Measuring Innovation in Late-comer Countries: An Experience from Thailand

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Abstract

This study is mainly about understanding innovation through innovation surveys, and using them to inform policy. It highlights that with late-comer countries, innovation surveys can play a particularly important role. Nonetheless, late-comer firms and countries are different from the forerunners. An example of Thailand Innovation Survey is used here as an example to highlight the shortcomings of standard surveys and provide suggestions for suitable adaptation. The study suggests that for 'less' successful late-comer countries, more attention on passive technological learning of firms and persistent systemic failures is necessary to make the survey more effective for policy purposes.

Keyword: Late-comer countries, late-comer firms, innovation surveys, systemic failures, Thailand

1. Introduction

Today's world economy has been characterized as a "Knowledge-Based Economy" (OECD, 1996) with knowledge being the most important resource and learning being the most important process (Lundvall, 2003). Innovation is regarded as one of the most important factor in the Knowledge-Based Economy (Asia-Pacific Economic Cooperation, 2000). It is, therefore essential not only for developed but also developing countries to foster innovation, especially at the firm level, since firms, not countries, are the ones that have to compete internationally.

A new and trendy approach to measure innovation at present is Community Innovation Survey (CIS) firstly developed by OECD countries. The standard set of guidelines for innovation surveys, the OSLO manual was prepared in 1992. Afterwards, The CIS was conducted in all member states of the European Union and has been implemented every four years starting in 1993. The innovation survey plays an important role in generating policy relevant information about innovation processes, innovation behaviour and innovation performance.

Nonetheless, there are criticisms of innovation surveys especially when they are applied to late-comer countries. This is because innovation systems of late-comer countries are fundamentally different from those of developed ones. Unlike frontier countries, actors in innovation systems in late-comer countries (firms, government agencies, universities, research institutes and so on) are weak and not linked to each other in system-like manner. Institutions like appropriate intellectual property right regime, laws and regulations, entrepreneurship are not well in place. Systemic learning is rather limited (Arocena and Sutz, 1999; Gu, 1999). Among late-comer

countries, there are also differences. It can be divided into two groups: the more successful and less successful ones. The learning-intensive nature of innovation systems of the former led to successful catching up with the forerunners, at least in some industrial sectors. This is, for example, the case of East Asian Newly Industrialised Countries or NIEs (Korea, Taiwan, Singapore). On the other hand, the innovation systems of the latter are too weak and fragmented to do so. This is the case of most developing countries in Asia, Africa and Latin America (Intarakumnerd *et. al*., 2002)

The paper is mainly about understanding innovation through innovation surveys, and using them to inform policy. It highlights that with late-comer countries, innovation surveys, if appropriately adjusted, can play a particularly important role in innovation policy formulation and implementation.

The outline of the paper is as follow: Section 2 will provide a short discussion on the innovation studies literature in late-comer countries. Then section 3 will highlight theoretical debate on the problems of measuring innovation and the roles of innovation surveys on this. It will also briefly map out several initiatives in adjusting innovation surveys to fit the context of late-comer countries. Section 4 will examine the case of innovation surveys in Thailand, one of 'less successful' late-comer countries. Section 5 will draw some implications on how to improve the present innovation surveys to measure innovation in late-comer countries and help policy makers in those countries to formulate, implement and evaluate better innovation policies.

2. The Nature of Learning in Late-comer Countries

Understanding differences across countries in their level of development and the reasons for backwardness have been a central concern of economists for a long time. However, it was Alexander Gerschenkron in his "Economic Backwardness in Historical Perspective" (1962) who explicitly asserted that development problem was a catch up problem. He analysed on the policies and new institutions of the states of continental Europe during the mid and late 19th century as they strove to catch up with the U.K., and reflected on the present day relevance of this experience. Based on such analysis, Gerschenkron proposes the theory of *late-comer* advantages which stressed that the late-comer firms could acquire and use the latest technology, at much lower costs than the pioneering countries by transfer agreements, inward investment and the recruitment of skilled people.

His view is supported by Parez and Soete (1988) who point to 'windows of opportunity' of late-comer countries in acquisition and assimilation of existing technologies. Nonetheless, they also argue that late-comer countries had disadvantages that the cost of imitation could be rather high in absence of an infrastructure which is in place in forerunner countries. So the successful exploitation of such late-comer advantages depends on appropriate social, industrial and technology policies of countries. This is similar to Moses Abramowitz' propositions (1986) about the institutional and political conditions explaining why countries catch up, forge ahead, and fall behind. For him, the differences among these countries are

largely attributed to the presences or absence of social capability for institutional changes, and especially for those types of institutional change which facilitate and stimulate a high rate of technical changes, i.e., national innovation systems.

The concept of national innovation system can provide a 'holistic' view in understanding reasons behind successful catching up or falling behind. The roots of the innovation systems (IS) concepts are based on the Schumpeterian economics, emphasising innovation and entrepreneurship, combining with the essence of evolutionary theory of Charles Darwin. The emergence of the NIS concepts, particularly in the industrialized countries in the Northern hemisphere, can be traced back to the mid 1980s (see Lundvall, 1985, Freeman, 1987; Nelson, 1988). NIS is the interactive system of existing institutions, private and public firms (either large or small), universities and government agencies, aiming at the production of Science and Technology within national borders. Interaction among these units may be technical, commercial, legal, social and financial as much as the goal of the interaction may be development, protection, financing or regulation of new science and technology (Niosi et al, 1993: 139).

