SME DEVELOPMENT AND INTERNATIONALIZATION IN THE KNOWLEDGE-BASED AND INNOVATION-DRIVEN GLOBAL ECONOMY: MAPPING THE AGENDA AHEAD

by

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Executive Summary

This paper focuses on a major, and relatively neglected, structural problem in fostering the development and internationalization of SMEs in ASEAN. These enterprises are a major economic force in the region and elsewhere in the world. They have also come of age along with the greater decentralization and dispersion of production and services activities in the creation of value. Generally, however, most ASEAN firms (both large and small) are not well prepared to manage the challenging business environment ahead.

For one thing, economic and financial liberalization and deregulation has led to an expanding flow of trade and foreign investment but it has contributed as well to intensified commercial rivalries which are translated into rising benchmarks of performance expected from suppliers over time. For another thing, rapid technological progress has led to new and innovative industrial structures and organizational modalities. But this has also caused a rapid erosion of first-mover advantages, sped up the obsolescence of skills and machinery, and rendered market demands more sophisticated and exacting.

Currently, the Achilles heel of regional business is the low level of productivity gains and local value addition. This is because most ASEAN producers and suppliers have relied heavily on external technologies which are mature, readily available and widely shared. Illustratively, the high-tech electronics industry is a major achievement in trade and investment but, like several others in ASEAN, it has been mired in labor-intensive, low valued-added and standard-segment production activities.

The prerequisite in building up technological capabilities and a solid R&D base has become even more pressing, especially if the regional enterprises are to leapfrog in competition, or if middle- and high-income ASEAN economies are not to specialize downward under fast-rising competitive pressures. In particular, there is the blazing speeds in competence building and technological catch-up by China which has, meanwhile, gained sizable market shares from, among many others, producers and exporters in East, and to a lesser but increasing extent, Southeast Asia.
In the above context, a changed mindset is overdue among ASEAN firms and industries as regards R&D which has become the key to higher productivity and sharpened competitiveness. SMEs have a valuable contribution to the technological transformation process directly as inventive enterprises and indirectly as innovative and competitive suppliers and subcontractors to dynamic large firms. This is one of the insights gained from the experiences in developed countries as well as from the successful technological transformation among developing economies in East Asia.

Without doubt, the agenda for action by business and government is extensive, complex and costly. There are wide-ranging needs in human and institutional capacity building and upgrading, in fostering better synergies among business firms and knowledge institutions, and in the identification and pursuit of feasible and rewarding paths of technological specialization. All these highlight once again the richness of the unfinished agenda for policy attention and further research.

Key words: globalization, trade and investment, technological capacity building, small and medium-sized enterprises, ASEAN and East Asia.
Abstract

This paper focuses on a major, and relatively neglected, structural problem in fostering enterprise development and internationalization to take full advantage of the expanding opportunities in liberalized production, trade and investment. The SME sector is the backbone of most economies in ASEAN and elsewhere but regional firms (both large and small) are in general not well prepared to manage the challenges from intensified global competition, more sophisticated consumer requirements, fast eroding first-mover advantages, and the speedier obsolescence of skills and machinery.

Currently, the Achilles heel of ASEAN business is the low level of productivity gains and local value addition because of the persistent and heavy reliance on external technologies which are mature, readily available and widely shared. The high-tech electronics industry, among others, is illustrative of labor-intensive, low valued-added and standard-segment production activities. A changed mindset is thus overdue among ASEAN firms and industries as regards R&D which has become increasingly important as the key to higher productivity and sharpened competitiveness.

SMEs have a valuable contribution to the technological transformation process directly as inventive enterprises and indirectly as innovative and competitive suppliers and subcontractors to dynamic large firms. The agenda for action by business and government is extensive, complex and costly. There are wide-ranging needs in human and institutional capacity building and upgrading, in fostering better synergies among business firms and knowledge institutions, and in the identification and pursuit of feasible and rewarding paths of technological specialization. All these highlight once again the richness of the unfinished agenda for policy attention and further research.

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Introduction 5
I. Impulses and Imperatives in Enterprise Development and Internationalization 6
   A. Changed development paradigm 6
   B. The coming of age of SMEs 8
   C. The Achilles heel of ASEAN enterprises 10
   D. The high costs of borrowed ideas 12
   E. A case in point: The electronics industry in ASEAN 14
II. Options and Agenda on Enterprise Development and Internationalization 16
   A. Overview 16
   B. A race without end 17
   C. The China factor 18
   D. R&D synergies between large and small firms 19
   E. R&D thrusts and possibilities 21
   F. Bridging the human resource gap 22
   G. Improved systems and instruments on IP rights 23
Conclusion 24
References 26

I. INTRODUCTION

Small and medium-sized enterprises (SMEs) and their entrepreneurs remain the backbone of virtually all economies of the world, those in the Asia-Pacific Economic Cooperation (APEC) grouping and the Association of Southeast Asian Nations (ASEAN) included. They are the foundation of socio-economic stability, gender and minority-group empowerment, and equitable distribution of opportunities and incomes across domestic regions. Nevertheless, the long-term growth and competitiveness of most segments of the SME sector has not been free of problems and difficulties.1

1 SMEs are the most important source of overall job creation and employment opportunities outside the agriculture sector, especially for women and for those with limited skills and capital. They can be found across domestic regions and in peri-urban areas, including many internal locations disadvantaged by limited access or mass
The financial and economic crisis among most “miracle economies” of East and Southeast Asia in 1997-1998 has led to a redirection of policies and resources (both local and aid-based) in favor of the SME sector. This can be regarded part and parcel of a strategic response to the changed paradigm of interdependence in trade and investment. For SMEs and risk-taking entrepreneurship have come of age in a global economy increasingly underpinned by new knowledge and steered by commercial inventions and innovations in the creation of value.

The following discussion first sketches out some of the issues and implications in development and internationalization facing all business firms, both large and small. It then maps out a number of business options and policy measures in an agenda to foster SME growth and competitiveness in a world of ever-higher thresholds and benchmarks of performance expected from producers and competitors alike.

