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## Knowledge Management: A New Perspective for Development Strategy

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## 1. INTRODUCTION

The Asian crisis of 1997 appears ostensibly to have stemmed from the mismanagement of the financial sector. But it is rooted fundamentally in the systemic weaknesses of national development strategies. Many countries in Asia, particularly those most severely affected by the crisis, had developmental state. The government consolidated sufficient power to pick “winners” and mobilized and allocated resources to them for ambitious developmental goals. Such an approach inevitably led to corruptive collusion between the state and big businesses, the consequent mismanagement of the financial sector with serious resource misallocation, a heavy reliance on state protection and resultant over diversification of big businesses beyond their financial and technological capacities, and the lack of transparency and accountability in the economic system. These pathologies of the past have led to an increasing number of unprofitable firms and in turn drastic rise in foreign debts. Foreign investors’ panic not to renew short-term debts resulted in the Asian crisis of 1997. A new perspective is called for development strategies.

Knowledge explosion, increasing globalization, the rapid development and diffusion of information and communication technology (ICT), and their interactive effects on competition call for a paradigm shift in development strategies. The effective knowledge management at both the micro and macro levels could offer a new analytical perspective.

The importance of knowledge management is not new. Even in the past, business firms have expended their resources to recruit better-skilled human resources and train them further to be more competent and to undertake R&D activities so as to cope with the turbulent technological and market environments. Some firms have invested in building management information systems. They also have patented new knowledge to appropriate their investment. These are important knowledge management activities at the micro level. States have also invested heavily in education, basic research, and information infrastructure that provide economic externalities to business firms. These are all knowledge management activities at the macro level. Not

surprisingly, many studies have shown that more than 50 percent of the past economic growth in industrialized countries can be attributed to the advancement and application of knowledge (Denison, 1967; Grossman, 1991). It is also the knowledge deepening that has enabled most newly industrializing economies (NIEs) such as Taiwan and Korea to transform themselves from technologically backward and poor to relatively modern and affluent economies. Despite a recent economic crisis, each of these countries now has a significant collection of industrial firms producing technologically complex products and competing effectively against firms based in industrially advanced countries. For example, the proportion of technologically complex products in total manufacturing exports increased from 1.53 percent in 1960 to 68.59 percent by 1999 in Korea. High technology products accounted for 52.42 percent of the complex manufactures in 1999 (Kim, 2000).

Effective knowledge management will become even more important in the new century for three highly interrelated reasons. First, in the face of knowledge explosion product life cycles get shorter than ever before; any products or services based on existing knowledge will soon become obsolete. Firms and economies that fail to acquire, generate, and utilize new knowledge cannot sustain their competitiveness. Second, the rapid development and diffusion of web technology enables one to access to a vast pool of knowledge through worldwide information networks. This gives tremendous opportunities to those who have capacity to take advantage of it, while ever increasing gap and frustrations to those without such capacity. Third, increasing globalization based on new international rules allow both tangible and intangible resources to move freely across national borders. The success of globalization for both suppliers and recipients of such resources would largely hinge upon knowledge and the capability to create and utilize such knowledge. That is, the creation of wealth will be more dependent on knowledge than it has previously been and “the next wave of economic growth is going to come from knowledge-based businesses” (Davis and Botkin, 1994, 165). This raises questions as to how firms and states in

developing countries could manage knowledge effectively so as to sustain their economic development and eventually catch-up with advanced countries.

Nevertheless, research on knowledge management is a recent phenomenon even in advanced countries. Recognizing the increasing importance of knowledge in wealth creation, literature on knowledge management at the micro level has just begun appearing in the past few years in advanced countries (e.g., Leonard-Barton, 1995; Wiig, 1997, Davenport, De Long, and Beers, 1998; Coombs and Hull, 1998). The importance of knowledge management at the macro level is only being recognized (e.g., World Bank, 1999). In contrast, research on knowledge management in developing countries at both the micro and macro levels is scarce, except for a few fragmented studies (Kim, 1997a, 1998, 1999; World Bank, 2000, Erst, 2000; Ernst and Lundvall, 2000). This paper attempts to develop a knowledge management model in developing countries.

Knowledge management of firms in developing countries is significantly different from that in advanced countries. Most, if not all, firms in developing countries are engrossed in knowledge management activities to catch-up with firms in advanced countries. As a result, sources of external knowledge, the nature of learning activities, the degree of sophistication in products and services in developing countries are noticeably different from those in advanced countries. Even developing countries vary significantly in terms of development stage, requiring different degree of sophistication in knowledge management. The first-tier NIEs, including Singapore, Taiwan, and Korea require a significant degree of sophistication in knowledge management, as they increasingly take creative approaches in their developmental endeavor. The second tier-NIEs, encompassing Indonesia, Malaysia, Thailand, and coastal China, are at the early stage of technological development and thus require a lower degree of sophistication in knowledge management. The remaining countries have made little progress in their economic and social development. Consequently, the nature of knowledge management may be appreciably

different from that in the first- or second-tier NIEs. This paper focuses on the issues relevant to the first-tier NIEs, which might also offer useful implications for the second-tier NIEs.

Knowledge management can take place at the four mutually interfaced levels of analysis: individual, organization, sector or region, and nation. First, individuals are the primary actors in learning and knowledge creation (Hedberg, 1981). They constitute local capabilities that may be combined at the organizational, sectoral, regional, or national level. Second, organizations or firms are primary production units that drive economic development. Organizational learning, however, is not the simple sum of individual learning. Only effective organizations can translate individual learning into organizational learning. Third, knowledge management is also important at the sectoral or regional level. The spiral process of knowledge creation among a cluster of dynamic firms in a sector or region plays a vital role in disproportionate growth of innovation and employment. Finally, knowledge should also be managed effectively at the national level in order to strengthen its national innovation system (Nelson, 1993). This paper first develops an analytical framework of knowledge management at the micro (individual and organization) level and then draw its implications for public policy at the macro (sectoral, regional, and national) level.