Applicable and conceptualized studies on NIS of late-comer countries have been done by Arocena and Sutz (1999) and Gu (1999). They provide 'comprehensive' understanding and insights on NIS in developing countries. Both studies share the views that the NIS concept for developing countries is 'ex-ante', which opposed to an 'ex-post' concept suitable for developed countries whose institutions are working in a system-like manner. This is because micro-innovative strengths that exist in developing countries remain isolated and encapsulated and many of institutions relevant to the innovativeness do not exist. Arocena and Sutz (1999) point out further that industrial innovation in developing countries is highly informal, i.e., not products of formally articulated R&D activities. In addition, dominant cultural patterns of these countries undervalue scientific knowledge and technological innovation.

Intarakumnerd *et.al*. (2002) elaborates further by differentiating between 'more successful' and 'less successful' national innovation systems of late-comer countries. For the former, as in the case of East Asian Newly Industrialising Economies (NIEs), institutions and systems were built and shaped to produce 'intensive learning' which facilitated technological catching up processes (see Kim, 1993; Hou and Gee, 1993; Wong, 1996; Wong, 1999). The latter's national innovation systems are, on the other hand, too weak and fragmented to produce intensive learning. The differences will be illustrated further in Section 4 which will compare a less-successful national innovation system of Thailand with those of East Asian NIEs.

Hobday (1995) applies the concept of latecomer to the firm level. He defines a latecomer firm as a firm that faces two sets of competitive disadvantages in attempting to compete in export markets. The first disadvantage is technological in nature. Latecomer firms are behind technologically, lacking in research, development and engineering capability. Their surrounding industrial and technological infrastructure is poorly developed. It operates in isolation from the world centres of science and innovation. The second disadvantage concerns international markets and demanding users. Latecomer firms are dislocated from demanding international markets that help to stimulate technological advance and innovation. To succeed, these latecomer firms have to devise mechanisms to overcome these two

disadvantages. He demonstrates at length how electronic firms in East Asian NIEs used OEM and ODM[i] mechanisms to advance their technological capabilities and access to demanding markets in advanced countries.

Latecomer firms have different level of technological capabilities. Technological capabilities are classified differently by different people. The most comprehensive and well-accepted one is Bell and Pavitt (1995). They develop their technological capability framework based on Westphal et al. (1985) and Lall (1992). Firstly they differentiate "technological capabilities" from "production capacity". The latter incorporates the resources used to operate existing technological systems (i.e., to produce goods at given levels of efficiency and given input combinations). On the contrary, technological capabilities are resources needed to generate and manage technological change. These include skills, knowledge, and experience as well as the particular kinds of institutional structures and linkages necessary to produce inputs for technical change. They also distinguish between "depths" of technological capabilities. A basic level of capabilities permit only minor and incremental technical change, whereas technological capabilities at the intermediate and advanced levels, may result in more substantial, novel and ambitious change. Functionally, they classify capabilities into types: facility user's decision-making and control, project preparation and implementation, process and production organization, product-center, developing linkage and capital good supply. They emphasise that more successful late-comer firms in Korea and Taiwan, before being able to produce more original innovations as of today, have developed strong capabilities for generating continuous incremental change in technologies initially acquired from forerunner countries. In less-successful late-comer firms elsewhere, the accumulation of this kind of technological capability within firms has been much more limited.

Similarly, Amsden and Hikino (1993) point to the unique historical setting of the 20th century, that is, the increasing codification of technology and the widening opportunities to buy foreign technology for the 'post-adolescent' or 'mid-tech' industries has allowed firms in late-comer countries to diversify to several industries (1993: 246; 1994: 124). The diversification of these firms takes the technologically 'unrelated' direction. This is because of the absence of proprietary technology in latecomer firms to move up to the higher end of the industry and/or to diversify into other 'related' industries like large industrial enterprises in advanced countries. Therefore, the latecomers firms have evolved as 'learners', not innovators, by borrowing and improving technology already commercialised by innovating firms from developed countries. Moreover they argue that at initial stage of development, not 'innovative' capability in generating new products and processes like in advanced countries, but the so-called 'project execution capability', the skills required to establish or expand operating and other corporate facilities (including undertaking pre-investment feasibility studies, project management, project engineering, procurement, construction and starting up operations), plays a supporting role in the diversification process, for example, the case of Korean conglomerates during the 1960s-1970s.

3. Initiatives in Measuring Innovation in Late-comer Countries

Measuring innovation is not easy because innovation is, by definition, novelty. However, there have been several attempts to measure innovation. Traditional indicators like R&D and patent have been used for a long time as proxies of innovation. There is, nonetheless, dissatisfaction with these indicators. R&D data is always constrained as an innovation indicator, as it measures an input only (Kleinknecht et al. 2002). Using it as an indicator also implies that R&D being the primary source of innovation, while neglecting the importance of non-R&D inputs to innovation: design activities, engineering developments, and experimentation, training and exploration of markets for new products and so forth (Smith, 2005). It is biased against all industries, especially low-technology ones, that employ non-R&D methods of knowledge creation. For patent, it is an indicator of invention rather than innovation. Further, some types of invention and technology are not patentable. There is also a sizeable share of patents that never translated into commercially viable products and processes, and firms may not commercialise patent but use it just to prevent a competitor patenting and using a similar invention (Kleinknecht et al. 2002).

To have theoretically sounder indicators based on innovation studies literature, OECD developed a proposed guideline for collecting and interpreting technological innovation data, which became known as Oslo Manual in 1992. Based on the manual the European Commission started to implement Community Innovation Survey. The CIS goes beyond traditional indicators by incorporating several aspects of innovation: non-R&D inputs to innovation process, source of information relevant to innovation, technological collaboration among actors in innovation systems, perception of obstacles to innovation and factors promoting innovation and so on. Though the main focus of the survey is private firms, the latest edition (2005) of the Oslo manual expand the innovation measurement framework in three important ways: greater emphasis on the role of linkages with other firms and institutions in innovation process, more recognition of the importance of innovation in less R&D-intensive industries such as services and low-technology manufacturing, and broader definition of innovation to include organizational innovation and marketing innovation.

