Technology: Its Transfer and Development in Asean Countries — A review and some theoretical re-considerations — *

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This paper develops a model of “technology” and relates it to the process of transfer and development particularly in Asean. It criticizes the ineffectiveness of static, business-like transfers as an action at the disposal of supplier nations, and the attitude of host nations which wait for the “big transfer of appropriate technology” to come by. For nations that are looking towards the road to industrialization, they need to adopt a pro-active and dynamic stance to “individualize” their own skills.

What is Technology?

Technology is said to be as old as man himself (Forbes, 1967a). Before man even thought of the existence of the sciences or the arts, man was already practicing “technology” through the use of stone knives and axes for the puposes of hunting to satisfy their survival instincts. Unknowingly then, technology was born and used by early men as a means to adapt to the natural environment.

Technology in today’s context is taken to mean a “quantum of knowledge by which such inputs as patents, rights, scientific principles and research and development are translated into production of marketable materials, components, and products” (Hayden, 1976: 23). Similarly, technology is said to consist of a “system of knowledge, skills, experience, and organization, that is required to produce, utilize, and control goods and services” (UNIDO, 1984: 97).

Stressing on the element of knowledge, technol-

ogy could include “both specific knowledge about physical production embodied, for example in machines, designs, formulas, etc., and also more general know-how such as organizational procedures concerning coordination in production, procurement, marketing, and research and development” (Liebrenz, 1982: 33).

Enlarging the coverage on knowledge, another researcher proposes that technology is an “organized body of all knowledge used in the production, distribution (by trade or any means) and use of good and services” (Sabato, 1984: 352). This knowledge includes not only scientific and technical knowlege resulting from research and development, but it also covers those that result from empirical studies, tradition, manual skills, intuition, and adaptation. Putting a human touch on the issue, technology could be further stretched to mean human knowledge that is used to achieve ends (Weiss et al., 1984: 230).

Technology is an across the board, interdisciplinary field that touches on almost anything man-made. Thus, anything man-made has to do with technology. The musician’s trumpet, the soldier’s uniform, the pancake from the bakery, the computer’s keyboard, and the space shuttle. This relationship is by no means exhaustive.

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Technology is suggested to have only two modes of existence (Emmanuel, 1982: 19). They are information and know-how. Information is thought to be autonomous and is not “embodied” in anything solid. On the other hand, know-how is not autonomous as it is “embodied” in the human. Others talk of technology in terms of software and hardware technology (Sharma, 1986; Scott-Stevens, 1987). Hardware is taken to mean blue prints, computers, automobiles, and equipment, while software consists of know-how, managerial techniques, and patents.

Technology could also be viewed as composing of three elements, namely the human element, information element, and machinery element (Ogawa, 1993; 1990). The machinery element composes of physical and infra-structural equipment such as trucks, factories, computers, ships, and raw materials. Information covers publications of all sorts, records, documents, charts, and models. There are classified under data bases, and engineering related intelligent systems. Man poses a more complicated and interesting element. With information and equipment alone, technology cannot be put into purposeful use. Man there-

fore must act as a medium to launch the mix into a purposeful mission.

An alternative model of technology and its dynamics is proposed in figure 1. The highlight of this model is two-fold. One is an attempt to make a clearer delineation of what makes up technology. The second shows that man is the epicenter, the initiator and creator and of all technology. Technology, by virtue of its “ogy” tail implies a science or a body of knowledge (Bresson, 1987). This body of knowledge is created by man’s own hands, and is thus quite naturally “personalized” or “individualized” into the human body by default, in the form of skills, experiences, intuition, creativity, and judgment, etc. This gives rise to the central component labeled “individualized knowledge”.

With this alone, there is enough “technology” that can be activated by man to attain a set aim. It is at this very stage that the early cave men were sometimes called the first technologists. As they learned how to achieve their aims, for example, hunting an animal, or collecting wild berries with just their bare hands, they increased their skills and sharpened their intuitive judgments while their

Figure 1 A Model of Technology

experiences gained depth.