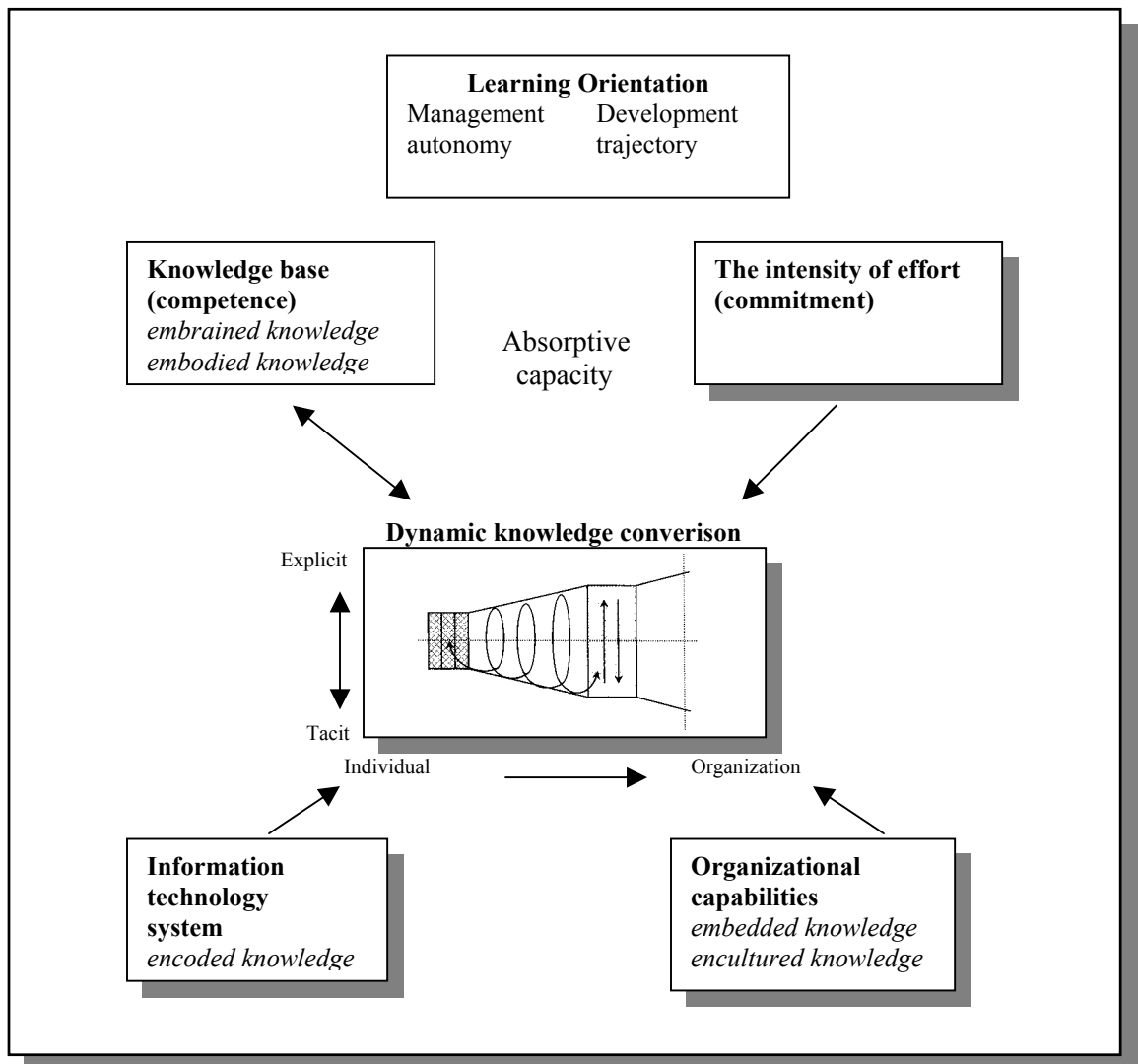
## **2. KNOWLEDGE MANAGEMENT AT THE MICRO LEVEL: A FRAMEWORK**

Knowledge management is a complex, interactive process of many different actors and factors, which defies a simple analysis. This paper, however, attempts to present a knowledge management model in NIEs at the risk of over simplification. Firms occupy a center stage in the knowledge management model, as they contribute a lion's share to economic development in the industrial and post-industrial society. Figure 1 depicts the internal components of knowledge management at the micro level.

Knowledge may be classified into various categories depending on the purpose of its use. Polanyi's (1962) classification into explicit and tacit knowledge may, however, be most useful for

Figure 1: Internal Components of Knowledge Management

**External Environment**





our purpose. Explicit knowledge refers to knowledge that is codified in formal, systematic language (encoded knowledge). Thus, explicit knowledge may easily be combined, stored, retrieved, and transmitted through rapidly developing ICT. In contrast, tacit knowledge refers to knowledge that is so deeply rooted in the human body and mind that it is hard to codify and communicate and can only be expressed through action, commitment, and involvement in a specific context. Tacit knowledge can be acquired only through experience such as observation, imitation, and practice and can be transferred largely through training or human mobility.

With the benefit of rapidly developing ICT, a growing amount of explicit knowledge may be easily and conveniently accessed worldwide in real time at minimal costs, resulting in revolution in organizational arrangements, work methods and life style. But explicit knowledge is useful only when tacit knowledge enables individuals and organizations to make sense of and utilize it. That is, tacit knowledge is the underlying fertile intellectual ground for all knowledge management (Gelwick, 1976) and effective performance in the economy (Nelson and Winter, 1982). In the face of increasing uncertainties in globalization, tacit knowledge becomes even more important (Ernst and Lundvall, 2000).

Many have attempted to unpackage the tacit knowledge (e.g., Sparrow, 1998; Spender, 1996). For our purpose, the following categories, first coined by Collins (1993) and later expanded by Blackler (1995), appear to be most useful. Tacit knowledge may become part of human body as skills (embodied knowledge); part of human being as cognitive capacity (embrained knowledge); routinized in organizational practice (embedded knowledge); or inculcated in the organization as basic assumptions, beliefs and norms (encultured knowledge).

The nature of business requires different kind of tacit knowledge. For example, the basis of economic system had shifted from embodied knowledge such as craft skills in the eighteenth century to embedded knowledge such as Taylor's work system in the twentieth century (Drucker, 1993). Both embodied and embedded knowledge are used to raise productivity in dealing with

familiar problems. In the modern society, the former is essential in professional bureaucracy, while the latter is in machine bureaucracy. But a shift is now occurring towards embrained and encultured knowledge, as firms focus more on novel problems in the face of increasing uncertainties created by rapid changes in the market and technology (Blackler, 1995).

