Measuring Innovation in Catching-up Economies: An Experience from Thailand

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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 trendy approach to measure innovation is Community Innovation Survey (CIS) firstly developed by OECD countries. The standard set of guidelines for innovation surveys, the OSLO manual was prepared under the auspices of the OECD in 1992. Afterwards, The CIS is 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 behavior and innovation performance. 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, there are criticisms of innovation surveys especially when they are applied to developing or catching-up countries. Several initiatives to improve the surveys to be more suitable for developing countries have been carried out. In this paper, we will map out those initiatives and examine the case of innovation surveys in Thailand in order to draw some implications on how to measure innovation in catching-up economies.

2. Initiatives in Applying Innovation Surveys to Catching-up Economies.

There are several initiatives in several geographical regions.

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Latin American Initiatives: Bogota Manual and the Annex of Oslo Manual

Still, there are criticisms of innovation surveys especially when they are applied to developing countries. The strongest attempt in devising indicators of technological innovation for developing countries and making innovation survey fit better with conditions of developing 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 four characteristics of the innovation process in developing countries:

- *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.
- 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,
- 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. In the context of underdevelopment, 'innovation as learning' also has weak social legitimacy due to the enduring assumption that there is an obvious and unspoken international division of labor that puts innovation efforts in the industrialized countries, sparing developing ones the effort of re-inventing the wheel and the fact that developing countries themselves do not have, apparently, much to show in innovation terms. Taking into account of 'innovation as learning systemic failure', she suggests that future innovation surveys in developing countries should include the following features:

- include in the design people with experience in measuring public opinion;
- formulate 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;
- ensure 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);
- assure 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;
- allow for all types of linkages to be included, particularly with technological tailors;
- design carefully the "innovative activities" section, allowing idiosyncratic features to emerge, to assure that the category "potentially innovative firm" will be fully recovered;
- reserve a space for identification of technological demand, linked to questions related to actual policy instruments and those that the respondents may envisage.

The last but not least is the ECLAC initiative. The Division on Production, Productivity and Management of the United Nations Economic Commission of Latin America and the Caribbean – ECLAC, is initiating an effort to articulate some Latin-American institutions responsible for the design, data collection and treatment of innovation surveys in order to achieve better comparability and use of their results.

The Initiative of UNU-MERIT for Africa

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 economies. The study 'Designing A Policy-relevant Innovation Survey fro NEPAD' was finished in 2004. According to this study, previous innovation surveys did not cover the full range of actors in an innovation system. They focused mainly on the industrial sector and within it on manufacturing firms. Recent innovation surveys have been shaped more by 'innovation system' thinking and the scope of the survey was thus widened to include service sector enterprises, notably utilities (electricity, gas and water supply), transportation, banking and in some instances wholesale trade and transportation. 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 RTD). 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 Bogota 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. Therefore the survey should include:

- The introduction of new waste management, maintenance and quality control routines, new ways of organizing production and marketing, including through sub-contracting relationships

- The purchase of new machinery and equipment from within the country or abroad over the previous three years

- Whether the firm has a licence contract for product or process technology, the year in which it was obtained and whether it was obtained from a local or foreign firm or research institute.

- The impact of licensing on learning.

The main thrust of the UNU-MERIT's study is to enhance policy relevance of the innovation survey by focusing on highly policy-relevant questions, such as:

- Who are the more innovative firms?

- What drives or hampers firms to undertake different innovative activities?
- What are the strategies of firms that undertake them?
- What is the impact on firm performance?
- What is the firms' perception of the policy environment?

The example of questionnaires given by the study pay a special attention to the question of 'who are the more innovative firms', which is important for designing suitable government supporting policies. Based on the literature on innovation, the characteristics affecting the firms' propensity to learn and innovate are proposed:

- the location of the firm within or close to a major urban area and thus in greater proximity to sources of new knowledge and ease in participating in knowledge flows.
- Educational level of the Owner/CEO/Manager, especially a degree from a technical university or engineering programme that stimulates and facilitates problem solving.
- global exposure through training, work or study abroad which opens opportunities for networking for knowledge flows and collaboration and creates an awareness of the utility to do so.
- ownership structure of the firm, which influences the choice of products and processes as well as their subsequent modification or change.
- the firm's sector, which provides a measure of the stimulus to innovation resulting from the higher R&D intensity of the sector and nature of competition within the sector.
- the size of the firm, which is related to its access to resources to and opportunities for knowledge scanning to support a process of innovation.
- exports (as a percentage of sales) and whether this is rising as an indicator of the firm's competitive interests and abilities.
- habits and practices of innovation as reflected in having innovated previously

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ASEAN Initiative

ASEAN (Association of Southeast Asian Nations) is quite keen in developing its science, technology and innovation indicator system. One aim of the Hanoi Plan of Action, for example, is to establish a technology scan mechanism and institutionalise a system of science and technology indicators. In collaboration with Korea, ASEAN in 2004 initiated a project on 'Development of Technology Competitiveness Indicators'. However, the project did not aim to improve existing indicators or developing new ones but to produce a composite indicator derived from Hard Statistics Data from R&D Survey and Economic Series as well as Soft Data from Executive Opinion Survey (IMD's World Competitiveness Yearbook).