To achieve goals more efficiently, man subsequently realized that the body of knowledge created could be "physicalized" into tools and equipment such as the early stone ax and knife, adding a second component called "physicalized knowledge" to the model. However, not every detail of individualized knowledge can be successfully physicalized into equipment. One explanation that due to financial, operational, or ethical impracticalities, a firm facing scarce resources has to be sure of a good success rate, or not allowed to experiment on the new method with a high risk of failure, before plunging itself into any commitment. Another related explanation is that much knowledge is contained in a continuously experimental R & D state. This creates a time lag as once the knowledge starts becoming physicalized, it becomes a stock, and turns static. Static physicalized knowledge is thus continuously "lagging" behind the fluid individualized knowledge.

For long periods of time, the state of technology remained as such that man relied on just his organizational skills, intuition, experiences, judgments, and simple tools and equipment. Only in the last thousands of years back was man able to develop a writing system (Forbes, 1967b) to "informationalize" the individualized and physicalized knowledge components shown in Figure 1 into the form of reports, data, manuals, and books, thus making up the third component, labeled "informationalized knowledge" in the Figure model.

Again, not all individualized knowledge and physicalized knowledge can be informationalized. Individualized knowledge such as skill, intuition, feeling, and sense of judgment, being tacit in nature, simply cannot be informationalized. The Hanging Gardens of Babylon serve as one example of individualized knowledge (the technical skills of building the garden) that was physicalized (the garden itself) but was not able to be informationalized. How the Hanging Gardens were built still remains unknown.

The individualized, physicalized, and infor-

mationalized knowledge is put into a combination to achieve some set aims of man. These aims are always updated by changing wants and needs of consumers, thereby giving a push for a search for new technology, thus forming a cycle of dynamism. In this process of physicalization and informationalization of knowledge to satisfy wants, new knowledge is created and is channeled back as individualized knowledge. The double headed arrows linking the three elements imply that in the process of physicalization and informationalization, man enriches him/herself with deeper individualized knowledge such as skills in designing physical machines, and experience in recording information.

Technology: Its transfer and accumulation

"Technology transfer" made its first appearance in the 1960s. Initially, it was taken to mean the "optimization of the commercial value of innovation based on scientific technology" (Inkster, 1991: 20). The idea was to efficiently shorten the time needed to bring the results from the laboratory and experiment stations to the market without any loss of quality.

Among some recent definitions, technology transfer is viewed as the "movement of a technology or product from the context of its original invention and diffusion to a different economical context, and is normally conceived of as occurring between nations" (Miedzinski, 1979). Technology transfer is suggested to occur when "technical knowledge, a technique or device which emerges from, or is developed by one group becomes taken up and used or applied by another" (Ng, Hirono, and Siy, 1986). A third source proposed that technology transfer has occurred "when new technology was employed efficiently, when the local work-force was able to use the technology with confidence; when the know-how was successfully disseminated to other local enterprises or plants; or when the local work-force was able to adapt and further improve the imported technology" (Robinson, 1988).

There are basically four categories of technology transferors (Agmon and Von Glinow, 1991).

They are public international bodies such as those of the United Nations; governments and parastatal bodies; non-profit organizations such as universities; and private business enterprises. Of these, the transferor that has attracted the most controversy is undoubtedly the private business enterprises like the multinational corporations (MNCs), because of their conflicting motives.

For this reason, technology transfer has come to mean different things for different nations. For the advanced nations, technology transfer means power, economically and militarily. Without transferring leading edge technology to comparable rivals, an advanced nation can maintain and strengthen her bargaining power in the international political arena.

Technology transfers are normally capable of enlarging immediately the magnitude of physicalized and informationalized knowledge, which is called a "location" transfer. But this is not so for the case of individualized knowledge for the recipient, which involves a "personal" transfer (Natarajan and Tan, 1992).

At the early stage of a specific transfer process, the relative magnitude of individualized knowledge is smaller than that of the physicalized equipment and machines, and informationalized manuals and reports (see Figure 2). The little individualized knowledge is gained from the scant knowledge and skills of basic operations. This

magnitude dictates the degree of initial absorptive capacity of the recipient nation, which in turn is affected by the literacy rate and quality of scientific and technical education received by the citizens of the nation. A transfer without comparable follow-up development activities involving human resource development (Wakabayashi and Graen, 1991) results in a static transfer. This brings about a weak link among the three components (refer to Figure 1) when they are combined to achieve the set goal. The minute individualized knowledge becomes a "sub-set" of the other two components.