### **The Dynamic Process of Knowledge Conversion**

The center of knowledge management, as depicted in Figure 1, is the dynamic process of knowledge conversion between explicit and tacit knowledge and accompanied spiral processes that expand knowledge from individuals to groups, a whole organization, and other organizations. Firms learn and create knowledge primarily through the dynamic process of four modes of conversion between explicit and tacit knowledge in production and R&D activities (Nonaka, 1991). Tacit-to-tacit conversion (socialization) takes place when tacit knowledge within one individual is shared with others through training, where explicit-to-explicit conversion (combination) takes place when an individual or a group combines discrete pieces of explicit knowledge into a new whole. Tacit-to-explicit conversion (externalization) takes place when an individual or a group is able to articulate the foundations of individual tacit knowledge, whereas explicit-to-tacit conversion (internalization) takes place when new explicit knowledge is shared throughout the firm and other members begin to use it to broaden, extend, and reframe their own tacit knowledge. Such conversion tends to become faster in speed and larger in scale in a spiral process as more actors in and around the firm become involved in knowledge conversion. Using Japanese examples, Nonaka and Takeuchi (1995) provide excellent detailed discussions of a spiral model of organization knowledge creation, showing how an upward spiral starts at the individual level and moves up to the organizational level.

Such a dynamic process is generally affected by five interrelated factors: knowledge base, the intensity of effort, organizational capabilities, information technology system, and

learning orientation. Successful firms in knowledge management are generally effective in managing tacit and explicit knowledge in all of the five factors.

First, the knowledge base refers to local capabilities available within the firm and consists of distinctive individual units of tacit knowledge embrained or embodied in human resources within the firm.<sup>1</sup> It is the core of the firm's absorptive capacity (Cohen and Levinthal, 1990) and intellectual capital (Ullrich, 1998).<sup>2</sup> The knowledge base, as embrained in human resources, enables the firm to make sense of, assimilate, and use existing knowledge available elsewhere and create new knowledge through various knowledge conversion activities in production and R&D. Without the adequate level of knowledge base, firms cannot take the advantage of a rich worldwide pool of explicit knowledge through the web. As a result, it plays a pivotal role in knowledge creation processes (Nonaka and Takeuchi, 1995). For these reasons, it is imperative for local firms in NIEs to develop their own in-house knowledge base in order to maximize their benefits from knowledge management.

Second, the intensity of effort represents the amount of emotional, intellectual, and physical energy expended by organizational members to acquire or generate new knowledge in solving complex problems. Exposure of a firm to relevant external knowledge is insufficient unless an effort is made to internalize and use it. Learning how to solve complex problems is usually accomplished through many practice trials involving a series of conversion of external and internal knowledge. Hence, considerable time and effort must be directed to learning (Kim, 1998). Along the same vein, Ullrich (1998) argues that intellectual capital requires both competence and commitment. As his equation (intellectual capital = competence x commitment)

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<sup>1</sup> Kusunoki, Nonaka, and Nagata (1998) also include such explicit knowledge as elemental technologies, various information processing devices, databases, and patents in the knowledge base. Those explicit knowledge will, however, be covered later under the discussion of Information and Communication Technology, as ICT becomes increasingly important in knowledge management.

<sup>2</sup> Cohen and Levinthal (1990) coined the concept of absorptive capacity, which includes prior knowledge base and intensity of effort, while Ullrich (1998) defines intellectual capital, which encompasses both competence and commitment.

multiplies rather than adds, a low score on either competence or commitment significantly reduces overall intellectual capital.

Third, organizational capabilities create climate, in which knowledge conversion takes place. The prime actors in the process of organizational learning are individuals within the firm. Individual learning through knowledge base and the intensity of effort is, therefore, an indispensable element for organizational learning, but cannot be the sufficient one. Only effective organizations can translate individual learning into organizational learning. That is, organizations can play a decisive role in fostering or inhibiting individuals in building their knowledge base and intensity of effort for converting and utilizing knowledge. Organizations should have capabilities that facilitate individual learning and spiral processes in organizational learning.

Organizational capabilities refer to a collection of organization-specific knowledge and resources that have been accumulated through long-term and continuous learning. Kusunoki, Nonaka, Nagata (1998) suggest that architectural and process capabilities are critical organizational capabilities in knowledge management. In addition, human resource management (HRM) and corporate culture are serious organizational characteristics that create environment, in which prime actors of the organization acquire, share and utilize knowledge. The first three – architectural, process, and HRM -- reflect *embedded knowledge*, while the last one – corporate culture -- mirrors *encultured knowledge*.

Architectural capabilities refer to the firm's ability to manage organizational structure and strategies that determine the stable patterns or configurations of linkages between individual units of knowledge and their priorities. In contrast, process capabilities provide effective communication and coordination across different functional and task groups, enabling individuals and groups to interact dynamically in combining and transforming knowledge.

HRM is critical in recruiting, developing, and retaining individuals with high knowledge base and intensity of effort. Only firms with sound HRM practices can make them an attractive place for human resources with high-level embrained and embodied knowledge to join, grow, and

remain. Corporate culture is a set of basic assumptions that determines the thoughts and behavior of individuals within the organization (Schein, 1985). Corporate culture provides an important organizational climate, in which individuals and groups interact with each other for combining and transforming knowledge.

Fourth, information technology provides an effective system for firms to acquire, store, retrieve, and use encoded knowledge. User-friendly ICT rapidly changes not only the way we work but also the way we acquire, share and utilize knowledge in the firm, making itself an important component of core capabilities and directly affecting the firm's learning processes. That is, ICT enables firms to tap explicit knowledge available worldwide through the internet, to develop effective communications with multinational flagship companies in global production networks, and to undertake e-businesses such B2B and B2C. In addition, it plays a pivotal role in the firms' learning processes, as Andreu and Ciborra (1996) note.

ICT can be an essential ingredient of the firm's core capabilities by enabling the firm to gather data, information, and knowledge in customer services, transactions with network organizations, to prepare information for control purposes, and to design and access database; by becoming part of well coordinated primary value chain activities such as CAD/CAM in designs and manufacturing and just-in-time inventory control; and by becoming part of well coordinated support value chain activities such as decision support systems (DSS). ICT can also contribute to the routinization and capability learning loops by supporting the firm's capability creation process through such techniques as knowledge-based procedures and artificial intelligence; by sharing work practices and facilitating communication within groups and among groups through such technology as a groupware; by facilitating reflection, experimentation, and training on routines and work practices through the use of simulations, expert systems, and computer assisted instruction; and by supporting and enabling capability diffusion through on-line real time decision makings shared by various functional or geographical groups.

