is government, domestic firms, and universities and research organisations. This paper analyses evidences from two-country cases in order to demonstrate how government can play an important role as a facilitator in international technology transfer process. In contrasting between two cases of transferring high-speed rail technologies, the Korean represents a successful experience whereas the Thai demonstrates an unfulfilling story. Following this introductory section, the second discusses the dynamic perspective of technology transfer in industrialising countries connecting technology and development and highlights a limitation in previous research which focusing on firms at both ends of technology transfer process. The third explains the use of a case study method. The fourth and the fifth analyse the evidences of the Thai and Korean cases respectively. The sixth provides discussions and conclusions of this paper.

2. International technology transfer

In the literature, 'international technology transfer' has been indicated as a mechanism or process by which industrialising countries acquire technical knowledge which is not available in their own countries (Cooper and Sercovich, 1970; Fransman, 1986). Technical knowledge refers mainly to know-how required for setting up production facilities in industrialising countries.

Earlier researches have concentrated on the 'appropriateness' of acquired technologies i.e. using the technologies for production purposes (e.g. Fransman, 1986). Many attentions have been later shifted to a dynamic perspective related to technology and development. That is adaptation and assimilation of the acquired technologies and creation of their own ones (Bell, 1996; Radosevic, 1999). This perspective pulls together technology transfer and technological capability accumulation concepts.

Following this perspective, frameworks of technology transfer have been developed for analysing, for instance, what is transferred 'via the transfer of technology'? By what mechanisms is it transferred? How might variation in these affect the development of technological capabilities and innovation systems in those countries? (Bell, 1996; Kim, 1999). As a result, several distinctions have been made between tacit and codified knowledge, formal and non-formal mechanisms, the active and passive role of foreign suppliers and domestic recipients of technologies (Kim, 1999). These distinctions are useful analytical tools for explaining facilitators and barriers for technology transfers.

However, because most firms are on both ends of technology transfer, either as transferors or as recipients, the role of government is less considered. But, this is not the case of mega infrastructure projects, for instance, mass-transit or high-speed rail projects in which government is a buyer but not a recipient of technology transfer. In fact, it is domestic firms who are ‘learners’ of technologies although they are not the buyer of those technologies. In addition, a market mechanism alone would likely be found insufficient to facilitate technology transfer from foreign suppliers to domestic firms. As widely indicated, most firms in industrialising countries have low absorptive capacity for adopting, adapting, and assimilating foreign technologies on their own (Bell, 1996; Kim, 1999; Arnold et al., 2000). Hence, it may be required that government plays an important role in that technology transfer process which includes facilitating the process through organising a tripartite cooperation of technological capability development amongst domestic firms, and universities and research organisations.

3. Methodology

This research adopts a case-study method. For the Korean case, the author relies extensively on the secondary sources of information whereas in the Thai case the author conducts in-depth interviews with key persons in charge of the project implementations. Given the limitation of data collection in the Korean case, the author will give more analyses in the Thai case and use the Korean as a ‘shadow’ case. In fact, the large gap of technological development levels between Thailand and Korea means that a ‘direct’ comparison between them is not possible. However, the benefit of analysing a successful story like the Korean is that possible policy recommendations might be drawn for helping future development of a less successful country such as Thailand.

4. The case of Thailand

The city of Bangkok has endured a severe traffic congestion problem for several decades. In 1974, the Thai government started a study on using a mass-transit system in Bangkok for alleviating the problem. Although the study results clearly indicated and recommended an implementation of a mass-transit system, the project did not become a reality. Subsequent governments have attempted to revise the study plan and relevant investment options. Still, contracts were terminated before the construction even began.