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

To assess the innovative capabilities and innovation characteristics of firms in Thailand, R&D and Community Innovation Surveys have been carried out by the National Science and Technology Development Agency (NSTDA) since the year 1999. R&D surveys were carried out ever year but the innovation surveys were done only in the year 1999 and 2001 and 2003.

The survey in 1999 was the first of its kind in Thailand and it covered both R&D and other technological innovation activities only in the manufacturing sector. The second survey, in year 2002, added service sector in order to gain a better understanding of the nature and differences of R&D and innovation activities in both manufacturing and services. The survey adopted definitions and methodologies used by OECD (namely, Frascati Manual (1993) and Oslo Manual (1997)) and other countries in Asia (namely Singapore, Malaysia, Japan, Taiwan and Korea) to meet international standard.

The Surveys focused on determining the characteristics of firms that carry out R&D and other innovation activities. It also covered the types of R&D and other innovation activities as well as factors, which influence firms' abilities to carry out R&D and other innovation activities. The sampling methodology was developed in order to obtain unbiased estimates of the population R&D/Innovation parameters to be measured – expenditure on R&D/Innovation, and total R&D/Innovation personnel in manufacturing and service enterprises. The Business On-Line (BOL) database, with comprehensive information on around 50,000 establishments registered with the Commercial Registration Department, Ministry of Commerce, was used. In addition to the BOL database, other sources of information such as the Board of Investment, the Department of Export Promotion and the Computer Professional Information 2002 were also utilized for the service sector's sampling frame. 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)

These surveys will be used to examine technological and innovative capabilities of firms in Thailand and their linkages to other actors in the national innovation system. To illustrate weaknesses and strengths, some parts of the analysis will be carried out by comparing with the results of Korea Innovation Survey (KIS) 2002[2]

3.1 Technological and innovative capabilities of Firms in Thailand

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-kemis, 1985; Chantramonklasri, 1985; TDRI, 1989; Dahlman and Brimble, 1990, Tiralap, 1990; Mukdapitak, 1994; Lall, 1998). The recently commissioned by the World Bank's study (see Arnold, 2000) also 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 majorities are 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. The slow technological capability development of Thai firms are quite different from those of Japan, Korea and Taiwan. Firms in these countries moved rather rapidly from mere imitators to innovators. As early as 1960s, Japanese firms advanced technologically to the world-class level. They became more innovative, invested heavily in R&D and relied less on importation of foreign technologies (Goto and Odagiri, 1993). In general, firms in Korea and Taiwan, where industrialisation and technologically catching-up processes started more or less in the same period as in Thailand, are more successful in increasing absorptive capacity (of foreign technology) and deepening indigenous technological capabilities in several industries (see for example, Amsden, 1993, Kim, 1993, Lall, 1996, Hobday, 1995, Kim, 1997). In electronics industry, for instance, Korean and Taiwan firms were able to climb up technological ladders (from simple assembly to own design and R&D) by exploiting institutional mechanism like OEM and ODM to help latecomer firms in those countries to access to advanced technology and demanding foreign markets (see Hobday, 1995).

From the innovation surveys, percentage of innovating firms is quite low (see Table 1). To illustrate this point, we compare the situation in Thailand with that of a

[2] 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.

country being successful in technologically catching up, Korea. Comparison of innovation surveys, Thailand R&D/Innovation Survey 2001 and the Korean Innovation Survey 2002, in more or less the same period shows the differences in terms of innovative capabilities of these two countries. Since the Korean survey only cover manufacturing sector, here our comparison will limit to the manufacturing sector only.

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, while this is quite rare in Korea. This could be an indication that Thai-companies are at the stage where they rather use their resources to improve production process than the product itself, which in turn could hint towards a rather OEM-oriented economy. At the same time very few companies in Thailand do product as well as process innovations, which is very common in Korea. This reflects more mature innovation behaviour of Korean companies which improve in a systemic manner. Subsidiaries of TNCs in Korea are also much more innovative than their counterparts in Thailand (see Table 4). Nevertheless, Thailand and Korea display some similar patterns: large companies are more likely to be innovative than SMEs (see Table 3) and most R&D is conducted in-house (Table 5). Given the higher resources of larger companies and the strategic importance of R&D this result is not surprising.