In short, the creation of wealth will be increasingly more dependent on knowledge than it has previously been, making effective knowledge management crucial for firms to sustain their competitiveness. Various factors such as knowledge base, the intensity of effort, organizational capabilities, and information technology system affects knowledge management processes within firms, enabling them to acquire, create, share, store, convert, and utilize knowledge for building their core capabilities. Coloring these processes is the learning orientation of the firm.

### **Learning Orientation**

All organizations are learning systems. They learn, as they develop, produce, market products. All learning systems have specific learning orientation, reflecting the values and practices that determines what is learned, when, and how. That is, learning orientation determines the way firms acquire, share, and utilize knowledge. It might emphasize knowledge source, product-process focus, documentation mode, dissemination mode, learning focus, value-chain focus, or skill development focus (Nevis, DiBella, and Gould, 1995). In developing countries, two important aspects in learning orientation appear to affect most strongly the firm's knowledge management: the management autonomy of the firm and stages in development trajectory.

First, the management autonomy of the firm for our purpose is the degree of autonomy in management decision-making from multinational enterprises and is reflected inversely in the management control by the latter through equity share. In the case of a wholly owned multinational subsidiary or joint venture, the parent company actively transfers production technology but paces the learning process on anything beyond that, leading to a *passive learning orientation* on the part of local firms. In contrast, local independent firms, not constrained by outsiders, have complete management autonomy and may have a very *aggressive learning orientation* through managing knowledge base and the intensity of effort. In other words, the management autonomy of the firm makes significant differences in learning orientation and in turn knowledge management.

A classic example in a NIE may be a contrasting learning orientation between independent Hyundai Motor and Daewoo Motor, a 50-50 joint venture with General Motors, in Korea. Independent Hyundai takes an aggressive strategy in learning orientation, licensing technologies from multiple sources and independently takes the responsibility to integrate them in a workable system, entailing a major crisis but significantly expediting technological learning. At the same time, Hyundai invests heavily in in-house R&D in order to continuously upgrade its absorptive capacity, enabling it to develop its own state-of-the-art engines and transmissions. As a result, Hyundai enjoys the largest share in both the domestic and export markets. In contrast, constrained by GM's global objectives, Daewoo relied solely on GM for production technology but undertook little R&D for its own advanced learning. As a result, Daewoo operated at 19.5 percent of capacity compared with 67.3 percent for Hyundai in 1982 and had 17 percent passenger car market share compared with 73 percent by Hyundai, giving the smaller Kia a chance to outpace Daewoo in the early 1990s. It was only after a divorce from GM in 1992, when Daewoo set its own global strategic direction and navigated at its own ambitious pace, recapturing the second position after Hyundai.

Second, learning orientation varies considerably by different stages along development trajectory. NIEs have evolved from the duplicative imitation stage to the creative imitation stage and to the innovation stage (Kim, 1997a). At the *duplicative imitation stage*, firms in developing countries import or imitate mature technologies, whose products and markets have already been well tested and proven elsewhere. Technology tends to be readily available in machine-embodied forms. Learning orientation is largely associated with a mere assembly operation of foreign inputs or reverse engineering (E) of foreign products to manufacture fairly simple, standard goods, in many cases under original equipment manufacturing (OEM) arrangements. Duplicative imitation requires only a low level of learning, since the firms do not have capacity to and are not required to generate new knowledge. For this purpose, knowledge base is not sophisticated, but the intensity of effort can expedite learning speed. Firms in the second-tier NIEs are mostly

progressing at this stage, while firms in the first-tier NIEs underwent this stage through the mid 1980s.

In the face of increasing wages and emerging competitive threats from the second-tier NIEs, most firms in the first-tier NIEs have progressed to *the creative imitation stage*. At this stage, firms invest substantially in building their in-house capabilities to acquire, assimilate, and adapt increasingly sophisticated foreign technologies and manufacture facsimile products but with new performance features, in many cases under original design manufacturing (ODM) arrangements. Creative imitations involve not only such activities as benchmarking but also notable learning through substantial investment in R&D in order to create imitative products, the performance of which may be significantly better or production cost considerably lower than the original. They require considerably sophisticated knowledge base and the high intensity of effort.

Some industries in NIEs are stretching their R&D activities to transform themselves into innovators as well as effectively creative imitators. Firms at *the innovation stage* are marked by intensified in-house R&D activities and active participation in global strategic alliances to become a pioneer in introducing a new product to the market. Innovation requires a highly sophisticated knowledge base and the high intensity of effort in acquiring, assimilating external knowledge and generating new knowledge.

## **IMPLICATIONS FOR PUBLIC POLICIES**

Discussions above indicate that effective knowledge management in the first-tier NIEs requires: (1) strong knowledge base that provides local cognitive capabilities; (2) a high level of the intensity of effort that energizes the dynamic knowledge conversion processes; (3) effective organizational capabilities that make the dynamic processes efficient; (4) powerful information technology system that provides instantaneous links with the worldwide knowledge pool and effective management of encoded knowledge within the organization; and (5) dynamic adjustment to changes in learning orientation that determines the way firms acquire, share, and



utilize knowledge. How could firms build these factors? What then can the government in the first-tier NIEs do to help firms manage knowledge effectively? Since this paper's main focus is on the first-tier NIEs, learning orientation is largely associated with that at the creative imitation stage. This section addresses these issues.