As the transfer stage advances, the recipient nation should be accumulating experience and skills with regards to technology transferred. This dynamism should increase the magnitude of the individualized knowledge, as is illustrated by the upward sloping curve in Figure 2. Meanwhile, the transfer rate of inflow of machines, reports, and other information related to the physicalized and informationalized components, gradually decreases as they begin to become obsolete. This is shown by the downward sloping curve in Figure 2.

Seen from another viewpoint, the actual act of technology transfer from foreign lands merely constitutes a first phase of the whole process. The more crucial is a set of activities that follow, those involving local skill upgrading that revolves around the imported technology (Ahn, 1991).

Figure 2 is also consistent with a three-stage

Figure 2 Changing relative magnitudes of technology components over transfer stages

Figure 3 Six step model of technology accumulation
(adapted from Ogawa, 1992)

model of development of industrial technology in developing economies (Kim, 1980). Stage one coincides with the early stage whereby foreign technology is transferred and implemented into local soil, thus enlarging the magnitude of the physical and information components. The second stage (intermediate stage) calls for assimilation of the imported technology while the third stage (advanced stage) improves on the imported technology. All these stages call for the increase in the skill levels that would eventually enlarge the size of individualized knowledge.

One relevant guide (Ogawa, 1992) sees the development of manufacturing technology as composing of a six-step process. They are basic manufacturing operations, maintenance operations, production control, industrial engineering, product design, and research and development. Manufacturing and maintenance operations can be handled by workers of high school level, while the rest can be the responsibility of employees who are university graduates. R & D however, is to be the field of employees with graduate level degrees.

Starting from routine assembly manufacturing operations, a firm engages into a trial and error learning process. The path is not so smooth as is illustrated by the loops in Figure 3. As learning processes evolve, skill accumulates and the firm moves to the next higher step. The learning process continues as the firm aims for the highest step of research and development. This model may be partially applied to the skill accumulation process of a nation under one assumption. That is,

the model assumes that the technology accumulation process must start from basic manufacturing operations, and that research and development constitutes the most difficult step. Consequently, although experiences of some nations have provided the successful evidence already, the leap-frogging channel of technology accumulation is ruled out in this model.

Technology transfer: An evidence of Japan's attempt in Asean countries

Technology transferees are usually developing nations like those in Asean which look at technology as a road to the economic status¹⁾. Embarking on trade policies to attract MNCs²⁾ to their countries, these governments hope to acquire technology to help achieve their national aspirations.

From the 1950s onwards, MNCs from developed countries have moved their production facilities offshore (Dahlman and Wastphal, 1981; Chen, 1983; Ting, 1987; Hughes and Dorrance, 1987) with East and South East Asia chosen as increasingly favorite target locations. While the NIEs of East Asia have adapted well to upgrade their level of technology upstream (Ariff and Lim, 1987; Natarajan and Tan, 1992), Asean nations cannot lie back and be contented with the economic activities brought in mainly by direct foreign investments (DFI)³⁾.

MNCs are primarily driven by profit motives, and most research that give a ranking of reasons for off-shore production do not explicitly mention the transfer of technology as one of their

fundamental aims, however minor it may be. Without successful transfer, no profit motives would be satisfied.

When the relative balance of favorable factors such as low labor cost, proximity to raw materials and markets, attractiveness of investment incentives etc., changes, Asean may find itself in difficulty to maintain the current speed of growth of a regional average of 6%⁴⁾ brought in by the current DFIs. In order not to miss the boat in the event that DFI by MNCs catches another flying geese (Akamatsu, 1956) "fever", Asean needs to tread carefully. Already relocations of manufacturing operations by Japanese subsidiaries to Vietnam and Southern China are proof of a coming "fever" (Nikkei Weekly, 1993).