Nonetheless, for late-comer countries, their technological learning patterns are different from those of forerunner countries both at the level of firm and innovation system, as mentioned above. It is necessary to have a different or supplementary set of indicators for measuring innovation and technological capability accumulation. There are several initiatives on this.

The strongest attempt in devising indicators of technological innovation for late-comer countries and making innovation survey fit better with conditions of latecomer countries was carried out by Latin American scholars especially those belong to the Iberoamerican Network of Science and Technology Indicators (RICYT). The result of their attempt is the Bogota Manual for Standardisation of Indicators of Technological Innovation in Latin American and Caribbean Countries (2001). Subsequently, this group of Latin America scholars (led by Lugones and Peirano) used the Bogota manual as a base, together with comments of researchers and practitioners with experiences in innovation surveys in developing countries, to develop an Annex of the Oslo Manual (2005) for Innovation Surveys in Developing Countries. The Bogota manual and the annex of the Oslo Manual emphasis the four following characteristics

of the innovation process in developing countries, which are very much in line with the aforementioned literature on late-comer countries and firms. *Acquisition of embodied technology* (equipment) for both product and process innovation is a major component of innovation. *Minor or incremental changes* can be the most frequent type of innovation activity in some developing countries, together with innovative applications of existing products or processes. *Organizational change* is extremely significant in the innovation process. Besides its direct impact on firm performance, it also contributes to the firm's preparation to absorb new technologies incorporated in machinery and other equipments (the most frequent type of innovation). Heterogeneity frequently prevails with regards to firms technological, organizational and managerial patterns, with 'high tech' firms coexisting with *informal* businesses (in many cases the majority), and with organizational structures not being professionalized enough, leaving much room for organizational change, often independent from product and process innovation processes. Finally, innovations in the *agricultural sector* have high economic impact, due to its significant overall economic weight.

Therefore, according to Bogota Manual and the Annex of Oslo Manual, priority given in developing countries to measuring **innovation capabilities** should focus on the following aspects that have received less attention elsewhere: human resources (e.g. number of skilled employees, level of qualification, numbers of training hours, technological training linked to new processes and products, management and administrative training), linkages (frequencies by type of linkage, frequencies by agents or institutions, causal objects/actor relationship, and degree of satisfaction obtained from links and link assessment), quality assurance systems, and incorporation and use of ICTs (separating front and back-office activities). The surveys should also include these activities: hard ware purchase, software purchase, industrial design, engineering activities, lease or rental of machinery, equipment and other capital goods, in-house software system development, and reverse engineering.

Another very recent study is done by a respected Latin American scholar, Judith Sutz (2006). She proposes very interesting concept linking innovation and underdevelopment together. Underdevelopment, she argues, can be very partially but not inaccurately characterized as an 'innovation as learning' systemic failure. There is a mismatch between the available capabilities to use and search for knowledge to solve problems and the opportunities to put such capabilities to work for that aim. She suggests that future innovation surveys in developing countries should include the following features: including in the design people with experience in measuring public opinion; formulating questions in a way that allow respondents of very different backgrounds to recognize what they really do in terms of searching how to solve problems, an issue that requires in particular to revise the definition of R&D; ensuring that questions related to human resources are made to the whole sample, regardless if firms declare or not to have introduced innovations during the period of analysis, so the negative indicator "not having skilled human resources" can be fully analyzed in relation to different types of firm characteristics (size, sector, exports, type of capital, performing of innovation); assuring that not only the level of studies of the working force will be asked, but that the field of knowledge will be asked as well for the whole personnel of the firm; allowing for all types of linkages to be included, particularly with technological tailors; designing carefully the "innovative activities" section, allowing idiosyncratic features to emerge, to assure that the

category “potentially innovative firm” will be fully recovered; reserving a space for identification of technological demand, linked to questions related to actual policy instruments and those that the respondents may envisage.

Also, at the request of the New Partnership for Africa’s Development (NEPAD), UNU-MERIT led by Lynn Mytellka was invited to develop an innovation survey instrument that would be of utility to African countries now interested in stimulating innovation and building knowledge-based countries. The study ‘Designing a Policy-relevant Innovation Survey fro NEPAD’ was finished in 2004. According to this study, the focus on manufacturing and/or manufacturing and service sector firms has tended to bias questionnaires towards those factors internal to the firm that shape choices about whether to innovate, the kind of innovation (product, process, organizational or marketing) and through what means (licensing in, arms length purchase of new generation machinery and equipment, in-house design and product development, in-house R&D, collaborative R&D). The study, therefore, recommends the adoption of a focus on the enterprise sector, complemented by questions that provide indicators of the broader set of linkages and knowledge flow that are needed for a dynamic innovation system. Similar to the Latin America’s Bogotá Manual, the UNU-MERIT study calls for a broader definition of innovation in the context of developing countries to include the process by which firms master and implement the design and production of goods and services that are new to ‘the firms’, small improvements in product design and quality, changes in the way production is organized and knowledge managed, the introduction of new maintenance routines, creativity in marketing and modifications in production processes and techniques, and the introduction of process innovations through the purchase of machinery and equipment or through the licensing-in of technology.