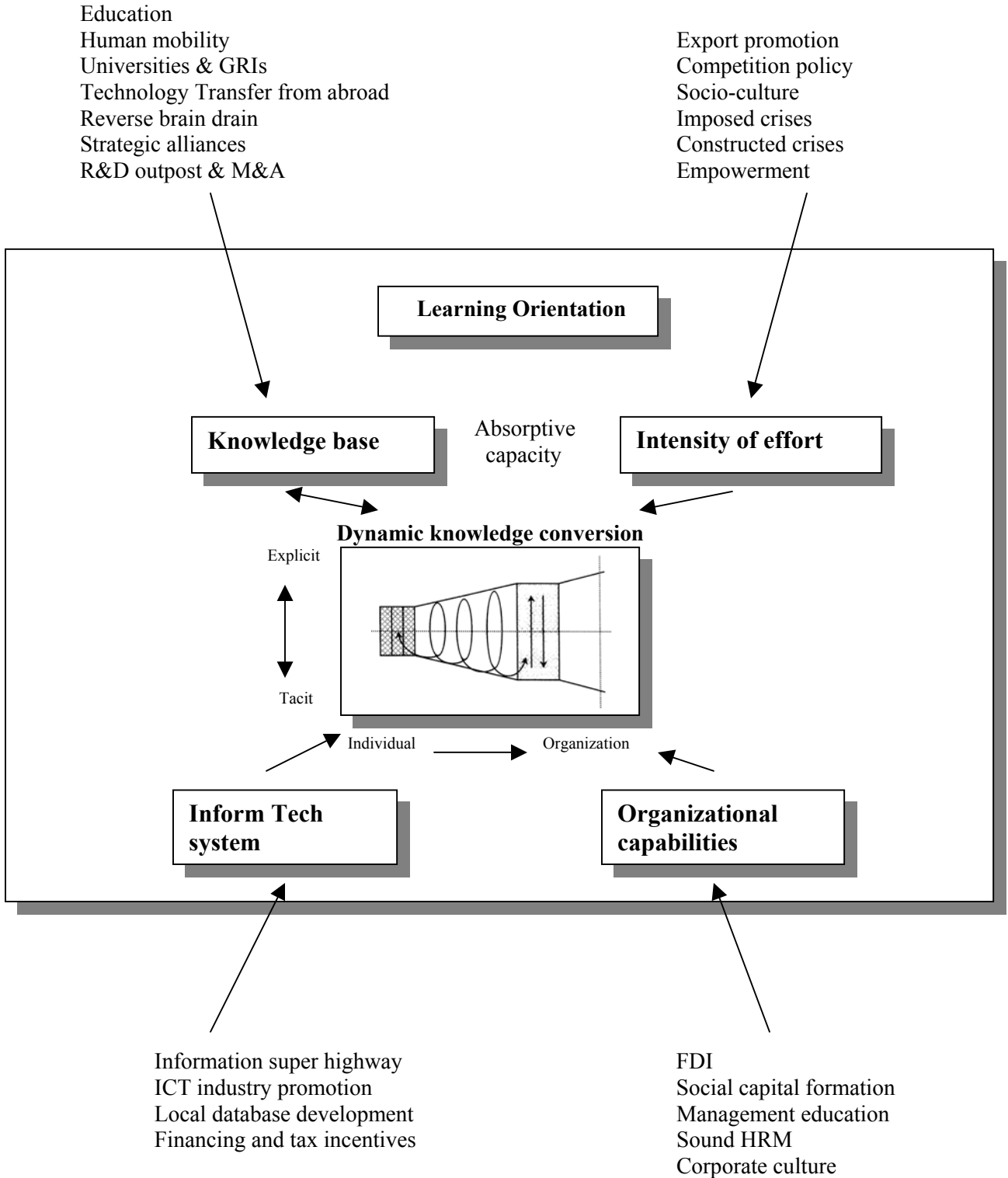
### **In Building Knowledge Base**

The firm has diverse means for building and upgrading knowledge base. They include, among other things, the availability and quality of formal education, inter-firm mobility of experienced personnel, collaborative research with universities and government research institutes (GRIs), learning from the association in the global production networks (GPNs) of multinational companies (MNCs) and reverse brain drain. The government can play an important role in helping firms in those aspects. Figure 2 captures some of these sources.

First, firms hire new human resources largely from educational institutions. Thus, it cannot be overemphasized the importance of the availability and quality of education within the economy, as it determines the initial tacit knowledge embrained in them. Three developing economies – Korea, Taiwan, and Yugoslavia -- which had invested heavily in education in the 1950s and 1960s compared to their economic development level have subsequently made remarkable progress in industrialization (Harbison and Myers, 1964). Many studies also show that there is a high correlation between educational achievements and the pace of industrialization (see Baumol, Blackman, and Wolff (1991). It is the embrained and embodied knowledge of human resources from educational institutions in the first-tier NIEs that acquire, assimilate, and adapt foreign technologies and that enable them to become attractive production locales for MNCs (see Hobday, 1995; Kim, 1997a).

Drastically expanding and upgrading formal education are largely the government's responsibility in the first-tier NIEs. Despite there are a large number of private schools and universities in these countries, it is unrealistic to expect them to drastically increase their

Figure 2: External Components of Knowledge Management



investment for expanding and upgrading their schools. The government should provide public resources not only to public schools but also to private schools to achieve ambitious educational goals. Education should also have goals associated with the formation of desirable attitude.

Far-sighted planning and investment are imperative for education, as human resources require two or more decades to develop. The government, therefore, has not only to put education in the top priority in national development strategy, but also to invest proactively early enough to prepare for the subsequent periods. While sufficient proactive investment in education in the early years enabled Japan, Korea, Taiwan, and Singapore to achieve rapid growth in the past, but insufficient proactive investment in upgrading education and research in these countries is a serious bottleneck in sustaining competitiveness. It is not surprising that these countries are now in the process of revamping and upgrading their schools in order to cope with rapidly changing environment in the knowledge-based economy. Unfortunately, the second-tier NIEs are far behind in investing in human resource development compared to Japan and the first-tier NIEs at the identical level of development, reflecting the misallocation of public resources of the second-tier NIEs in development strategy.

The government should also take initiatives in coping with new emerging issues such as life-long continuing education and campaign for science and engineering education. One, life-long continuing education is crucial, as human resources developed in the past cannot handle rapidly changing technologies today and tomorrow. Retraining and continuous upgrading of skills are imperative for an economy to dynamically adapt to the changing economic environment. Australia's "New Apprenticeships" program is a good example of a flexible training system initiated by the government. Over 250,000 workers are developing new skills for the future under the program. In some developing countries, continuing education may be effectively instituted in military, where such service is compulsory. Given cost effective information technology, a high quality program can be easily introduced through the web. Two, best high school graduates in advanced countries and the first-tier NIEs in general shun science and engineering education.

Rather, they throng to medicine, law, and finance. The government's effective campaign early in advance to indoctrinate young people for science and engineering is in order. The consequent shortage of scientists and engineers in advanced countries creates a chain reaction of brain drain in developing countries. This issue will be covered below.