As the chronic congestion problem became worse and worse, the local government i.e. the Bangkok Metropolitan Administration (BMA) could not wait longer the implementation of a mass-transit system. In 1992, BMA awarded a concession for the Bangkok’s first mass-transit system on a Build-Operate-Transfer (BOT) basis to Tanayong Company, the then Bangkok Mass Transit Public Company Limited (BTSC). After resolving pre-construction problems, the construction began in October 1996 by Italian-Thai and Siemens as a turnkey contractor. In 1999, the operation of the first mass-transit system in Bangkok started and the system is known as a BTS sky train. In 2000, the second line of a mass-transit system in Bangkok was built under the master plan of central government. Yet, the concession scheme is different i.e. government invested in civil infrastructure and a private company installed and operated the rolling stocks. Once again, Italian-Thai won the construction contract and Siemens was in for rolling stocks and mechanical and electrical (M&E) rail-system installation. Opened in 2004, the system is operated by Bangkok Metro Public Company Limited (BMCL) and became known as an MRT underground train.

Having successfully constructed and operated two mass-transit lines in Bangkok, the government has set a master plan to build a network of hundreds of kilometers of routes to help further the congestion problem. This includes a construction project of Airport Rail Link (ARL) connecting the Bangkok's new Suvannabhumi Airport with the City Terminal Station and the inner city area. For this project, the Thai government decided to hand it to the State Railway of Thailand (SRT), a state enterprise supervising the country's long-distance trains. Hence, unlike BTS and MRT, ARL is owned and operated by SRT. In this case, the Thai government can and should make the most of a government procurement strategy for technological development in the country. However, it was not so as elaborated below. The country continues to enjoy buying foreign technologies without any serious effort to absorb, assimilate and create its own technologies.

SRT did not adopt a government procurement strategy that supports domestic technological development. In fact, major concerns of the government on a mass-transit system are on route alignments, construction problems and perhaps importantly investment options. Rarely have a consideration on the transfer of bought technologies and the development of domestic industry capabilities been made seriously. Accordingly, SRT concentrated on the project bidding costs and construction. Following the review of proposals from three bidders, a consortium led by Sino-Thai Engineering & Construction Public Company Limited won the contract with around 26 billion Thai Baht, in early 2005.

In fact, there was a clause concerning technology transfer in the contract but extremely thin. The technology transfer component was composed mainly of obtaining related manuals and instructions about utilising and operating technologies and some local and oversea training of SRT personnel and staff. SRT was not aware that domestic firms and industries, rather than itself as the project owner, were true recipients of technologies. As a result, there was no outsider i.e. industries and research organisations involvement in the technology transfer process. That means SRT was the only recipient of knowledge and transferred technologies. Still, personnel and staff assigned for attending the training courses were those who are timely available, not the ones responsible for operating and maintaining technologies.

However, this is not unexpected because the SRT has adopted a rather static perspective on international technology transfer. That is, a process by which knowledge and technologies is acquired from external sources and utilised by SRT. Such view may simply imply that the scope of international technology transfer would mean the ability of a recipient to acquire and use imported technology accordingly. This is insufficient as clearly pointed out by Mowery and Oxley (1997:140) that "…technology transfer can rarely be embodied in a "book of blueprints", and even more rarely transferred as such. International technology transfer, like domestic technology transfer, is a costly, time-intensive and knowledge-intensive process.". As a result, the Thai government tends to pay the price of purchasing rather than the cost of learning technology.

That means in search of building their technological capabilities in order to be suppliers of railway parts, domestic firms have to make their own efforts to connect directly with the main contractor, Siemens. Unsurprisingly, only some firms are successful. Even so, learning technology was rather limited. Without strong support from government, it was difficult for domestic firms and industries in Thailand to absorb, adapt and develop technologies locally (Arnold et al., 2000; Intarakumnerd et al., 2002).