4. Innovative Capabilities and Competitiveness of Firms in Thailand: An Analysis from Innovation Surveys

This section will take Thailand as an example of ‘less-successful’ late-comer country where innovation surveys based on CIS have been conducted. We will investigate the lessons learned from such surveys leading to suggestions for carrying out innovation surveys in less-successful late-comer countries in the final section (Section 5). Before examining the design and implementation of innovation surveys in the country, as a background, the evolution of Thailand’s national innovation system will be highlighted in comparison with ‘more successful’ late-comer countries, the East Asian NIEs.

4.1 A General View on Evolution of Thailand’s National Innovation System

Thailand is a late-industrialising country. Before WWII, Thailand developed very small manufacturing capacity, which was mainly related to agriculture produce, rice and timber. The change came when the international demand for rice fall and Thai government started to induce foreign direct investment through Industrial Development Act in 1954 (Siriprachai, 1994). Afterwards, though Thailand’s

economic growth rate in the past 40 years is rather impressive, several studies of Thai firms conducted since the 1980s state that most firms have grown without deepening their technological capabilities in the long run, and their technological learning has been very slow and passive (see Bell and Scott-Kemmis, 1985; Chantramonklasri, 1985; Thailand Development Research Institute, 1989; Dahlman and Brimble, 1990, Tiralap, 1990; Mukdapitak, 1994; Lall, 1998). A more recent study commissioned by the World Bank confirms this long-standing feature of Thai firms. Only a small minority of large subsidiaries of transnational corporations (TNCs), large domestic firms and SMEs have capability in R&D, while the majority is still struggling with increasing their design and engineering capability. For a very large number of SMEs, the key issue is much more concerned with building up more basic operational capabilities, together with craft and technician capabilities for efficient acquisition, assimilation and incremental upgrading of fairly standard technology (see Arnold et.al., 2000). The slow technological capability development of Thai firms is quite different from what characterised East Asian NIEs. Firms in these countries moved rather rapidly from mere imitators to innovators. In general, late-comer firms in Korea and Taiwan, where industrialisation started more or less in the same period as in Thailand, were more successful in increasing absorptive capacity (of foreign technology) and deepening indigenous technological capabilities in several industries (see for example, Amsden, 1989, Kim, 1993, Lall, 1996, Hobday, 1995, Kim, 1997).

Why did Thailand fail to technologically catch up like those of East Asian NIEs such as Korea, Taiwan and Singapore? As mentioned earlier, apart from firms' behaviours and ability to learn, the differences in performance can be explained by examining their national innovation systems. While national innovation systems of East Asian NIEs were built and shaped to produce 'intensive learning' which facilitated technological catching up processes, the innovation system of Thailand has been too 'weak and fragmented' to do so (Intarakumnerd et.al. 2002).

Up to the government of Prime Minister Thaksin Shinawatra (January 2001-September 2006), scope of S&T policy in Thailand was rather narrow. It covered only four conventional functions, namely, research and development, human resource development, technology transfer, and S&T infrastructure development. This narrow scope of S&T was very much based on the perception that private firms were "users" of S&T knowledge mainly produced by government agencies and universities (see Arnold, et. al. 2000). There was no articulate national innovation policy. Though the word "innovation" was mentioned in several national plans, it was not whole-heartedly incorporated into the scope of S&T policies (see Lauridsen, 2002). In addition, unlike Japan, Korea, and Taiwan, S&T elements were not part of broader economic policies namely, industrial policy, investment policy and trade policy and, to the lesser extent, education policies (see Intarakumnerd, et.al., 2002).

Industrial policy of Thailand did not pay enough attention to the development of indigenous technological capability as an integral factor in the process of industrialisation (Sripaipan, Vanichseni, and Mukdapitak, 1999:37). Investment policy, especially the promotion of foreign direct investment (FDI), aimed primarily at generating inward capital flow and employment. There were virtually no selective policy measures, such as special credit allocation and special tariff protection, targeting particular industries or clusters. Interestingly, with the exception of automotive industry, there was no reciprocal performance-based criteria (such as

export and local value added and technological upgrading targets) set for providing state incentives like in Korea or Japan (see Johnson, 1982; Amsden, 1989; Chang, 1994; Lall, 1996).

As for public Research and Technology Organisations (RTOs) which have direct responsibility for developing S&T capability of the countries, RTOs in Thailand mainly focus on R&D with limited industrial relevance, not on building lower level capability such as technology assimilation and adaptation, designing and engineering, which are the technological thresholds faced by most Thai firms. In this aspect, Thai RTOs behave differently from those of NIEs in the 1970s and 1980s, when their level of development was more or less at the same level of Thailand. Korean Institute of Science and Technology (KIST) or Industrial Technology Research Institute (ITRI), for example, emphasised institutional and technical supports for industrial technological capability development within firms, such as helping firms to solve their operational problems and develop absorptive capacity, and disseminating foreign technologies to local firms through mechanisms like R&D consortiums and spin off (see Hobday, 1996; Mathews, 2007).

The major change in policy came recently under the Thaksin government. This government, unlike its predecessors which had paid most attention to macro-economic stability, focused more on enhancing meso- and micro-level foundations for international competitiveness. It was the first time that Thai government had serious "selective" policies addressing specific sectors and clusters. The government declared five strategic clusters which Thailand should pursue: automotive, food, tourism, fashion, and software. Building innovative capabilities of the nation was highly regarded as very important factor increasing and sustaining Thailand's international competitiveness. "Innovative nation with wisdom and learning base" was one of seven Thailand's Dreams projected by the government (see Phasukavanich, 2003).The new ten-year Science and Technology Action Plan (2003-2013) places the concept of national innovation system and industrial cluster at its heart. The scope of the plan is much broader than the aforementioned four functional areas. Measures to stimulate innovations and to strengthen national innovation system and industrial clusters are explicitly highlighted. Special investment package promoting "Skill, Technology and Innovation or STI" has been initiated.