II. IMPULSES AND IMPERATIVES IN ENTERPRISE DEVELOPMENT AND INTERNATIONALIZATION

The dynamics of production, trade and investment, industrial organization and inter-firm linkages have been fundamentally transformed since the production of a computer on a silicon chip in 1969. Yet, most large firms and SMEs in ASEAN, among other developing regions, are not well prepared for the race without end ahead.

A. Changed Development Paradigm

Four interacting trends can be identified. Firstly, the rapid progress in science and technology (S&T) and research and development (R&D) has led to an astounding and poverty. The sustained promotion of SME efficiency and dynamism will thus yield increasing social and economic returns in virtually all economies of the world. However, it is also well appreciated that, unintentionally or y default, SMEs and their entrepreneurs have long faced severe barriers and other built-in biases and obstacles in development and diversification. Wattanapruttipaisan (2002 and 2003) provides many references on the relative importance of SMEs in the structure of domestic employment and the creation of local value-added among APEC and ASEAN economies, the various constraints facing SME entrepreneurs in development and internationalization, and some responsive policy options to foster SME growth and competitiveness, including through cross-border subcontracting and other supply arrangements.
continuous decline in the cost of information and communications technologies (ICTs). In turn, this decline has facilitated the progressive and innovative incorporation of “artificial intelligence” and other intellectual property (IP) assets into an ever larger number of goods and services and their production processes. All these have given rise to the knowledge-based economies (KBEs) and the many first-mover advantages enjoyed by their firms and industries.  

Secondly, there has meanwhile been a vast expansion of external commerce and financial flows because of the increased liberalization of trade in goods and selected services, and the extensive deregulation of domestic factor and product markets in most global economies regardless of their former shades of ideology. A net result of this process is that world trade has expanded faster than world production, and a larger proportion of domestic output of goods and services is now traded globally (World Trade Organization 2004).

Thirdly, the ICT revolution along with complementary advances in transportation technologies and logistics has changed significantly as well the meaning of boundaries and distances, and the modalities of value-chain organization. In particular, many economies have shifted towards flatter (horizontal) decentralization and greater (vertical) dispersion of production and services arrangements. These are characterized by more complex systems of lean inventory and just-in-time delivery which typically involve smaller, more flexible and more specialized enterprises which are, nevertheless, interlinked by real-time (on-line) interactions with suppliers and clients both within and across border.

Lastly, the emergence of more sophisticated and more exacting market requirements and consumer choices has coexisted with intensified commercial rivalries and global competition, including from lower-cost producers of better, new or differentiated goods and services. 

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2 This is because competitiveness is increasingly determined by the cost-effective acquisition and application of new knowledge, by the self-reinforcing complementarities between new and existing knowledge, by the speeds of learning and on-going competence building for the effective and timely absorption and application of new knowledge, and by tactical and strategic considerations in the deployment and licensing to business partners or competitors of existing proprietary knowledge by the knowledge-owning entrepreneurs and firms (Carr 2003 and Audretsch 2002).

3 Non-price parameters and considerations have become an important determinant of consumer preferences. They include the quality, design, health and safety, social appeal, and environmental compatibility of products and services. In particular, a survey by the Boston Consulting Group in 2003 showed that shoppers would pay a price premium of up to 200 per cent for products of technology, functionality and emotional appeal. These consumer
Largely as a result, the expected performance of enterprises and industries is now routinely subject to ever higher benchmarks and thresholds, for example, in terms of lower prices, better quality and greater reliability, a larger assortment or mix of products (or mass customization), a greater amount of business transacted through e-commerce, and more timely and frequent deliveries.\textsuperscript{4}

All these development impulses and imperatives in production technology, trade and investment have interacted to raise significantly world demand for goods and services and to stimulate further the proliferation of national and trans-boundary production networks and service platforms. Driven largely by foreign direct investment (FDI), such a proliferation has opened up great opportunities in subcontracting activities and services, especially for SMEs.\textsuperscript{5} In the process, most manufactured goods have become standardized and are produced or customized in mass to reap greater operational economies. Commoditization is needed, too, to counter falling real prices and squeezed profit margins due to increased competition.\textsuperscript{6}

products range from highly sophisticated vacuum cleaners, audio-video equipment, camera cell phones to specialty olive oil (“Best of the Best”, \textit{Newsweek}, April 12, 2004, p. 43).

\textsuperscript{4} See Chen and Ku (2003: 48-50) for examples of rising performance thresholds demanded from (largely SME) subcontractors in the notebook personal computer industry in Chinese Taipei. As regards prices, for example, the drastic fall in the cost of many manufactured goods, especially electronics equipment, is well known. Concerning quality requirements, first-rank suppliers of automotive parts and components in Thailand are normally joint ventures (about 380 enterprises in number) while second-tier subcontractors are mostly locally owned SMEs (about 1,000 firms). All of them have now to comply with a stipulated defect ratio of 20 parts per million (ppm), compared to the previous ratio of 100 ppm. This is a very stringent requirement as it implies virtually zero defect and 100 per cent quality control check. At the same time, the target for subcontractors’ cost reduction is set at 15-25 per cent over the medium term of 2-3 years with the cost reduction benchmarks being the free-on-board prices of similar products on the world market. Additionally, the demand for just-in-time procurement has necessitated up to eight deliveries (instead of two previously) a day by arts and components suppliers so as to gradually eliminate inventories altogether at the assembly line (Tangkitvanich 2002: 7-8).

\textsuperscript{5} For details, see Yusuf and others 2003; Wattanapruttipaisan 2002; Urata 2001; and Borrus, Ernst and Haggard 2000).