Nonetheless, there is an initiative for changing. In 2009, the Thai government re-worked on a 20-year master plan for expanding a mass-transit network in Bangkok and extended city area covering 508 kilometres with around budget of 830 billion Thai Baht (MOT, 2009)[1].With this ambitious investment, the Ministry of Science and Technology (MOST) set up a committee tasked to develop a policy framework with regard to technology transfer from foreign suppliers to domestic firms (MOST, 2009). The committee was composed of representatives from the Ministry of Science and Technology, Ministry of Transport, Ministry of Industry, Federation of Thai Industries, government research organisations and universities. As a ground work, the Office of Industrial Economics (OIE) under the Ministry of Industry commissioned a study to investigate the existing technological capabilities of domestic railway-related industries including electrical and electronics, building and construction, automotive, and mechanical parts. The study results categorised the levels of domestic firms' existing capabilities into three main groups – strong, moderate and weak. The results revealed that domestic firms have strong capabilities in building civil infrastructure and manufacturing air-conditioning and lighting systems, and moderate in supplying utility system and traction feeding system, but weak in producing several major railway components such as controlling and signaling systems and locomotive, bogie and brake systems of rolling stocks (OIE, 2009). Figure 1 summarises the existing technological capabilities of domestic firms in railway-related industries classified by railway-work components. Capabilities asides, Thai firms in automotive and electronics industries were keen to involve in the railway-related industries.

[1] The master plan was approved by the cabinet on 9 March 2010.

Table 1: Level of the existing technological capabilities of domestic firms in railway-related industries

Railway component	Level of the existing technological capabilities		
	Strong	Moderate	Weak
1. Civil work			
On-grade concrete structure	√		
Elevated concrete structure	√		
Underground structure	√		
2. Track work			
Ballasted track	√		
Ballastless track		√	
3. Rolling stocks			
Bogie			√
Brake			√
Car train mainframe		√	
Coupler			√
Electrical and power supply		√	
Locomotive			√
Train control system			
Lighting	√		
Air conditioning	√		
4. Electrical work			
Utility system		√	
Traction feeding system		√	
5. Signaling			
Level 1			√
Level 2			√
6. Others			
Automatic Fare Collection		√	

NB: Strong = firms currently produce and supply parts to railway industry

Moderate = firms currently supply parts to non-railway industries and have the potentials for supplying railway-related industry

Weak = firms currently have no capabilities to produce parts for railway-related industry

Source: OIE (2009)

During the course of policy development, the committee agreed that the target was for the country to become a major supplier of railway-related parts, unlike Korea who had set itself to be a global manufacturer of the overall railway system. Hence, rather than a world-class research centre in railway engineering, a technical research institute to assist domestic firms and industries to assimilate technologies was expected.

In November 2010, a proposal was submitted by the committee to a sub-cabinet committee chaired by the Prime Minister for final approval. The proposal had two main parts. The first was about public procurement strategies aiming to facilitate the transfer of technologies to domestic firms. The second included a railway-related industries' roadmap including a plan for setting-up a railway technical research institute to help coordinating and assisting domestic firms to absorb and assimilate transferred technologies. Yet, the proposal was not approved and returned for further revision. So, it is to be seen if Thailand can take this high-profile opportunity for acquiring and absorbing railway-related technologies and building domestic firms' technological capabilities in railway-related industries.

5. The case of Korea

Korea drafted a plan to build a high-speed rail in 1989, broke the ground in 1992, signed a construction contract in 1993 and finally opened its first service between Seoul and Busan in 2004 (Lee, 2011). When Korea started implementing the high-speed rail project in 1993, the Korean government set its target to developing local high-speed rail technologies toward self-reliance within 10 years of technology transfer from foreign suppliers. Hence, from the very beginning, the government played an active role. Beginning from the procurement process, the Korean government considered intensively proposals of three major bidders from three countries, namely Japan, France, and Germany. The selection was based on three criteria – cost, financial agreement and arguably most important, technology transfer. The Eukorail Consortium led by France's Alstom Group won the contract due to its most convincing programme, among all bidders, to transfer technology to Korea. According to the contract clauses, Alstom would transfer the core technologies composed of rolling stock, catenary electrification system, train control system, and carried out more than 50% of the engineering design, production and testing of these core systems locally (Lee and Moon, 2005:259). In addition, Korea dispatched around 1,000 persons a year to France to obtain theoretical class-room trainings and on-the-job trainings (Lee and Moon, 2005:259).