Nonetheless, while the Thaksin Government was farsighted in trying to spearhead longer-term growth by targeting specific industries, the transformation from plans to specific policy programmes and to implementation took considerable time. This is because lower levels of the bureaucracy did not succeed in coherent implementation of concrete measures. They failed to provide real changes in terms of enhancing technological and innovative capabilities of firms in Thailand. They simply adjusted to the new government's catchwords of competitiveness, SMEs, entrepreneurship and community enterprises without delivering tangible and long-lasting outcomes. Obviously, there were path dependency and inertia in policy formulation process due to the problem of locking in old paradigms (Intarakumnerd and Chaminade, 2007). Thaksin government acknowledged the problem and tried to carry out public sector reform initiatives. However, several elements of the reform were not implemented and there was considerable political meddling with the administration. The overall picture of the regime was thus that of a mixed record that did not qualify to an

effective technological upgrading policy as East Asian NIEs did previously during the 1960s-1980s (Lauridsen, 2008).

Moreover, what Thaksin government (as well as previous governments) really ignored is the importance of building qualified pool of science and technology personnel, the issue being so crucial to the success of Japan and East Asian NIEs. Weak secondary education and vocational training creates inadequate skill base that has been an indispensable factor to a strong technology development. At university level, academia faces difficulties in adjusting its curriculum to suit the changing industrial needs. On the other hand, firms find it difficult to access the right channels to academia (College of Management, 2003: 20).

4.2 Thailand's Experiences in Innovation Surveys

To assess the innovative capabilities and innovation characteristics of firms in Thailand, Innovation Surveys have been carried out by the National Science and Technology Development Agency (NSTDA) in the year 1999 and 2001 and 2003.

The survey adopted definitions and methodologies used by OECD (namely, Frascati Manual and Oslo Manual) and other countries in Asia (namely Singapore, Malaysia, Japan, Taiwan and Korea) to meet international standard.

A) Technological and Innovative Capabilities of Thai Firms

The population size, sample size, and response rate, percentage of R&D-performing firms and innovating firms are illustrated in Table 1.

Table 1: Thailand's Innovation Surveys: Characteristics and Overall Results

	1999	2001	2003
Size of population			
- manufacturing sector	13,450	14,870	16,432
- service sector	n.a.	26,162	5,221
Total	**13,450**	**41,032**	**21,653**
Size of sample			
- manufacturing sector	2,166	3,945	4,850
- service sector	n.a.	2,137	1,181
Total	**2,166**	**6,082**	**6,031**
Response rate (%)			
- manufacturing sector	47.0%	36.7%	42.3%
- service sector	n.a.	37.3%	45.0%
Total	**47.0%**	**36.9%**	**42.8%**
R&D performing firms (%)			
- manufacturing sector	12.7%	4.4%	7.2%
- service sector	n.a.	0.2%	2.4%
Total	**12.7%**	**1.7%**	**6.0%**
Innovating firms (%)			
- manufacturing sector	12.9%	4.7%	6.4%
- service sector	n.a.	1.4%	4.0%
Total	**12.9%**	**2.6%**	**5.8%**

Source: Reports on R&D/Innovation Surveys Year 1999, 2001, 2003 by National Science and Technology Development Agency (NSTDA)

The percentages of innovating firms are very low. This confirms weak innovative capabilities of firms in Thailand, a less-successful late-comer economy. Next, we will analyse the survey more in details, especially in comparison with the one conducted in Korea, which is selected to represent a 'more successful' late-comer economy with 'intensive learning' capability. Here we will analyse the Thailand 2003 survey with the results of a survey in more or less the same period of time, i.e., the Korea Innovation Survey (KIS) 2002[ii]. KIS 2002 only covers the manufacturing sector. We will limit our comparison to the manufacturing sector only, since the literature on late-comer countries and firms mainly focus on that sector. Knowledge of characteristics and learning behaviours of these firms in the service sector is rather limited. Also, the Community Innovation Survey can be argued that it is, and was intended to be, manufacturing-specific and that extension to services would always be problematic (Smith, 2005).

Table 2 shows clearly those companies in Thailand lag far behind companies in Korea in respect to innovation and R&D activities. It strikes that a relatively high share of companies in Thailand carry out solely process innovations. At the same time very few companies in Thailand do product as well as process innovations, which is quite common in Korea If we apply the aforementioned frameworks of Bell and Pavitt (1995) and Amsden and Hikino (1993) here, it is obvious that Korean firms have already deepened their technological capabilities to the 'advanced' level, as a large percentage of firms could have product and process innovation. Many of them have already attained capability to conduct R&D (Table 5). On the other hand, only a small number of Thai late-comer firms have developed 'innovative capability'. The differences between the two countries are large regardless of firms size (Table 3) and ownership (Table 4). The differences become larger in the science-based industries such as chemicals and electronics than resource-base industries like food and labour-intensive industries like wearing apparel.

Table 2: Share of innovating companies

	Thailand	Korea
Innovating	6.4 %	42.8%
Product and process innovation	2.9%	21.0%
Only product innovation	4.1%	17.0%
Only process innovation	4.3%	4.0%

Table 3: Share of innovating companies in respect to firm size

	Thailand	Korea
SME*	7.3%	41.0%
Large Company*	14.4%	78.0%

* The definition of SMEs is different in Korea and Thailand. In Korea companies with less than 300 employees are defined as SMEs, while in Thailand companies with less than 200 employees are defined as SMEs. Because these categories relate to the general structure of the economy, no levelling has been applied.