By virtue of Japan's massive DFI into the region, Asean⁵⁾ countries have naturally relied much on Japan to transfer technology to her local citizens. How far has this process gone, and what are the important issues involved? Using a nine step framework for technology transfer, (Yamashita, 1991) discovered that usual operations dealing with assembly and maintenance are already transferred successfully to Asean countries. However, a recognition gap in the concept of technology transfer between donors and recipients leads to conflicts. This gap centers on the issue of whether or not technology transfer is successfully conducted. On one hand, Asean nations believe that technology transfer is successfully completed when foreign experts leave the plant for good. On the other hand, Japanese experts believe that technology transfer is a time consuming process, and that on-the-job training is an effective transfer method. This led Asean nations to be skeptical about the sincerity of a genuine transfer because, instead of leaving the host country, Japanese advisors keep "hands on" over operations while compatriot western advisors do not.

On the recipient side, several points can be scrutinized. In Thailand, the technology introduced tend to center around assembly and quality control processes (Shiowattana, 1991). Japanese firms show a strong tendency to formulate a "closed system" of production, whereby the

company itself produces the parts, or Japanese sub-contractors are brought in to produce parts. Such trends discourage the emergence of local suppliers and prevent the diffusion of related technology. The Thailand study also mentioned that technology transfer by Japanese MNCs is much determined by the interest of their headquarters which are increasingly setting up 100% wholly owned subsidiaries. Compared with joint ventures, the learning process of locals will become unimportant as MNCs are more heavily influenced by their global plans and the demands of international trade.

A research on Malaysia found out the most widely used channel of technology transfer is the training of local personnel in the parent company (Sivalingam and Yong, 1993). However, the most suitable method of technology transfer is the dispatch of foreign experts to the local company. The area of skills targeted in these activities cover merely those related to production and quality control. Other channels of technology transfer are mostly business transfers like turnkey arrangements and licensing agreements.

Singapore is widely believed to be the most successful among Asean nations in upgrading her technological base (Natarajan and Tan, 1992). There have been several indications of such a phenomenon. One is that Japanese subsidiaries have begun to appoint local Singaporeans to managing director and senior technical and managerial positions. Japanese MNCs have also entrusted Singaporean plants with the responsibilities of product design and development. And finally, Singaporean engineers and technicians are employed to design and set up assembly operations, and offer trouble shooting services to other Asean nations.

A study of technology transfer in the Philippines identified several common elements found among successful firms (Reyes et al., 1987). Reyes and his associates (1987) pointed out that the major ones are: direct, top level management support for R & D and technical training, formal organization for R & D, key roles played by a handful of highly skilled personnel, support lent to sub-contractors

and material suppliers, strong emphasis on training and human resource development, and assistance from consultants and experts who have sufficient knowledge about local conditions. Nevertheless, according to them the Philippines also face six major obstacles to technology development. These are lack of advanced equipment, low capability of local support industries, limited markets, lack of adequate product standards, low capability of local staff, and high turnover of staff and brain drain.

The issues can be broadly summed up by an extensive study undertaken by scholars from Japan and Asean (Ng, Hirono, and Siy, 1986). From the Asean point of view, there are five important issues involving Japanese MNCs. The first issue is the complaint that the Japanese make limited transfers of technology to Asean. The second point is that when transfers do take place, they are often under too much restrictions imposed on operational aspects such as marketing territories, purchasing and pricing strategies, diffusion of technology, and local research and development. Thirdly, Asean claim that the costs of transfers of technology are unfair to them. The fourth issue touches on the inappropriate technology being transferred which do not fit the factor endowments of Asean. Lastly, Asean admitted that the scarcity of skilled labor has thwarted plans of localization of personnel.

From the Japanese view-point, several issues could also be identified. The first relates to the availability of low wage labor that naturally calls for technology that could be efficiently matched to it. The small size of the domestic markets and the lack of international competitiveness at the same time requires MNCs to introduce technologies to produce goods made for exports to the third parties.

The under-developed supporting industries also act as a hindrance to the transfer of technology. With little linkage industries, diffusion of technology is difficult to achieve. Moreover, this is further constrained by the lack of technical absorption capability in local personnel. This is partly due to the inadequate vocational training institutions in

the host countries. Attitudinal inflexibility causes the stickiness related to learning new skills.