In order to achieve technology transfer programme, the Korean government established a specialised research organisation, the Korean Railroad Research Institute (KRRI). Apart from carrying out basic research on its own right, KRRI was designed to be a focal point of managing technology transfer process. In the process, KRRI became a 'match-maker' in matching local firms including Daewoo, Hyundai Rotem and Samsung with the technology owner, i.e. Alstom, in acquiring the core components of technologies. For instance, the first 12 of 46 rail trains were manufactured and delivered by Alstom from France while the remaining 34 were developed in Korea by Hyundai Rotem under a license contract with Alstom (Lee 2011:96). The role of KRRI is similar to that of an intermediary organisation in an industrialising country context bridging the gap between firms' absorptive capabilities and external knowledge (Dodgson and Bessant 1996:55; Intarakumnerd and Chairatana 2008). Obviously, the role of KRRI was crucial in making the process of transferring technology successful. Without KRRI, it could have been inefficient for local firms and industries 'to match' with the technology owner by themselves. In addition, there were a number of local universities and R&D organisations such as the Korea Institute of Industrial Technology (KITECH) that were ‘matched’ in technology transfer process (Lee and Moon 2005:259).

At the time of technologies being transferred from Alstom, the development of a Korean model was underway. As a result, an innovation network was formed between domestic firms in 38 railway-related industries, universities and government research organisations, with basic research being carried out by KRRI and universities (Lee, 2011:99). Importantly, the Korean perspective on transfer of technology went well beyond the acquisition and use of technologies – to include adaptation, assimilation and creation of local own technologies (Dahlman and Westphal, 1982; Lall, 1987; Kim, 1999). In 2003, Korea has achieved the design and manufacturing of the Korean high-speed train model, Korea Train eXpress (KTX-I) with a localisation rate of 92% (Lee and Moon, 2005:259).

In short, Korea spent around 4 years (i.e. 1993-1996) for absorbing Alstom technologies and spent 6 years (i.e. 1997-2002) to assimilate and develop trains based on its own technologies, KTX-I. By 2002, Korea began work on a Korean new generation train, KTX-II and applied technologies successfully in 2006 (Lee, 2011:96). In 2010, KTX-II was delivered on domestic route (KTX-Sancheon) (Lee, 2011:96). Following this achievement, Korea has set to develop further local technologies and a domestic railway industry through overseas expansion of Korean technologies (Lee and Moon, 2005:261). Recently, Korea has launched a proposal to become a Brazil’s partner to build 510 kilometres high-speed rail connecting three major cities i.e. Rio de Janeiro, São Paulo and Campinas in preparation for 2016 Olympic Games (Koh, 2011).

6. Discussions and conclusions

This paper indicates the important role of government in technology transfer process. This is particularly important for mega infrastructure projects in which government is a buyer of technologies but not the true recipient of transferred technologies as such. It is required that government pays a key role in organising, facilitating the process and generating a tripartite cooperation of domestic technological development. That is government, domestic firms and universities and research organisations.

In the case of Korea, government was active in organising and facilitating the process, from the stage of procurement of foreign technologies to development of local own technologies. During the procurement stage, government paid much attention to the technology transfer programme offered by the potential bidders, apart from cost and financial proposals. Then, the Korean government set up a state-owned research organisation i.e. KRRI to function as a ‘match-maker’ between the contractor i.e. Alstom and domestic firms to facilitate technology transfer and development. Importantly, the Korean government adopts a dynamic perspective on technology transfer that goes beyond the acquisition of technologies to include assimilation and creation of local own technologies. That resulted in Korea spent the last 6 of the 10-years technology transfer programme to develop Korean owned high-speed rail technologies. By the end of the programme i.e. 2003, Korea delivered successfully Korean high-speed rail based on its own technologies (KTX-I).

In contrast, the Thai government did not make the most of public procurement to facilitate technology transfer to domestic firms and industries. SRT Airport Rail Link was a case where government did not aware that domestic firms rather than SRT were the true recipient of technologies. In addition, its perspective on technology transfer was rather narrow – only considering the acquisition and utilisation of technologies. So, the transfer of technology was limited. Although there was an initiative for public policy change on technology transfer and development, it is yet to be materialised.

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