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%

Table 6 shows that the difference between Korean- and Thai-companies is especially large in the science-based sectors of chemicals and machinery (including electronics). This could be an indication for Thai-companies being more focused on production/ assembly than Korean-firms that are also strong in developing new products and improving processes. It could be concluded that this reflects an international division of labour, Korea doing research, development and production, while Thailand is confined to (rather simple) production/ assembly.

Table 6: Share of innovating companies in respect to sectors

Korea			Thailand		
SITC	Manufacture of…		TSIC	Manufacture of…	
15	Food, Products and Beverages	40%	31	Food, Beverages and Tobacco	18%
17	Textiles, Except Sewn Wearing apparel	20%	32	Textiles, wearing apparel, leather and leather products	7%
18	Sewn Wearing Apparel and Fur Articles	19%			
19	Tanning and Dressing of Leather, Luggage and Footwear	30%			
20	Wood and of Products of Wood and Cork, Except Furniture; of Articles of Straw and Plaiting Materials	19%	33	Wood and wood products, including furniture	10%
36	Furniture; Manufacturing of Articles n.e.c.	34%			
21	Pulp, Paper and Paper Products	19%	34	Paper and paper products, printing and publishing	10%
22	Publishing, Printing and Reproduction of Recorded Media	10%			
23	Coke, Refined Petroleum Products and Nuclear Fuel	57%	35	Chemicals and chemical products, petroleum, coal, rubber and plastic products	11%
24	Chemicals and Chemical Products	54%			
25	Rubber and Plastic Products	42%			
26	Other Non-metallic Mineral Products	25%	36	Non-metallic mineral products	7%
27	Basic Metals	37%	37	Basic Metals	6%
28	Fabricated Metal Products, Except Machinery and Furniture	49%	38	Fabricated metal products, machinery and equipment	13%
29	Other Machinery and Equipment	53%			
30	Computers and Office Machinery	67%			
31	Electrical Machinery and Apparatuses n.e.c.	56%			
32	Electronic Components, Radio, Television and Communication Equipment and Apparatuses	48%			
33	Medical, Precision and Optical Instruments, Watches and Clocks	58%			

34	Motor Vehicles, Trailers and Semitrailers	43%			
35	Other Transport Equipment	34%			
			39	Jewellery, diamond, gem and ornaments	10%
	TOTAL	**43%**		**TOTAL**	**11%**

Innovating companies were asked about the objectives of their innovation activities. Again, the original 5-point scale was converted into a 100-point scale. Table 7 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 well established products and therefore do not have to conduct innovations in order to replace product being phased out that often.

Table 7: 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	-
Fulfill 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, manufacturing firms spent more on acquisition of machinery and equipment, which is not surprising for catching firms relying more on acquiring technology from external sources. For the service sector, R&D seems to be less significant. What matter most for firms in this sector is design and other preparations for production and deliveries of services (see Table 8). Given the nature of the service sector whose products (services) depend very much on design and delivery. This is not so unforeseeable as well.

Table 8 Percentage of Expenditure Firms Spent on Innovation Activities in 2003

Activities	Sector		Overall
	Manufacturing	Service	
R&D	32.55	15.07	30.20
-Intramural	*30.18*	*8.40*	*27.25*
-Extramural	*2.37*	*6.67*	*2.95*
Acquisition of machinery and equipment	51.30	25.57	47.84
Acquisition of external knowledge	1.94	4.79	2.33
Training (internal & External)	1.95	4.93	2.35
Market introduction of innovations	8.77	7.05	8.54
Design and other preparations for production/deliveries	3.49	42.59	8.74
Total	**100.00**	**100.00**	**100.00**

The results of the surveys in the year 1999 and 2001[3] also suggest that majority of innovating firms also conducted non-R&D activities necessary for technological learning of catching-up firms, namely reverse engineering (50% of innovating firms), detailed design (60%), testing (90%), and quality control (90%).

3.2 Firms' Linkages with other actors in national innovation system

Firm's innovativeness and competitive advantages 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. Since the Korean report

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

converted the 5-point scale into a 100-point scale, the data on Thailand had to be converted accordingly.

Table 9 gives a general overview and 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.

Table 9: 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.