Table 4: Share of innovating companies in respect to ownership

Thailand		Korea	
Partly owned by TNC	12.2%	Affiliates of foreign firm	52.0%
		Affiliates of Korean firm	59.0%
100% Thai ownership	10.2%	Independent firm	42.0%

Table 5: Share of companies that conduct R&D and different types of R&D

	Thailand	Korea
TOTAL	11.0%	51.8%
In house	11.0%	42.8%
Contract R&D	2,0%	3.1%

It would have been very useful, if the survey had asked about firms other types of technological capabilities, not only 'innovative' one, namely, 'production' and 'investment'. It should ask about the 'level' of capabilities lower than advance level, i.e., mainly on R&D. Now we can only estimate that technological activities of most firms in Thailand are still focused on production, and their technological capabilities are either at the basic or intermediate levels.

Innovating companies were further asked about the objectives of their innovation activities. Again, the original 5-point scale was converted into a 100-point scale. Table 6 displays that there are common important objectives to conduct innovation in Thailand and Korea, such as 'improve product quality', 'reduce costs' and 'extend product range'. However, two objectives are rated distinctively different: 'Increase market share' and 'Replace products being phased out' are clearly more important in Korea than in Thailand. Especially, the latter leads to the conclusion that Korean companies are operating in a different business segment. Presumably they are closer to the 'leading edge of technology' and therefore are at an early stage of the product-life cycle. This segment is characterized by short product-lifetime and fierce competition, which causes companies to introduce new products frequently and trying to achieve short 'time to market' Thai companies, on the other hand, seem to be located at the more mature phases of the product-life cycle, where they produce rather mature products and therefore do not have to conduct innovations in order to replace product being phased out that often.

Table 6: Importance of Objectives of Innovation

	Thailand	Korea
Improve product quality	83.3	87.5
Learn about new technology	80.8	-
Reduce production cost	77.4	75.8
Reduce labour costs	-	73.2
Extend product range	74.9	72.7
Improve cycle time	69.8	-
Increase market share	69.2	83.4
Improve production flexibility	69.0	64.3
Open up new markets	68.7	70.5
Reduce energy consumption	68.0	-
Fulfil regulations& standard	64.0	-
Comply with domestic regulation	-	62.4
Respond to international standards	-	61.7

Reduce environment effects	63.6	64.2
Improve work conditions for employees	63.4	71.4
Replace products being phased out	56.9	80.5

What activities of firms do affect innovation? It is interesting to see the positive relationship between R&D and innovation in the case of Thai firms. For example, in 2003, the percentage of R&D-performing firms that have innovation (71%) is much higher than that of non-R&D-performing firms that carry out innovation (29%). The econometric study by Abhinorasaeth (2007) based on the survey in 2003 shows positive correlation between R&D and innovation. On that year, one third of total expenditure on innovation activities of manufacturing firms was spent on R&D. However, late-comer firms in Thailand spent more on acquisition of machinery and equipment (Table 7), this is in line with previous studies described before that late-comer firms relying more on acquiring existing technology available somewhere else, especially in forerunner countries.

Table 7 Percentage of Expenditure Innovating Firms in Thailand Spent on Innovation Activities in 2003

Activities	Percentage of Expenditure
R&D	32.55
- *Intramural*	*30.18*
- *Extramural*	*2.37*
Acquisition of machinery and equipment	51.30
Acquisition of external knowledge	1.94
Training (internal & External)	1.95
Market introduction of innovations	8.77
Design and other preparations for production/deliveries	3.49
Total	**100.00**

The results of the surveys in the year 1999 and 2001[iii] also suggest that majority of innovating firms also conducted non-R&D activities more than R&D. These activities are necessary for technological learning of late-comer firms, namely reverse engineering (50% of innovating firms), detailed design (60%), testing (90%), and quality control (90%).

B) Linkages between Firms with other actors in Thai national innovation system

Firm's innovativeness also depends on how well they position themselves in national innovation system of host countries, i.e., how well they develop linkages with and

learn from other actors in the system such as governmental research institutes, universities, government agencies, and financial institutions.

Korean as well as Thai companies were asked about the importance of different sources of information for their innovation activities. Table 8 displays that internal sources (which have not been further distinguished in the Thai survey) are generally most important for innovation activities of firms in both countries. For external sources of information, customers are the most import sources of innovation-related information in both countries. However, while competitors and patents are important sources in Korea, they are hardly considered important in Thailand. This is presumably a reflection of the lack of absorptive capacity in Thai companies. It requires a substantial amount of absorptive capacity to use information that can be gained from competitors (e.g. via reverse engineering) or patent disclosures. On the other hand, companies in Thailand rely upon information provided by parent or associate companies much more than Korean companies do. This hints towards a certain degree of dependence of companies/subsidiaries on parent (mostly foreign) companies when it comes to innovation.