\textsuperscript{6} Generally, the shorter product cycles and lower real prices are apparent in numerous dynamic industries within the broad technology class of consumer and office microelectronics as well as in such mature-technology manufactures ranging from fashion garments and high-end sport shoes to motor vehicles and other consumer durable goods. For example, articles of clothing were one-third cheaper to purchase in 2002 than they were a decade ago (“Rag-trade Deals,” \textit{The Economist}, 9 August 2003, pp. 52-3). Similarly, the average retail price of big-ticket, cutting-edge consumer goods such as digital video recorders was down from US$ 1,000 to US$ 300 between 2002 and 2004 (“Sony, Matshushita Lead DVD Group under U.S. Probe,” \textit{The Asian Wall Street Journal}, January 26, 2004, p. A7).
B. The Coming of Age of SMEs

But the new and innovative organization modalities in production and trade have also greatly enhanced the intrinsic importance of inventive entrepreneurship and the technologically-driven SMEs. Indeed, a rising share of domestic employment creation and the commercialization of new knowledge have now come from clusters of high-tech, innovative and entrepreneurial SMEs in cooperative linkage with R&D and S&T institutions. This is evident not just in the United States but also in many parts of Western Europe and Asia as well (Yusuf and others 2003, and Audretsch 2002).

In particular, SMEs (firms with less than 500 workers) in the United States have produced a disproportionately bigger share of breakthrough inventions which, in addition, are at least twice as likely (than those held by large firms) to be found among the top one per cent of the patents with the highest impact, commercial and technology-wise. Besides, SME patents score a citation index (a measure of technological diffusion) of 1.53, compared to 1.19 in the case of large firms’ patents. Furthermore, SME inventions cover a wider spectrum of technologies and the proportion of highly inventive SMEs (those with 15 or more United States patents) is also on the rise, too.7

The critical role of inventive entrepreneurship and the technology-driven SMEs in the KBEs is now well appreciated by most developing countries in the world. Concerted efforts have been made to remove long-standing policy constraints on SMEs and to allocate additional resources for SME development and internationalization in East and Southeast Asia, especially in the aftermath of the 1997-1998 crisis. Massive, multi-billion dollar investments have also been sunk virtually across Asia to foster and replicate local versions of California’s Silicon Valley, Boston’s Route 121, and high-tech corridors of interlinked clusters of dynamic SMEs and inventive entrepreneurships (Cook 2003: 11-21, and Yusuf and others 2003: 236-45).

7 CHI Research Inc. (2003a and b). Baumol (2004: 15) reproduces a highly interesting list of 68 inventions of enormous commercial and technological significance by American SMEs in the 20th century. The list ranges from A (air-conditioning and airplane) to Z (zipper). Other listed items include audio tape recording, catalytic petroleum cracking, computerized and X-ray scanning, DNA finger-printing, frequency modulation radio, gyro-compass, heat sensor, helicopter, integrated circuit, desktop and portable personal computers, Polaroid camera, computer operating software, soft contact lens, and xerography.
Largely as a result, SMEs are the driving force in several dynamic sectors in several Asian developing economies (more in section II.D below).

C. The Achilles Heel of ASEAN Enterprises

ASEAN producers, both large and small, have long been widely famous for their export-oriented manufacturing prowess. Generally, SMEs contribute directly about 20-30 per cent to gross sales value or manufacturing value added, and 10-20 per cent to export earnings in the region. However, their overall share in domestic manufacturing and export earnings is certainly much larger because SMEs feature prominently as subcontractors and services providers to ASEAN manufacturers and export firms in all manufacturing sectors, from labor-intensive assembly and testing of goods and services to the production of high-value, high-tech products, parts and components, and specialist services.8

As a whole, however, the striking achievements of ASEAN manufacturers have been largely pushed over time by higher levels of physical accumulation of capital, financial and human resources. Productivity gains from indigenous creativity and technological inventions based on advances in S&T and the commercialization of R&D have been subdued and limited. They accounted for one-third or less of the expansion in gross domestic product (GDP) in ASEAN over the last two decades or so, compared to as much as four-fifths of GDP growth in the United States, and about two-thirds in France, Germany and the United Kingdom.9

Invention patents are a good indicator of the technological capabilities and the commercial lead of firms and industries. During 1993-2002, for example, patented inventions from individuals, enterprises and institutions resident in ASEAN totaled some 1,600 or less than

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8 For further details as regards the relative importance of SMEs in domestic manufacturing output and sales value, and in direct and indirect exports in ASEAN, see Wattanaputrtpaisian (2003: 66-7) and the extensive references to the research literature cited therein.

9 (Eichengreen 2002: 17-22). Under the growth accounting methodology, total factor productivity (TFP or the Solow residual) is that part of output gains which cannot be explained by increases in tangible factor inputs. This is the so-called issue of perspiration versus inspiration which was provocatively put forward by Klugman in the mid-1990s in the context of TFP in relation to the growth and transformation patterns in East and Southeast Asia. It should be noted that there are numerous complex conceptual, specification, estimation and data problems in TFP accounting. For a recent discussion on those problems and related estimates, see Bosworth and Collins (2003: 2-5 and 33-4) and Yusuf (2001: 15-21).
one per cent of all the patents granted by IP Offices in ASEAN to both resident and non-resident inventors in the region. The predominance of external inventors is also well illustrated by patents grants from the United States Patent and Trademark Office (USPTO) to ASEAN inventors which numbered less than 1,600 during 1991-2001. This was below 0.1 per cent of all the invention patents issued by USPTO in the same period.10

More research is needed on the ownership structure and commercial significance of invention patents granted by the regional IP Offices and USPTO to ASEAN resident inventors. The available data from USPTO indicate that during 1997-2001 only 7 per cent of United States patents registered to Singapore (totaling 1,149) were held by individuals, including presumably SME entrepreneurs. In contrast, individual ownership of USPTO patents was in the range of 25-35 per cent in the case of Malaysia (with 210 patents during 1991-2001), the Philippines (62 patents) and Thailand (109 patents).