The next issue brought up by Japanese scholars is the problem of job hopping and the lack of incentives offered to facilitate transfer of skills and develop technology that is acquired. Lastly, the under-developed mechanisms for technology transfers is found to act as a brake to a smooth transfer process.

A survey conducted in late 1991 covering local joint venture companies and Japanese subsidiaries in NIEs and Asean countries resulted in consistent findings. Fundamentally, Asean companies are revealed to be "frustrated over technology transfer". Using a ten category framework, the survey discovered that the expected transfer of the first four basic categories (production line operations, maintenance, quality control, and process control) is about 70% achieved. For higher level technology such as design technology, development of new products, and development of production facilities, the achievement rate is much less than 40% of expectations (Nikkei Weekly, 1992). With reference to Figure 3, these two broad classifications approximately corresponds to the first three steps (basic operations, maintenance, and production control) and the last three steps (industrial engineering, product design, and R&D) respectively.

Transfer: The reality

Such recent findings hit home several reality issues that Asean nations should pay attention to. One of the most important issues is the *nature of relationships* between the technology transferor and transferee. While it cannot be denied that MNCs (the transferors for the most part) are the most important source of technology transfer for Asean, they are predominantly driven by profit motives. It is therefore not an understatement to maintain that technology transfer is the core for the international business success (Agmon and Von Glinow, 1991) for MNCs. Their precise presence in Asean is a result of such motives. Subsequently, they owe allegiance not to the host countries, but to their headquarters, wherever they

may be. When sacrifices have to be made, the obvious tendency is to lean home.

This relationship dictates the questions of “where”, “what”, “when”, and “how” of the MNCs’ globalization plans. When relative balances relating to markets, labor, currencies, and materials change, the MNCs would pack off without much hitch. There are still many countries in the world (such as China, India, Russia, and East European and Latin American countries) that have potential attractions to the inherent “hop, step, and jump” behavior of MNCs. But while favorable conditions exist in Asean, it is well said that there is an “inter dependent” relationship shared between the MNC involved and the host Asean country. Japanese MNCs are dependent on Asean countries for cheap labor and scarce raw materials while the Asean countries are dependent on Japanese MNCs for the provision of employment and direct foreign investment. This is the basis of the reluctance of Japanese MNCs to transfer anything more than the required minimum level of technology to the local soil.

This relationship consequently monitors the degree of completeness and primacy of the technology to be transferred (Robinson, 1988: 18). A technology far away down from the primacy level requires comparatively elementary user-type technology that is usually transferred in full completeness. But as a technology gains a higher degree of primacy, more complex skills such as product adaption, manufacturing, design, and R & D become necessary. At this point, MNCs at best only transfer partial technology to the host nation.

This is exemplified by the persistent philosophy of Japanese firms to retain authority and responsibility of major decisions such as those involving the higher levels of technological improvement. Japanese firms believe that advanced technologies even if made available locally, Asean simply does not have the capacity to make full utilization of them. Consequently, in most of the Japanese firms in Asean countries, there is little expectations shared among local staff members about technical inventions and improvements (Nikkei Weekly,

1992). R & D activities are even less localized because of the presumably shortage of trained personnel, and the ineffectiveness of laws with regards to copyright and patent protection.

The leverage of technology transfers are thus held by those that created the technology. Asean can express dissatisfactions about the slow speed and inappropriateness of the transfers, but in any case, they will come out with the shorter end of any bargain. This is because Asean plainly lacks the knowledge to negotiate for better terms, precisely because of the absence of the *knowledge* that they are seeking for. Meanwhile, this leverage provides a powerful bargaining instrument for Japanese MNCs.

The history of Asean industrialization is still short. Most countries started industrializing only after the second world war. Nonetheless, within a short span of just four or five decades, the “supplier-recipient” relationship has no doubt brought about favorable effects to Asean. Production of manufactures, especially those of export products, have increased sharply since the beginning of 1980s (Asia Yearbook, 1990-93). Employment of labor force among Asean countries has taken a positive path, and the growth indicators show that the region is spear-heading the economy of the world.