Table 8: Evaluation of the importance of different sources of information for innovation activities

Thailand (n= 299)		Korea	
	INTERNAL		
Sources within the enterprise	82.0	CEOs idea	75.6
		Production	74.1
		Engineering	72.1
		Development	84.2
		Research	81.5
		Marketing	77.5
		Purchasing	61.5
	EXTERNAL		
Patent disclosures	32.0	**Patents**	59.8
Fairs and exhibitions	53.1	**Exhibition**	65.5
Internet	63.0	**Internet**	64.9
		Trade Associations	44.2
Universities or other higher education institutes	35.8	**Universities**	53.6
Gov. or private non-profit research institutes	29.5	**Public Research Inst.**	52.6
		New personnel	51.9
Clients	77.4	**Customers**	77.7
Locally-owned suppliers	59.9	Equip. suppliers	57.7
Foreign-owned suppliers	54.8	Component suppliers	61.7
Competitors	42.1	**Competitors**	69.3
Parent/ associate company	61.2	**Enterprise within the group**	52.9
Business service providers	33.1		
Technical service providers	40.2		
Professional conference & meetings	55.2		

Specialist literature	56.6

N.B. bold expressions indicate an exact matching of the answers, while standard text does not have an equivalent.

Moreover, Korean companies acknowledge the importance of universities and public research institutes more than Thai companies do. This could be explained in three ways. Thai companies may lack the 'absorptive capacity' necessary to be capable of interacting with and learning from the S&T knowledge producers like universities and public R&D institutes. Thai university and public research institutes are of limited quality, which restricts the interest of companies to use it as information sources. There is a mismatch between what Thai universities and public research institutes can provide and what firms in Thailand want. Also it indicates that communication channels between the two sides are quite poorly developed, as stated in previous studies.

Interestingly, Korean companies regard enterprise within the group as important source of information. This is not surprising as many companies are members of Chaebols (big family business groups having activities in several sectors). Korean firms possess high capability in assimilating and diffusing imported technologies through capable engineers. Mobility of experienced engineers within Chaebols was an important process of diffusion (see Amsden and Hikino, 1993).

How well firms can access financial sources to finance their innovation activities is very important issue. At present, the venture capital industry may become the most suitable form of external finance of innovations especially at risky and early stage of product development**.** In Thailand, the result of the surveys shows that only around 5-10% of sampled firms have received venture capital for their R&D and innovation activities between the years 1999-2001.

C) External Environment Affecting Firms' Innovative Activities

In general, firms consider that the environment for innovation in Thailand is rather positive, with an average score of 3.1 (out of 5). They consider that openness of customer to innovation and attitude of people towards innovation as well as openness of suppliers to innovation are strong factors supporting the innovation environment (see Table 9). Intellectual protection environment which is significant in stimulating invention has been viewed relatively favourable in the survey. This reflects more serious enforcement of intellectual property protection by government in the past years. Societal attitudes, namely, acceptance to failure, trust and attitude on collaboration are also institutional context affecting innovation. The surveys illustrate that entrepreneurs in Thailand has rather low level of acceptance to failure. Nonetheless, surveyed firms did value long-term strategic collaboration between each other, as 63.5% of them perceive this as important or rather important for innovation. This implicitly shows that 'trust' between firms is relatively high.

Another special characteristic of the Thai Innovation Survey that standard CIS do not have is that there are questions regarding awareness and effectiveness of some

specific government supporting programmes provided by certain government agencies such as tax incentive for R&D, subsidy, technical services, consulting services, and so on. The result is not so impressive, as most surveyed firms do not use such programs. In some cases, firms in general do not even know their existence. For example, on average, firms perceive rather positively about the availability of government financial incentives for innovation (around 3 out of 5 points); but, on closer examination, only 2.7 % of surveyed firms has used 200% tax incentives for R&D, 7% has used 150% tax incentives for training and less than 4% received grants from Ministry of Science and Technology and National Science and Technology Development Agency (NSTDA). Not surprisingly, innovating firms used such incentives more than non-innovating firms.

Table 9: Assessment of Innovation Environment

(1 = very weak; 5 = very good)

Business Environment	Mean
Openness of customers to innovation	3.5
Attitude of people towards innovation	3.4
Openness of suppliers to innovation	3.4
Quality of telecommunications and IT services for enabling innovation	3.4
Availability of suitable manpower in business sector	3.3
Technological sophistication of local suppliers	3.2
Intellectual property protection	3.2
Availability of suitable manpower in scientific technical sector	3.1
Openness of government departments & regulatory authorities to innovation	3.1
Consultancy support services	3.0
Local university for technical support and R&D collaboration	3.0
R&D institutions for technical support and R&D collaboration	3.0
Acceptance of failure	3.0
Regulatory environment	3.0
Availability of finance for innovation	3.0
Availability of government incentives for innovation	2.9
Availability of other technical supporting services	2.9
Listing requirements on SET stock exchange	2.8

To summarise, innovation surveys point out that firms in Thailand are lagging behind in terms of enhancing their technological and innovative capabilities, improving learning process, and forging linkages with other actors of its national innovation system. The Thai characteristics might be able to categorised as those of ‘less successful’ late-comer economy, which are contrasting to ‘learning-intensive’ fast catching-up one like Korea. The standard CIS is quite helpful to differentiate the characteristics of different catching up countries. However, the Thai surveys have ‘special’ characteristics which have implications for conducting surveys in other developing/catching up countries as follows:

First, they illustrate stronger attempt to make the survey more relevant to the level of country’s economic and technological development which is still in ‘catching-up’ phase. Questions concerning learning mechanisms, besides R&D, and significant capabilities for late-comer economy, namely, reverse engineering, detailed design, testing, quality management were included. Nonetheless, they fail to include several

activities on investment and production functions and specify the level of technological capabilities of firms.

Second, they shows stronger attempt to make the survey more policy relevant. Questions regarding usage and effectiveness of 'specific' government programmes aiming at enhancing innovative capabilities of firms, such as tax incentive, grant, technical supports were directly asked. Therefore, policy makers can use the information to improve those specific programmes. The results from the surveys confirm previous studies that not only R&D but also these technological activities are important activities for the surveyed firm.