For context and perspective, enterprises and industries in both the Republic of Korea and Chinese Taipei were largely technological followers, copiers and imitators in the 1960s and 1970s. They were then not as open as ASEAN has been to FDI. Instead, they were striving to develop R&D linkages with their external business partners and technological leaders in the 1980s. Many of them, including a significant number of SMEs in Chinese Taipei, subsequently graduated in the 1990s as leading players and pioneers in several fields of consumer and office electronics. Those fields have since accounted for the large bulk of USPTO patents issued to the Republic of Korea and Chinese Taipei.

Comparatively, the number of locally issued invention patents owned by ASEAN residents (some 1,600 during 1993-2002 as noted earlier) equaled to just -4 per cent of the invention patents granted by the local IP Offices to the resident inventors in China, Chinese Taipei and the Republic of Korea in the same decade. In terms of USPTO invention patent, the Republic of Korea had been ranked at the 30th position globally, with just only 34 patents to its

10 Within ASEAN, Singapore has become most dynamic technologically thanks to concerted efforts made to widen the S&T base and increase R&D-intensive activities. This island economy was the source of 25 per cent of invention patents granted by ASEAN IP Offices to the regional residents in 1995-1996. The proportion went up to 59 per cent in 2000-2001 (Wattanapruttipaisan 2004b).
credit during 1977-1980. Chinese Taipei was in the 24th rank with 196 patents. By 2000-2001, however, the former country had moved up to the 8th global position, with 6,852 USPTO patents while Chinese Taipei had occupied the 4th position with 10,038 patents. Comparatively in those two years, ASEAN inventors secured just 660 USPTO patents -- 514 by those in Singapore (177 to Chartered Semiconductor Manufacturing or CSM), 82 in Malaysia and 40 in Thailand.

Technological creativity has cumulated to enable many SMEs in Chinese Taipei as well as many large corporations in both economies to become original designers as well as original manufacturers of high-margin, high-value ICT components and equipment under various global brands as well as under their own original brands, too. Exceptionally, individual inventors (including SME entrepreneurs) are the largest source of IP creativity in Chinese Taipei, accounting for 40 per cent of the total USPTO patents issued to resident inventors in this economy during 1997-2001. This stands in marked contrast to the case of the Republic of Korea where the four largest chaebols (business conglomerates) owned some 80 per cent of USPTO patents during the same period, with another 5 per cent going to individual inventors.

D. The High Costs of Borrowed Ideas

It is beyond doubt that the rapid and broad-based structural diversification, employment and income generation, social progress and poverty reduction in most parts of ASEAN have been largely driven by FDI, pushed by local accumulation and led by export-orientated activities over the last several decades. In fact, the ready availability of FDI and external technologies and machinery (or embodied technology) has enabled both large firms and SMEs in the region to move higher on the technological ladder without first building up a supportive foundation in local S&T and R&D capabilities.

However, the same growth and transformation model of the past will not be adequate or sustainable in the future, especially among the middle- and high-income countries of ASEAN.

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11 Other principal inventor countries in the world are the United States (with 195,680 USPTO patents), Japan (67,815 patents), Germany (22,717 patents), France (7,860 patents), the United Kingdom (7,632) patents) and Canada (7,025 patents) during 2000-2001. A detailed examination of the patterns and implications of IP creativity in terms of invention and second-tier patents in ASEAN along with an extensive bibliography can be found in Lam and Wattanapruttipaisan (2005).
There are, to begin with, absolute limits to the accumulation and utilization of natural and material resources -- economic, social, demographic and environmental. Furthermore, the opportunity costs and other negative externalities in using ideas, instead of creating ideas, are substantial and relatively well established (Yusuf and others 2003: 295-305, and Romer 1992: 64-6).

Firstly, the narrow scope and small base of S&T and R&D contributes to inadequate job creation in the S&T and R&D sectors, to the low enrolment rates in the hard sciences, and to the grossly inadequate supply of scientists, engineers, research technologists and technicians, and knowledge managers and workers in many critical manufacturing sectors of most ASEAN economies. This is a matter for concern because the lower the technological capabilities of enterprises (both large and small) are, the more limited is the feasible level of external technological diffusion (regardless of the modes of transfer).

Secondly, local value addition and technological capacity building are limited with technologies and machinery which may be increasingly complex but which are, nevertheless, mature, readily available and widely shared. Higher efficiency and flexibility can be gained by firms and industries from cumulative learning-by-doing and learning-by-knowing. However, the sequential and incremental acquisition of such tacit knowledge and skills will soon yield diminishing marginal returns and competitiveness because of the limited amount of know-how and know-why which can be gained from mature and standard technologies and equipment.

Thirdly, there is the constant and unrelenting challenge from lower-cost production platforms for relocated financial and human resources. ASEAN has long been an attractive target for the off-shoring of production and services by overseas firms (including SMEs) and investors. The relocation is not permanently anchored, however. Increased external competitive pressures over time have forced TNC subsidiaries and other local firms to migrate from, for example, Singapore and Malaysia to Thailand, Viet Nam and China in the recent years in the case of the electronics, textiles and sport shoes manufactures, among others.

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Such intra- and extra-regional movements to take advantage of lower input costs and/or better input supplies are not always the “races to the bottom” (Daly 2000). This is a process whereby developing economies that get a competitive advantage in international trade and inward investment are often those with a poorer record of internalizing all the social and environmental costs into the prices of traded products and services, or into incentive packages to attract FDI projects. There are, nevertheless, examples of competitive offers which lead to lower real wages while doing nothing to improve productivity and technological capabilities at the firm’s or industry’s levels (UNIDO 2002: 111).

Fourthly, both large companies and SMEs alike have to manage the shorter product cycles and the eroding lead-time advantage as a result of speedy technological advances and the continuous appearance of cheaper replications and new, differentiated or better products from rival and/or lower-cost suppliers. Yet, there is no guarantee that the innovative technologies or the additional licenses needed by firms to remain competitive and to retain existing market shares can be obtained on reasonable commercial terms or in a timely manner.