Second, inter-firm mobility of experienced engineers and managers is a major source of building knowledge base for latecomer firms. Evidence abounds in both NIEs and advanced countries. For instance, most latecomer electronics, machinery, automotive firms in Korea entered the market by poaching experienced engineers and managers from existing firms (Kim, 1997a). It is also the creative combination of different skills and resources from existing firms that has led to the dynamic surge of new high technology firms in Silicon Valley (Saxenian, 1994). The mobility of human resources may be a loss for existing firms, but a dynamic source of new knowledge base for emerging firms.

The government has three roles to play. One, the government should develop a flexible and open labor market, in which human mobility can be encouraged and facilitated. Life-time employment with hiring at the bottom, as practiced in Japan and some first-tier NIEs, may be a virtue in the days of continuous economic growth along the existing trajectory. It is compatible with hierarchical organizations with a seniority-based system. But in the days of discontinuous adaptation to the turbulent environment, such a system creates serious rigidity. Two, the government should take initiative in developing the venture capital industry so as to foster the surging of new ventures spinning off from existing firms. Three, the government can foster the creation of clusters of related firms so as to facilitate inter-firm mobility of human resources as well as knowledge.

Third, research at domestic universities and its transfer to industry can also be an important source of upgrading the knowledge base for firms in NIEs. But owing to the rudimentary nature of research at universities, experiences show a disappointing result in most developing countries. Although collaborative research between universities and firms is on the

rise in recent years, universities have not been as important partners in collaborative research in NIEs as in advanced countries.

Given the rudimentary nature of university research, many NIEs have invested heavily in developing government research institutes (GRIs) as a way to help industry, but almost without exceptions, they have not been effective in transferring new knowledge to firms (see Kim and Yi, 1999). GRIs are needed for public nature research such as large-scale basic research and research related to environment, nuclear energy, health, etc. However, GRIs by nature are not as effective institutions as universities in helping industry for three reasons. One, in most developing countries GRIs are less advantageous in attracting top scientists and engineers than universities, as they prefer the latter to the former for their long-term commitment. Two, GRIs are in general less effective than universities are as research institutions. The former is less autonomous than the latter owing to government intervention in management. Furthermore, salaried research assistants in GRIs are in general less motivated than degree students in universities. Three, GRIs are in a difficult position to transfer research outcomes to industry compared to universities. While universities embed research results in the cognition of graduating students who join industry, GRIs transfer research results in the form of research reports or transfer transactions. For these reasons, if NIEs need to have GRIs for helping industrial R&D, it is imperative for them to locate GRIs in the university campus and have universities manage them, as practiced in many advanced countries, so as to maximize the effectiveness of GRIs by combining government R&D support with generic advantages universities have.

For small and medium enterprises (SMEs), technical extension networks could be a useful source for upgrading knowledge base. Most NIEs have developed an extensive network of technical extension services, but most of them are rudimentary and not adequate to meet the increasingly sophisticated needs of SMEs. The government can learn a great deal from experiences in Germany and Japan.

Fourth, technology transfer from abroad in the form of foreign direct investment (FDI), foreign license (FL), capital goods, and production under OEM for foreign MNCs has also been one of the most important sources for upgrading knowledge base for firms in NIEs. FDI is known to be an important mechanism for technology transfer. However, as pointed out earlier, it does transfer production and management capabilities but not engineering or innovation capabilities. FL, capital goods, and OEM require recipients to have substantial absorptive capacity in order to maximize their learning. OEM usually takes place as part of GPNs.

The GPNs' flagship companies break down the value chain into a variety of discrete functions to locate them wherever they can be most effective. In doing so, they provide not only production orders but also transfer both explicit and tacit knowledge such as product designs, product specifications, production and quality control manuals, and training of engineers at the flagship companies and on-site (Kim, 1997a, Ernst 2000b), providing invaluable opportunities for local engineers and production workers to experience and accumulate their embrained and embodied knowledge. Even in the ODM and original brand manufacturing (OBM) stages, the flagship companies provide invaluable inputs for local firms to upgrade their knowledge base. For instance, when Daewoo undertook an ODM manufacturing of color television sets for NEC in Japan, the latter identified over eighty problems ranging from poor sound quality to faulty control knobs and helped the producer to correct them. Intensive interactions between engineers of the ODM buyer and those of the producer over years resulted in transferring a significant amount of embrained and embodied tacit knowledge in design, production, packing, styling, and quality control (Cyhn, 1999). Major electronics firms in Korea have reached OBM stage, but they still undertake a large proportion of their production under ODM arrangements for global flagship companies. For instance, LG produces computers under its own brand name, but also produces laptops for IBM under ODM arrangements, which often provides LG with opportunities to upgrade its knowledge base through collaborative R&D activities. However, OEM or ODM does not transfer frontier technologies.

The government should develop a favorable legal environment for MNCs to invest and transfer foreign technologies to local firms through FDI, FL, and to develop local nodes of the global production networks (GPNs). Intellectual property should also be well protected. Government policy on FDI should, however, be balanced. Too heavy reliance on FDI, like in Singapore, is undesirable, as it can easily lead to complete dependence on MNCs with little room for local initiatives. Extremely restrictive policy on FDI, like in Japan and Korea in the past, is also undesirable, as it can preclude learning opportunities that cannot otherwise be possible. However, given the WTO ruling, the host government has little room to exercise its influence on the inflow of foreign investment.

At the same time, the government should strengthen local absorptive capabilities through education, research, and dynamic interactions among firms so as to maximize benefits from MNCs. The higher local absorptive capacity, the more complex technologies MNCs transfer in FDI and GPNs and the easier for recipients to assimilate and improve them.

Fifth, as firms in NIEs approach closer to the world frontier, the return of high caliber scientists and engineers from abroad becomes a major source of new knowledge base. The dynamic growth of technology-based venture firms in Taiwan is attributed largely to the return of Chinese-American engineers and interactive networks with those in the Silicon Valley area (Saxenian, 1999).

The shortage of scientists and engineers in advanced countries create a chain reaction of serious brain drain problems in developing countries. But for the long-term purpose, a liberal policy on brain drain is necessary for developing countries to allow scarce scientists and engineers to migrate to advanced countries in the early stage of industrialization. Otherwise, most of them will not find suitable jobs at home to continue to advance their technical competence. And they will become obsolete by the time the country needs their skills. In the later stage of industrialization, the reverse brain drain can play a pivotal role in strengthening knowledge base. For example, the Korean government took a relatively liberal policy with regard to the brain drain

through the 1960s. As of 1967, 96.7 percent of Korean scientists and 87.7 percent of engineers educated abroad remained there, mainly in the U.S.A., compared with the corresponding world average of 35 and 30.2 percent, respectively (Hentges, 1975). When industrialization progressed rapidly in the 1970s, the Korean government made systematic efforts to repatriate Korean scientists and engineers abroad. The development of semiconductor memory chips, state-of-the-art automotive engines, electronics switching system, flat panel display, and CDMA mobile telephone technologies by Korean companies are largely attributed to those scientists and engineers who returned home (Kim, 1997a).