Table 10 shows the ranking of external sources of information. In both countries customers are the most import source of innovation-related information, but the further ranks display distinctive differences. 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 (e.g. in the form of an R&D department or scientific knowledge) to use information that can be gained from competitors (e.g. via reverse engineering) or patent disclosures. On the other hand, Thai-companies rely upon information provided by parent or associate companies much more than Korean companies do. This hints towards a certain degree of dependence of Thai-companies on parent (mostly foreign) companies when it comes to innovation.

Table 10: Ranking of external information sources according to importance

Thailand		Korea	
Clients	77.4	**Customers**	77.7
Internet	63.0	**Competitors**	69.3
Parent/ associate company	61.2	**Exhibition**	65.5
Locally-owned suppliers	59.9	**Internet**	64.9
Specialist literature	56.6	Component suppliers	61.7
Professional conference & meetings	55.2	**Patents**	59.8
Foreign-owned suppliers	54.8	Equip. suppliers	57.7
Fairs and exhibitions	53.1	**Universities**	53.6
Competitors	42.1	**Enterprise within the group**	52.9
Technical service providers	40.2	**Public Research Inst.**	52.6
Universities or other higher education institutes	35.8	New personnel	51.9
Business service providers	33.1	Trade Associations	44.2
Patent disclosures	32.0		
Gov. or private non-profit R&D institutes	29.5		

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 could 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 indicate that communication channels between the two sides are quite poorly developed.

Interestingly, Korean companies regard enterprise within the group as important source of information. This is not so 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. The staff who acquired generic knowledge were used to undertake intra-group diversification into new areas (see Amsden and Hikino, 2000).

How well firms can tap into 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.

3.3 External Environment Affecting Firms' Innovative Activities

In general, manufacturing firms considered that the environment for R&D and innovation in Thailand was 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 R&D and innovation environment in Thailand (see Table 11). The top two positive factors of R&D and innovation environment in Thailand for the service sector are similar to the manufacturing sector (see Table 12). However, the service sector also considers quality of telecommunications and IT services enabling innovation as important. This is not surprising as nature of service industries (such as financial services) these days depends so much on the readiness of IT infrastructure. For both sectors, listing requirement on the stock exchange was judged the weakest.

Another special characteristic of the Thai R&D/Innovation Survey is questions regarding firms' acknowledgement 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). Firms having innovation, i.e., innovating firm, used such incentives more than non-innovating firms.

Intellectual protection environment which is significant in stimulating innovation has been viewed more favourable in the second survey. This reflects more serious enforcement of intellectual property protection by government in the past few 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. However, the level of acceptance to failure has increased from 10.5 percent in the year 1999 to 19.5 percent in 2001. Other attitude indicators also show more positive trend towards better innovative environment. The openness towards innovations of government regulators, customers, suppliers and ordinary people has increased in the second survey. Further, surveyed firms did value long-term strategic collaboration between each other more in the second survey, as 63.5% of them perceive this as important or rather important for innovation. This implicitly shows that 'trust' between firms have increased.

Table 11: Assessment of the R&D & Innovation Environment 2001: Manufacturing Sector

(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

Table 12: Assessment of the R&D & Innovation Environment 2001:

Business Environment	Mean
Attitude of people towards innovation	3.7
Openness of customers to innovation	3.7
Quality of telecommunications and IT services for enabling innovation	3.6
Openness of suppliers to innovation	3.5
Availability of suitable manpower in business sector	3.4
Intellectual property protection	3.4
Technological sophistication of local suppliers	3.3
Openness of government departments & regulatory authorities to innovation	3.3
Availability of finance for innovation	3.3
Consultancy support services	3.2
Local university for technical support and R&D collaboration	3.2
Availability of government incentives for innovation	3.1
Availability of suitable manpower in scientific technical sector	3.1
R&D institutions for technical support and R&D collaboration	3.1
Availability of other technical supporting services	3.1
Regulatory environment	3.1
Acceptance of failure	2.9
Listing requirements on SET stock exchange	2.8

Service sector (1 = very weak; 5 = very good)

4. Conclusion

Innovation survey, itself, is an innovative step towards understanding innovations in firms. It also covers the role of linkages with other firms 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 developing/catching-up countries have adopted the surveys. Also there have been several initiatives to highlight the shortcomings of standard CIS. They provide suggestions for suitable adaptation of the survey to the context of developing/catching-up 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.

For Thailand, 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' catching- up 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 economies. However, the Thai surveys have 'special' characteristics which have implication for conducting surveys in other developing/catching up economies as follows:

First, 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.

Second, 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 catching-up economy, namely, reverse engineering, detailed design, testing, quality management were included. The results from the surveys confirm that not only R&D but also these technological activities are important activities for the surveyed firms.

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