There are, furthermore, various restrictions on (geographical) sales opportunities and fields of-use in technology transfer or licensing contracts. Such restrictions serve as a means for IP asset owners to determine the timing, conditions and circumstances in market entry of business partners as well as commercial rivals. Lastly, royalties and licensing fees themselves are a heavy burden on business, being equivalent to as much as 25-33 per cent of the retail prices of many licensed products.  

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13 The terms and conditions of licensing contracts are normally a commercial secret. The scattered evidence available indicate, however, that royalties and licensing fees paid by China, currently the world’s largest supplier of digital versatile disk players, absorbed up to 33 per cent of the unit retail price of US$ 60 in 2003 (“China Spins a New Disk”, Far Eastern Economic Review, February 26, 2004, pp. 34-5). Outward payments for royalties and licensing fees were equivalent of 30 per cent of the revenue of semiconductor firms in the Republic of Korea in the mid-1990s (Dodgson 2000: 242). In total, they had averaged around US$ 100 million a year in the 1970s and, after the liberalization of licensing agreements in 1978, outward licensing payments jumped up to one billion dollars in 1990 and two billion five years later (Organization for Economic Cooperation and Development or OECD, 2000: 58). Meanwhile, the technology fee on genetically modified cotton seeds sold by Monsanto in China is about 44 per cent of the retail price of 42 remihibi (US$ 8) per kilogram; this fee is equivalent to about 27 per cent of the value of the harvested crop (Keeley 2003: 8 and 20-1).
E. A Case in Point: The Electronics Industry in ASEAN

Driven by trade-related FDI, ASEAN emerged within the 1990s as a major producer of electronics products on a global scale. This industry is another impressive achievement of tiger capitalism whereby fast-growing economies in East and Southeast Asia have provided an expanding (albeit cyclical) market as well as the complementary investment resources for each other (Yusuf and others 2003; and Borrus, Ernst and Haggard 2000).

Exports of ICT items from developing economies in East and Southeast Asia reached almost 65 per cent of their intra-regional exports (totaling US$ 418 billion) in 2001, compared to less than 19 per cent (or US$ 44 billion) in 1985 (Ng and Yeats 2003: 14 and 37-9). Strikingly, these developing economies registered faster rates of exported microelectronics products than the (already rapid) growth of their total exports. They also gained a larger share in world production of microelectronics products than their relative share in global trade itself. Hong Kong Special Administrative Region of China was the only exception.14

Within ASEAN, microelectronics production from both large firms and SMEs remains mired in product segments which are labor-intensive, have limited value added, and are technologically standard instead of top-of-the line. In terms of employment, the electronics industry is largest in Malaysia, with some 330 thousand workers and an output of US$ over 27 billion in the late 1990s. However, local value added was less than one per cent in computers, 7 per cent in consumer electronics, and 21 per cent in semiconductors testing and calibration. It was also rising only marginally, by 10 per cent or less, between 1994 and 2000 except in consumer electronics due to the initially low value added levels (Yusuf and others 2003: 272).

Subdued productivity and limited value addition, too, are characteristic of the electronics industry in Thailand (with output of US$ 14.6 billion in 1998), the Philippines (US$ 7.3 billion)

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14 The relative shares (in order of importance) of Singapore, Malaysia, Thailand, Philippines and Indonesia in global electronics production combined to reach 1.8 per cent in 1985, 4.2 per cent in 1990 and 8.5 per cent in 1988. The corresponding ratios for the Republic of Korea plus Chinese Taipei were 2.6 per cent, 5.4 per cent and 6.7 per cent (Wong 2001: 4).
and Indonesia (US$ 5.2 billion). Exceptionally, Singapore has successfully developed an integrated base of microelectronics production (valued at US$ 37.8 billion in 1998) embodying high capital and skilled-labor intensities, and high value addition (Lam and Wattanapruttipaisan 2005). It is also worth noting that CSM, owned by Singapore investors, is the largest single source of USPTO patents in ASEAN.

CSM, the world’s third largest dedicated chip foundry, had 282 invention patents to its credit, or 32 per cent of the total of 872 registered to Singapore residents during 1997-2001. Meanwhile, USPTO invention patents in microelectronics secured by other firms in ASEAN are negligible for all practical purposes. For context, Taiwan Semiconductor Manufacturing Company and United Microelectronics Corporation in Chinese Taipei (two highly profitable businesses) is respectively the world’s largest and second largest dedicated chip foundry. The former owned 1,538 USPTO invention patents and the latter, 1,568 patents during 1997-2001.

II. OPTIONS AND AGENDA ON ENTERPRISE DEVELOPMENT AND INTERNATIONALIZATION

The preceding discussion highlighted another major structural problem facing government and the business sector in ASEAN and elsewhere, too. This problem has not attracted due attention as yet despite its considerable adverse impact on government policies and business efforts in development. These include policies and efforts to achieve higher levels of local productivity and value addition, to attract and anchor high value-added activities in production and trade, to regain the dynamism and resilience of the miracle years, and to provide “decent work” and social safety for all in Southeast Asia (World Commission on the Social Dimension of Globalization 2004, Yusuf and others 2003, UNCTAD 2003, and Yusuf and Evenett 2002).

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15 For a more detailed discussion on these matters, see Tham (2004: 31-3); Tangkivanich, Nikomborirak and Krairiksk (2004: 20-24); Lall (2003: 22-4); UNCTAD (2003: 112-23); Dodgson (2000: 245-8) and Linden (2000: 213-8). Lam and Wattanapruttipaisan (2005) examine at some length the new electronics-based specialization in production and trade in ASEAN, and related opportunity costs in terms of defensive and positive restructuring plus the heightened vulnerability to cyclical external demand facing the region.
A. Overview

A strategic response to facilitate and accelerate enterprise development and internationalization in ASEAN has become even more pressing, especially among the middle- and high-income developing economies and among the regional enterprises and industries which need to leapfrog technologically in global competition. This is because technological progress is now increasingly based on existing plus newly found discoveries from a host of related as well as diverse sectors and processes. Meanwhile, the ceiling for expected enterprise performance is also rising over time, as noted previously. All those mean greater complexity in learning and more time in absorption, and a constant need for new and more costly equipment and specialist skills.