4. Conclusion and Suggestions for Innovation Surveys for Late-comer Countries

Innovation survey, itself, is an innovative step towards understanding innovations in firms. It is based on innovation studies literature, especially the innovation system concept. The survey covers the innovation activities of firms and their interaction between each other and with other actors and institutions in innovation process and innovation system. The survey has high potential to be used for formulating innovation policies. Though the survey was first design for developed countries, more and more late-comer countries have adopted the surveys. Nonetheless, as illustrated in previous studies, late-comer firms and countries are different from the forerunners in terms of historical context, capabilities of actors, embedded institutions and opportunities and difficulties to innovate. As a result, there have been several initiatives (for example, the Bogotá Manual and the Annex of the recent Oslo Manual) to highlight the shortcomings of standard CIS. They provided suggestions for suitable adaptation of the survey to the context of developing/late-comer countries. More emphasis should be paid on idiosyncratic nature of technological learning and systemic failures in those countries such as the acquisition of machinery, licensing activities, adoption of quality system, problem solving activities, broader definition of R&D, human resource development, global exposure, 'potentially' innovative firms, and so forth.

Nonetheless, these initiatives fail short to differentiate between 'more' and 'less' successful late-comer countries. The learning-intensive nature of innovation systems of the former led to successful catching up with the forerunners, at least in some industrial sectors. This is, for example, the case of East Asian Newly Industrialised Economies such as Korea, Taiwan, Singapore. On the other hand, the innovation systems of the latter are too weak and fragmented to do so. This is the case of most developing countries in Asia, Africa and Latin America, including Thailand. There are two reasons explaining the different between the two groups. Technological learning of late-comer firms in these countries is much slower and more passive than those in 'more' successful ones. Though firms in both groups rely very much on borrowed technologies generated somewhere else, the pace of accumulation of absorptive capacity and ability to generate technological change, albeit minor, through various mechanism especially non-R&D ones like basic and detailed design, reverse engineering and so forth are much different, as indicated by previous studies on late-comer firms. Furthermore, the extent and degree of perpetuation of systemic failures

in the less successful late-comer countries are considerably greater than the more successful one. The Thai innovation surveys may somewhat address these two shortcomings in the standard CIS surveys. Nonetheless, they are still far short of filling the gaps. The future surveys should take into account the recommendation of the Bogotá Manual and other aforementioned studies. They should also pay special attention on addressing the two main characteristics of 'less' successful late-comer countries.

On technological learning of late-comer firms, the survey for 'less' successful late-comer countries should pay attention to not only innovative activities but also capabilities on 'project execution' (such as feasibility studies, technology evaluation sourcing, selection of plant site, training and recruitment of personnel, project scheduling), and production, for instance, process engineering (equipment stretching, process adaptation and cost saving, maintenance) , product engineering (product design, adaptation to market needs, product quality improvement, industrial engineering (workflow scheduling, productivity monitoring and improvement, inventory control). These capabilities are not qualified as formal R&D and, to a large extent, not for creating innovation, but they are very essential to understand technical change and learning of late-comer firms.

If companies do not have aforementioned capabilities, internal and external obstacles should be identified: lack of strategic vision and willingness to change of companies' executives, limited resources, limited external sources of knowledge firms can rely on, high risk, too little competition and so on. Understanding these obstacles are useful for devising supportive and targeted 'capability-enhancing' public policies.

On systemic failures of national innovation system, the survey for 'less' successful late-comer countries should focus on why the weakness and fragmentation of national innovation systems of these countries has sustained for such a long time, given that most countries had embarked on industrialisation for at least half a century. In other words, why are their systemic failures in these countries greater and so persistent? Questions explicitly addressing these systemic failures mentioned in the literature (Carlsson and Jacobsson, 1997, Norgren and Haucknes, 1999: Smith 2000; Woolthuis, Lankhuizen et al. 2005; Chaminade and Edquist, 2006) should be included:

a) *infrastructure provision and investment* failures,

b) *transitional* failures (late-comer firms being less capable to foresee the emergence of new technological paradigms),

c) *lock-in* failures (late-comer firms being locked into acquired existing technologies and technology systems),

d) *formal and informal institutional* failures (laws, regulations, norms and routines hampering innovation and capability building),

e) *network* failures (too weak knowledge intensity of exchange or too strong linkages leading to blindness to what happens outside the network),

f) *capability and learning* failures (the insufficient competences of late-comer firms limiting their capacity to learn, adopt or produce new technologies over time), and

g) *complementarity* failures (the competences of the systems of these countries might not complement each other).

To make innovation surveys more useful for policy makers, like the Thai survey, specific questions on awareness and effectiveness of existing policy measures intentionally or unintentionally targeting on tackling aforementioned systemic failures should be asked. If firms do not satisfy with the existing measures, they should be given opportunities in the surveys to make suggestions on revision or introducing new measures.

Endnote

[i] OEM and ODM are specific forms of subcontracting. Under Original Equipment Manufacture, a latecomer firm produces a finished product to the precise specification of a foreign transnational corporation, which will market under brand name via its own distribution channels. Under Own-Design Manufacturer (ODM), a latecomer firm carried out most or all product design (Hobday, 1995:37).

[ii] The 2002 Korean Innovation Survey gathers information about the period 2000-2001. The population of the survey are manufacturing firms with 10 employees or more (based on a commercial database with 32, 551 companies). 8,000 firms were drawn from the sampling matrix of 31 two digit SITC (Korean Industrial Classification) subgroups by 5 firm-size subgroups.

[iii] Unfortunately, the question was not included in the year 2003 to make the survey conform to the European CIS-3.

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