There are other means for firms to strengthen their knowledge base, for which the government has few means to help. A few leading firms, particularly large Korean *chaebols*, have begun to enter into strategic alliances with the global flagship companies to develop future technologies. For instance, Samsung has teamed up in semiconductors with such rivals as Toshiba, Mitsushita, NEC, Fujitsu, General Instrument, Micron Technology, ISD, and Array (Kim, 1999).

Some firms in NIEs also establish R&D outposts abroad and undertake merger and acquisition (M&A) of high technology foreign firms as means to get access to frontier technologies. For example, Samsung Electronics set up an outpost R&D center in Silicon Valley and successfully upgraded the knowledge base of its R&D center in Korea by transferring its explicit and tacit knowledge embraced in high caliber human resources from the former to the latter (Kim, 1997b). Hyundai Electronics acquired several high technology firms in California in attempts to get access to frontier technology in computers and semiconductor design.

Not only knowledge base affects the dynamic process of knowledge conversion, but also the knowledge conversion in production, engineering, R&D, and training activities within the firm can give rise to the knowledge base, as indicated by a reverse arrow back to the knowledge base in Figure 1.



### **In Building Intensity of Effort**

The firm has various sources that may be mobilized for stepping up the intensity of effort. They include, among other things, competitive market pressure, socio-culture, deliberately imposed crises, in which the government can play a useful role.

First, the competitive market generates pressure that demands firms to generate, integrate, and reconfigure internal and external knowledge and resources to match the requirements of the changing market environment. For Taiwanese and Korean firms, exports have been a “life or death struggle,” forcing firms to expedite technological learning. Although their local market had been protected, exporters had to remain dynamically competitive in price and quality demanded in the international market. Even in OEM arrangements, local firms had to intensify their efforts to sustain their attractiveness as production locales.

As a result, firms in export-oriented industries (EOI) learned significantly more rapidly and in turn grew faster than firms in import-substituting industries (ISI). Likewise, countries with EOI grew faster than those with ISI. The average annual economic growth rate for EOI countries was 9.5 and 7.7 percent, respectively, for 1963-1973 and 1973-1985 compared with 4.1 and 2.5 percent for ISI countries. The real per capita income growth rate was 6.9 and 5.9 percent during the same periods for the former as compared with 1.6 and -0.1 for the latter, as the ISI group had a higher population growth rate. Exports by MNC subsidiaries, however, do not necessarily lead to competitive pressure and in turn effective learning, as local firms simply carry out production of products designed by the parent companies, which also take care of marketing and sales.

The government can no longer provide subsidy to exporters under the WTO ruling, but it still has various instruments to help local firms grow into major exporters. They include effective service for marketing and market information, infrastructure to improve product and packaging quality to meet international standards, infrastructure to provide reliable ICT for SMEs to participate in GPNs, efficient banking service for exporters, and assistance for international trade fairs, just to mentioned a few.

Another important area the government can play an important role is to create a competitive domestic market through various competition policy instruments. Legislation and effective enforcement for anti-trust and fair trade practices and trade liberalization may fall under this category.

Second, socio-culture plays an important role in forming hardworking trait of the society. East Asians are known as hard workers. Americans have long complained about hardworking Japanese (Vogel, 1979; 1986). Japanese in turn complain about hardworking Koreans (Vogel, 1991). Chinese, who constitute the majority of Singapore and Hong Kong and a significant proportion in some other Southeast Asian countries, are also well known for their hardworking trait. Many Westerners attribute it to Confucian tradition (e.g., Kahn, 1979; Hofstede and Bond, 1988), while others to situational factors (e.g., Vogel, 1991; Kim, 1997a). Whatever may be the cause, socio-culture definitely affects the intensity of effort in organizations.

Socio-culture cannot easily be changed. But many studies show that systematic and consistent efforts over an extended period of time can lead to significant changes in socio-culture. For instance, reading materials on achieved leaders in kindergarten and elementary schools are reportedly related to improved achievements in the society a generation later. If that is so, the government can develop a well-studied program and implement it through educational institutions and various civil organizations to change socio-culture to desirable directions.

Third, deliberately imposed crises can be a strategic means to intensify effort. Cumulative learning along the current trajectory can take place under normal conditions. Discontinuous learning, however, takes place normally when a firm perceives a crisis and deploys strategy to resolve the critical situation (Meyers, 1990). Crises usually come from external sources, but can also be deliberately imposed by stakeholders such as the government in NIEs.

The government can impose crises on firms to realize overly ambitious goals. The most dramatic case was the promotion of heavy and chemical industries (HCIs) in Korea at far greater intensity, much earlier, and in a far shorter time than originally envisioned as a way to create a

local defense industry. The hasty creation of HCIs on a gigantic scale without adequate preparation in technological capability led to drastic increase in foreign debt and further concentration of economic power, but created a major crisis for Korean firms to make a great leap in building technological capabilities. The government used a similar approach in transforming the Korea's automobile industry from a mere assembly of foreign cars into designing and producing its own cars (Kim, 1997a).

There are a few other internal means for firms to deploy in enhancing the intensity of effort, for which the government has no instruments to help them. Like deliberately imposed crises by the government, top managers can also construct a crisis deliberately, either in response to or in the absence of an external crisis, by setting ambitious goals to achieve. Studies show many cases in different sectors as to how Korean managers intensify learning effort by deliberately constructing internal crises (see Kim, 1997b and 1998 for detailed discussions).

Empowerment within the organization is another way to give rise to the intensity of effort. Empowerment has been widely discussed in organizational, educational, social, and political contexts but its concept is still ill defined. In the organizational context, it may be defined in the form of an equation:  $\text{empowerment} = \text{freedom} \times \text{direction} \times \text{support}$  (Birren, 1996). Empowerment gives freedom for workers to seize the initiative, enjoy taking risks, volunteer their ideas, solve problems on their own, and not to be afraid to speak their minds, all of which involve knowledge conversion. Empowerment, however, is a "directed autonomy." That is, freedom should be exercised within a focused mission and a context of direction, without which freedom can easily invite anarchy. Empowerment also requires support from management. Otherwise, workers are encouraged to be empowered without getting any power. When all three determinants – freedom, direction, and support – are present, workers are truly empowered to give their very best to the company. There is a multiplicative relationship among the determinants, and if any of them goes to zero, the result is zero.