Inevitably, a major component of any strategic response by government and business has to include the promotion of on-going inventions, innovations and competence building among enterprises and industries. The process is not possible without interactive investment in education, training, R&D and S&T by all the concerned stakeholders. It is also necessary to ensure the development and transfer of commercially relevant and viable technologies from S&T and R&D institutions to private business in the region. This can be achieved through improved synergies between R&D and S&T institutions and the industrial fabrics as well as through closer alliances with cross-border commercial or institutional entities in R&D and S&T.

The agenda involved is extensive and complex, and requires costly investment up front and long-gestation periods before the dividends can be reaped. The following discussion focuses on a few important parameters for further consideration by government and business, and for follow-up research and cooperative action in ASEAN.

B. A Race without End

Technological competence building is a life-long and expensive process, and the current figures are revealing. Public spending on R&D in ASEAN is generally around 0.3 per cent of GDP, compared to 2.5-3 per cent in Japan and the Republic of Korea, and 1.2 per cent in China.
Exceptionally, such spending has risen to 1.8 per cent of GDP in Singapore since the mid-1990s. Meanwhile, R&D outlays by private enterprises are insignificant, and the interactions between research institutions and businesses leave much to be desired in the region, with the possible exception of those in Singapore from the late 1990s (Lam and Wattanapruttipaisan 2004: 77-9).

As such, a changed mindset is needed among the ASEAN enterprises and entrepreneurs concerning commercial R&D. That is not just because of the costly free ride in using ideas, instead of producing ideas, and the coming of age of inventive SMEs as discussed previously. There is now tighter and broader protection of IP rights globally and regionally, plus the stronger (or Trade Related Aspects of Intellectual Property Agreement-plus) regime in various free-trade agreements completed or under negotiation between several regional economies and several developed countries (Wattanapruttipaisan 2004a).

R&D can be a profitable activity, yielding economic returns in the range of 70-100 per cent to firms and industries. Those rates are far higher than the commercial gains from using ideas, from learning by doing and knowing, and from imitation and reverse engineering activities. In particular, R&D spending produces payback rates of 20-40 per cent for OECD economies, 60 per cent for middle-income countries, and as high as 100 per cent for low-income economies (Lederman and Maloney 2003: 3 and 12-4). Another survey of 57 published studies on industrial R&D plus 292 publications on agricultural R&D shows consistently double-digit rates of economic returns (Watson, Crawford and Farley, 2003: 10).

C. The China Factor

Another imperative and wake up call for changed mindset among ASEAN enterprises and industries is China’s blazing speed in competence building and technology catch-up. The country has emerged as a powerful global competitor, with significant gains within a decade of world market shares across the technology spectrum at the expense of East Asian and, to a lesser but increasing extent, ASEAN.\textsuperscript{16} But business firms and industries in China are also constantly

\textsuperscript{16} Lall and Alabadejo (2004) contains a detailed analysis of China as a competitive threat in world market to East and Southeast Asian economies in four technological categories (resource-based, low-tech, medium-tech and
moving up the value-added chain through an equally fast-paced widening and deepening of their industrial and technological capabilities.

In the context of managerial and organizational competencies, an extensive survey of 406 plant managers in China and 681 in the United States yields several interesting results in five major benchmarks in manufacturing best practices (Mei and Wonnacott, 2004).

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Chinese Plants</th>
<th>American Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. On-time delivery rate</td>
<td>99%</td>
<td>96%</td>
</tr>
<tr>
<td>2. Products meeting specification on the first pass</td>
<td>98%</td>
<td>97%</td>
</tr>
<tr>
<td>3. Offer more than 20 hours of training to workers</td>
<td>53%</td>
<td>35%</td>
</tr>
<tr>
<td>4. Plants less than five years old</td>
<td>29%</td>
<td>2%</td>
</tr>
<tr>
<td>5. Percentage of sales revenue spent on ICTs in 2004</td>
<td>5%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Additionally, China is now regarded as competitive in many advanced technologies. Indeed, Bill Gates (the chairman of Microsoft) noted in July 2004 that China has now overtaken the United States as the center for handset technology. This is in part because major companies in China are spending heavily on R&D instead of piggybacking off foreign technologies, a costly free ride in the case of ASEAN as examined earlier. From US$ 8 billion in 1998, corporate expenditure on R&D was estimated to reach US$ 18 billion in 2003.

In particular, the international norm of R&D expenditure by American firms is about 5 per cent of sales revenue (Roberts 2004: 54). Huawei Technologies Company has already spent more than 10 per cent of revenue on R&D relating to ICTs. Other budding Chinese TNCs with R&D outlays of 4-6 per cent of sales revenue include the Haier Group (maker of household appliances with sales revenue of US$ 9.7 billion in 2003), TLC and Lenovo (both belonging to the ICT sector with sales revenue of US$ 3.4 and US$ 3 billion respectively), and the SVA and Galanz Groups (consumer electronics and home appliances maker respectively).
D. R&D Synergies between Large and Small Firms

All the above companies are big businesses in China, and large firm in many developing countries have a decided advantage over SMEs in undertaking costly and time-consuming commercialization projects based on newly developed technologies of their own or purchased from elsewhere (Baumol 2004: 13-4). In the Republic of Korea, for example, the five largest cheabols account for 90 per cent of all USPTO invention patents issued to Korean resident inventors. Those conglomerates have served not only as a production and export platform for their extensive networks of highly innovative and competitive SME subcontractors. They are also the initiator and the source of in-house R&D and IP generation on a broad front.

There is, nevertheless, a definite place for SMEs in R&D and commercialization even in developing countries. Many SME start-ups, for example, can act as a vehicle for the incubation and eventual transmission of leading-edge ideas and breakthrough technologies to the industrial mainstream. These ideas and technologies may be developed by the SMEs concerned or by such other entities as public-sector institutions in S&T and R&D. The subsequent transmission process can be mediated through mergers with or acquisitions by large firms, through collaboration between small and large firms, or through export-driven transformation of the dynamic SMEs into large enterprises or TNCs in their own right.

That has, in fact, been the transformation model in Chinese Taipei where institutional research efforts (e.g., from the Industrial Technology Research Institute and the National Science Council) have sustained the dominant role of SMEs in both desktop and notebook computers on a global scale, despite the considerable barriers facing them in terms of technology and scale economies. This provides a sharp contrast to the failure of the much larger and resource-rich

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17 By the mid-1990s, some three-fifths of the world supply of desk-top personal computers had come from this island economy which had also become the world’s largest producers of notebook personal computers. In the production of personal desktop computer and computer peripherals especially, SMEs in Chinese Taipei have overcome the technological barriers to entry through vertical disintegration (or deverticalization) and a de-technology arrangement whereby the most advanced and demanding technology functions are outsourced to specialist, independent subcontractors. In addition, economies of scale and scope are realized through the pooling of work orders and other inter-firm linkage and coordination arrangements in the capital-intensive segments of production and manufacturing. Moreover, the flexibility and capacity to adjust to abrupt and often unexpected
corporations in the Republic of Korea to enter and maintain even a modest presence in these particular segments of the electronics industry (Ernst 2000: 114).

Similarly, the world-famous ICT sector in India was pioneered by SMEs but, in contrast to the case of Chinese Taipei, without much government support at the initial stages of development and internationalization. With success, however, come many mergers and acquisitions and large ICT firms have subsequently assumed a more prominent role in the sector. However, SMEs and their entrepreneurs are still playing a leading role in the export-oriented development of ICT-related technologies and services packages. Another up-and-coming industry in India is pharmaceuticals which are populated by some 10,000 small firms producing generics for the local market, and supplying existing and new chemical compounds to large domestic and foreign firms. About 5-10 per cent of those firms are regarded as highly inventive on a global basis (Kripalani 2005).

E. R&D Thrusts and Possibilities

The payoff to R&D investment made by firms, industries and public-sector institutions will depend heavily on what precise products and processes are to be targeted. Market signals and the evolving paths of technological change can provide the needed inputs but business “savvy” count, too.\(^\text{18}\) Failure is often disastrous financially, given the typically lumpy investment required (relative to capitalization of even large corporations in ASEAN and elsewhere), and the short-term horizon of market valuations of listed firms.

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\(^{18}\) Samsung Electronics (and for that matter, LG Electronics Incorporation) has taken a pole position technologically, with strong pricing power, over major rival corporations in several top-of-the-line electronics products. This is due to astute foresight in making contrarian decisions to invest huge resources for the commercialization of newly developed, advanced technologies in plasma flat-screen display panels right in the aftermath of the 1997-1998 crisis in East and South-East Asia (Yusuf and others 2003: 148). Global sales of Samsung, which had secured 6,749 USPTO invention patents during 1997-2001, amounted to US$ 50.2 billion in 2003, or about four-fifths of those achieved by Sony, the inventor of consumer electronics itself. However, the former recorded a much higher profit margin over sales, 12 per cent, compared to less than 2 per cent in the case of Sony (with 5,475 USPTO invention patents in the same period). Matsushita Electric Industrial Company, with 5,284 USPTO invention patents in 1997-2001, is the world’s second largest consumer electronics firm (with global revenue of US$ 62.6 billion but with a net loss of US$ 145 million in 2003). See “Forbes 2000”, Forbes, May 23, 2004, pp. 46-76.
Microelectronics fields typically pre-dominate R&D activities as well as the USPTO patents gained by the late inventors such as the Republic of Korea and Chinese Taipei, and by Singapore as well among ASEAN members, as noted earlier. This is because, firstly, ICT products are subject to a huge global demand and are also the fastest growing segments of world merchandise trade. The export value of semiconductors, telecommunications equipment, and automatic data processing machinery alone reached US$ 679.3 billion in 2000, compared to US$ 183.3 billion in 1990 (UNIDO 2004: 190). Comparatively, the market for refined petroleum products was worth US$ 156.3 and 78.8 billion, and for medical and pharmaceutical products, US$ 106.5 and 36.3 billion during these two respective years.

The second reason is that microelectronics is more engineering driven than science-based chemicals and pharmaceuticals. Equally important, technological progress in microelectronics is both very fast and characterized by discontinuities, thus offering good entry opportunities and niches for the late comers. In fact, many electronics firms often require access to a “thicket” of complementary or interdependent patents in order to invent, produce and sell the products and processes concerned legally. Many of those patents may be held by business partners or rivals, and this factor accounts for the frequent litigations relating to patents and other IP rights within the electronics industry (both the hardware and software segments).  

As such, the earlier movers have a decided advantage in R&D activities on science-based chemicals and pharmaceuticals which require time-consuming learning by doing and painstaking selection through a highly expensive process of trial and error. Thus, most science-based technologies pose great difficulties to the late comers which invariably have a much shorter period of industrial experience and a much shallower and narrower S&T base (Luthria and Maskus 2003: 147-8). Notably in this connection, Singapore is pursuing a broader front in S&T capacity building and R&D activities. Biomedical outputs were worth some US$ 7 billion, and the industry attracted some US$ 0.5 billion of overseas investment in biotechnology.

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19 Among the good cases in point were the legal battles between Sony and Eastman Kodak (as defendants) relating to digital camera technologies, and the suits and counter-suits over technologies in (flat-screen) plasma display panels between Fujitsu and Samsung (the world’s largest and second largest producers).
manufacturing facilities in 2003.\textsuperscript{20} Comparatively, pharmaceuticals are a US$ 9 billion industry in India at present.