### **In Building Organizational Capability**

There may be ways for the government to help firms build up organizational capabilities. They are FDI, social capital, and management education. First, FDI can play an important role in building organizational capabilities. While MNCs are reluctant to transfer knowledge to their subsidiaries and joint venture partners beyond that related to production, they are active and effective in transferring knowledge related to organizational capabilities. In research of Korean firms over a long period of time, we have repeatedly observed that firms with foreign equity participation are far better managed than local firms with greater transparency in transactions. It has been the experience of local firms that it is relatively easy to identify from literature the nature of international best practices and the foreign companies for benchmarking, but it is extremely difficult to emulate their organization-specific embedded and encultured knowledge.

As mentioned earlier, the government should create a conducive environment, in which MNCs find it attractive to undertake FDI. The government can also provide various forms of assistance for firms to organize inter-firm and inter-industry study groups, like those widely available in Japan, to bring about the effective diffusion of MNCs' organizational capabilities.

Second, social capital is believed to be an important variable in explaining the efficiency of human organizations and the economic performance of contemporary societies (e.g., Coleman, 1988; Fukuyama, 1995). Social capital refers to the existence of a certain set of informal values or norms shared among members of a group or society that allow cooperation among them on the basis of interpersonal trust. This includes virtues like truth-telling, the meeting of obligations and reciprocity. Whiteley (2000), in his study of thirty-four countries, finds that social capital is as strong a variable as human capital or education in explaining cross-national variations in economic growth. Lack of social capital may be one of the most serious barriers in social, economic, and political development in some developing countries. Social capital, as Coleman (1988) suggests, can be created and destroyed, just like any other forms of capital. How to help

forming social capital can be a major challenge for policy makers in NIEs. Such a task calls for in-depth psychological and sociological studies.

Third, firms can gain new management skills from regular and executive programs at universities. The government can provide education and research grants for business schools to upgrade and expand their programs that may be directly helpful to industry.

In addition, firms have internal means to build up organizational capabilities, for which the government has few means to help. For example, top management can design organizational structure and HRM practices in such a way that they can well be tuned to the acquisition, creation, share, and utilization of knowledge. The benchmarking of best practices can be an important source of learning for such purposes. They cannot, however, be easily emulated, as each organization has to develop them to be most compatible with its economic environment and corporate culture. And it takes many years to form their organizational capabilities, as they, except for some aspects of HRM, involve both embedded and encultured knowledge.

### **In Building Information Technology System**

Information technology system is indispensable in effective knowledge management. While other factors discussed above generally are crucial in managing tacit knowledge, information technology system is imperative in managing explicit knowledge. Knowledge management requires the effective management of both tacit and explicit knowledge and conversion between the two.

The government should help firms benefit from various capabilities available in information technology. First, the government should develop “information super highway” to enable ICT users to maximize the benefits from resources available worldwide through web. Without such infrastructure, local nodes cannot be connected instantaneously with GPNs.

Second, firms should be able to acquire both hardware and software systems locally that enable them to access to the worldwide web and to effectively undertake knowledge management

within the organization. It is often found that knowledge management system (KMS) solutions supplied by foreign software companies are not compatible with organization and management system of the firms in the first-tier NIEs. The government can promote the ICT industry so that local firms can easily acquire both hardware and culturally compatible software locally. Cultural compatibility includes capacity that embraces both local language capability and idiosyncratic local situations.

Third, the government should also promote the development of useful local databases. Well-developed databases are readily available in advanced countries, which can be easily accessed through the web, but developing countries are far behind in building local databases.

Fourth, the government can also offer tax and financial incentives for SMEs to have easy access to information technology systems. Systematic training programs to continually update skills necessary to manage ever-changing technology are also in order.

## **SUMMARY AND DISCUSSIONS**

Despite the very rapid growth in the first- and second-tier NIEs in the past decades, their input-driven economic strategy had led to declining productivity growth. Their prospects for the sustained growth in the future is bleak in the face of increasing competition stemming from globalization, knowledge explosion, and ICT development. This paper presented knowledge management as a new perspective for development strategy. Firms, the basic production units, play a central role in the knowledge-based economy. At the micro level, five factors affect dynamic knowledge conversion processes. They are knowledge base that provides local cognitive capability, the intensity of effort that energizes the dynamic knowledge conversion processes, organizational capabilities that make the dynamic processes efficient, powerful information technology system that provides instantaneous links with the worldwide knowledge pool and that manages encoded knowledge within the organization, and learning orientation that determines the way firms manage knowledge.

The government can play a crucial role in helping firms manage knowledge effectively. Proactive investment in education, effective knowledge diffusion through human mobility, liberal policy for brain drain, science and technology infrastructure to complement industrial R&D, and the creation of conducive environment for FDI and GPNs are crucial mechanisms, through which the government could help firms build their knowledge base. The government can also create an environment, in which firms find it imperative to intensify their learning efforts. They include exports promotion, competition policy, the deliberate imposition of crises, and the inculcation of desirable socio-culture. The government can also help firms build up organizational capabilities. They include the promotion of FDI, the promotion of business education, and the inculcation of desirable socio-culture. Finally, the government can help firms have efficient information technology system by building “information super highway” across the country, promoting ICT-related industries, helping build local database, and providing financial and tax incentives for firms to afford ICT systems.

For the government to be effective in doing so, it should itself become smart and efficient, calling for major change in its administration. First, the government should itself become an effective knowledge manager, constantly monitoring changes in the international political and economic environment. This is particularly crucial in the face of increasing globalization. For this purpose, the government should develop a strong knowledge base with strong empowerment to energize its workers, compatible organizational capabilities to make it small, clean, flexible, and efficient, and effective information technology systems to develop closer and transparent relations with firms and citizens. Second, the government should change its role from direct intervention to the provision of an incentive and regulatory framework that facilitate the effective functioning of market mechanisms. At the same time, it should address market failures, missing markets, public goods promotion, and inequities resulting from knowledge divide (World Bank, 2000).

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