\section*{F. Bridging the Human Resource Gap}

The lack of a minimum critical mass in S&T and R&D has had an adverse impact on the enrolment rates in the hard sciences and on the supply of qualified human resources virtually across ASEAN. Returning nationals and expatriate personnel have helped to bridge the knowledge gap among enterprises and industries in Singapore, and in China, Chinese Taipei and the Republic of Korea as well. However, this is not a solution equally feasible in other regional economies in the foreseeable future, and long-gestation and costly capacity and institutional building is no longer an option in ASEAN (more below).

Another possible measure is the formation, diversification and deepening of strategic linkages with trans-border entities in S&T and R&D so as to share risks while leveraging collective capabilities in research and commercialization.\textsuperscript{21} However, there is a “Catch-22” situation in this regard: the success and sustainability of such networking depends on the age-old conditions of trust, reliability, quality and timeliness in the agreed delivery of R&D results among partners and collaborators. The lack of adequate experiences and outcomes among the regional R&D and S&T entities is a binding constraint on efforts to promote alliances and linkages with their trans-boundary counterparts.

Meanwhile, systemic reform in education and training has been high on the policy agenda of ASEAN and this has been another daunting challenge not just because of the initial low rates of enrolment in the hard sciences. There is also the pressing need to improve technical competence and analytical mastery as well as to stimulate creativity, imagination, and thinking “outside the box.” Again with the exception of Singapore, progress has been slow in the region because of

\begin{itemize}
\item \textsuperscript{20} “Biomedics on the Way to $ 20b Target”, \textit{The Straits Times} (Singapore), 20 February 2004, p. 1). Malaysia’s BioValley is still in a budding stage, however (“Penang Seeks Biotechnology Investments”, \textit{The Straits Times} (Singapore), 2 February 2004, p. 4).
\item \textsuperscript{21} In fact, S&T networks and R&D alliances with cross-border entities and/or trans-boundary R&D activities of foreign firms, both large and small, are particularly evident among the new and dynamic fields of technology, especially electronics and biotechnology, and in the automobile industry since the early 1980s (UNCTAD 1999).
\end{itemize}
institutional inertia, fixed mindset, costly investment in infrastructure and in building up educators’ and trainers’ capacity, etc (Yusuf and others 2003: 181-216, and APEC 2000: 195-8).

But IP creativity and technological inventions are not sufficient in themselves because they must be successfully tested, financed and commercialized. In the ideal scenario, therefore, education and training in entrepreneurship development and business management should be part of the curriculum in senior high schools, in vocational and technical schools, and in tertiary institutions. In addition, there is no substitute for apprenticeship and incubation, on-the-job learning, and practical experience in R&D plus in business management (Amsden, Tsang and Goto 2001: 11-2). Exchange and internship programs are particularly relevant in these regards.

G. Improved Systems and Instruments on IP Rights

A variety of institutional problems and systemic constraints concerning IP right regimes in ASEAN have had an adverse impact on the willingness of enterprises and entrepreneurs to invent and to register and maintain their IP assets. The pertinent issues, implications and options have been discussed at length by Lam and Wattanapruttipaisan (2004: 67-75). Some of the more notable difficulties and barriers are briefly sketched out below.

To begin with, there is much scope for greater user-friendliness in the regional systems and instruments on IP rights, especially to SMEs and their entrepreneurs. In particular, excessive delays of many years are typical in the processing of invention patent applications, and this in effect shortens considerably the protected life of the IP assets under application. Besides, the fees and charges for patent registration and maintenance (over 20 years) are quite high, ranging from US$ 11,000 to US$ 14,000 in Indonesia, Malaysia, the Philippines, Thailand and Viet Nam. For perspective, the corresponding expenses in the United States are US$ 10,000 and in the United Kingdom, US$ 16,000.

Moreover, the great diversity in patent laws and regulations overseas has made it extremely expensive, in the range of US$ 160,000 to as much as US$ 360,000, to obtain and maintain a 20-year patent in nine major developed countries. Lastly, procedures for enforcement
under the adversarial systems are also very expensive in terms of time and resources. There is almost a universal desire for low-cost, speedy and non-judicial approaches to encourage voluntary agreements and discourage confrontation in IP right enforcement. Is that a day dream?

Currently, there are no regional institutions on IP rights in ASEAN. Hopefully, some of these will emerge to foster and stimulate IP creativity and collaboration among ASEAN enterprises and institutions from the current efforts to build up an ASEAN Economic Community by or in 2020.

CONCLUSION

All business firms, regardless of their operational scale or technological specialization, have to manage their development and internationalization in changed conditions and circumstances under the knowledge-based and innovation-driven world economy. There are now fast-paced technological changes and fleeting first-mover advantages, intensified business competition and greater mobility of factor inputs, rising enterprise performance expectations, and more exacting and sophisticated market requirements for both intermediate and final goods and services.

Competitiveness and the availability of decent work in ASEAN or elsewhere can no longer sustained for long through good geographical location, inexpensive labor, and the cheap pricing of socio-environmental resources and infrastructure services. The regional businesses and industries must attain higher trajectories of technological capabilities and productivity, and SMEs have an integral and vital contribution to make to such a transformation. The process is undoubtedly challenging not just because the formation of intangible capital at the enterprise’s or industry’s level typically requires long gestation periods and lumpy investment up-front.

There are also wide-ranging needs in human and institutional capacity building and upgrading, in fostering better synergies among business firms and knowledge institutions, and in the identification of technological specialization paths which are both feasible and rewarding for pursuit by all stakeholders. All these highlight once again the richness of the unfinished agenda
for policy attention and further research. In this context, the speedy process of competence building and technological catch-up achieved by the developing economies of East Asia provides an additional imperative for transformation in ASEAN as well as many valuable lessons and insights for consideration by firms, industries and government in the region.
REFERENCES


Asia-Pacific Economic Cooperation (APEC), 2000. “Towards Knowledge-Based Economies in APEC”. Report by the APEC Economic Committee to the APEC Ministerial Meeting, Brunei Darussalam, November