These are however, a result of the “side-effects” of the activities of MNCs which bring in the DFI. Here, attention should be drawn to the difference between “growth” brought about by the MNC activities, against “development” which is sought after by the host countries (Malecki, 1991:23). This MNC-dictated growth if prolonged, results in what is called a dependency theory, whereby Asean will have little hope to break out from without enlarging the magnitude of the individualized knowledge of the local workers (UNIDO, 1984:112).

The dependency of technology on the MNCs persists because of the mentality of host governments that hold a self-contradictory assumption saying that the developed countries “owe” the less developed countries a living. In practice, it is taken for granted that developed countries have a moral

obligation to furnish the less developed countries with appropriate technologies when requested. Less developed countries thus simply have to import the technology when required. But with technology introduced and not supported by complementary skill development, the physical process of machinery obsolescence begins. When this takes place, the less developed countries start the cycle again by requesting for "newer" technology to be transferred.

Technology: Its development

Asean led by Singapore is on the "verge of transforming itself from a labor-intensive type of production to a more capital-intensive and skills-oriented type of production" (Sivalingam and Yong, 1993). Hence, how Asean enlarges the magnitude of the individualized knowledge should be the heart of her industrial advancement. The limited scope of formal business transfers is insufficient to attain this objective. Thus instead of talking about only technology transfer, Asean should shift its emphasis more towards the concept of informal technological development, particularly of blue collar workers.

Development does not solely refer to R & D. It refers to the enhancement of the quality of workers through basic, intermediate, and advanced skill training in formal as well as informal way. Even though there are signs of increasing R & D facilities being located or established in Asean countries, technical development of blue collar workers need not be overly dependent on this formal channel, but on the informal channel through the on-the-job training over the extended period of time. A study suggested that a nation can become a "significant industrial power simply on the basis of proficiency in production" and need not depend on a high level of technological sophistication (World Bank, 1981).

Right from the early stage, the most important aspect in this development is that of nationally nurtured skills (Anuwar, 1992; Scoville, 1951). A skill is a "capacity to perform a task competently" and may or may not be based on knowledge (Bennet, 1991:360). It can be technical when

dealing with coordination of a mechanical process, or it can be interpersonal when dealing with a fellow human being. Skills, in the author's opinion, can never be recorded and transferred. Manuals can systematically record how an operation can be performed skillfully, but the recordings cannot guarantee a skillfully performed operation by a recipient who reads the manual.

Skills however, can be imported wholesale through migration. Immigrants bring along skills and experiences with them and a process of diffusion takes place so as to eventually enlarge the magnitude of individualized knowledge as skills get diffused to the local people. For Asean to attract such migration is a quite a task. On the contrary, Asean is facing an outflow of skilled local personnel as is frequently mentioned by the brain drain phenomenon (Austin, 1990:254). But there are cases whereby a phenomenon called reverse brain drain (Ting, 1987: 140; Austin, 1990: 257) is happening. Such can be observed in India, South Korea, Taiwan, and Hong Kong. In most of these cases, highly skilled personnel trained abroad bring home some much needed technology to be diffused to fellow citizens.

For most of Asean, they have to rely on radiation diffusion to upgrade their technological capability (Scoville, 1951). This method relies on transmission through the processes of imitation, observation, and infection through direct contact. To develop skills through this method requires long periods of time and patience. A *hanchō* (foreman) in Japan is usually regarded as a benchmark to denote a full and multi-skilled worker. It takes up 15 years or more for a fresh employee to reach this level⁶⁾ through formal and informal training combined with annual performance evaluation. This time factor with a sustained attention for performance is one price of technology that is often overlooked by Asean in her search for quick-fix technology. Japan had began to seek technology transfers actively in the mid 1800s. Germany started out slightly earlier (McNeil, 1990). Seen from this time perspective of the two nations, most of Asean is still in its infancy stage as far as skill development is

concerned.

Although there are multiple methods available, on-the-job training (OJT) is frequently recommended as a most effective way to develop worker skills at the manufacturing operations and maintenance levels. By actually doing the work, employees are learning with their own hands, and learning occurring proximity to the site of work operations proves to be highly relevant for skill development (Analoui, 1993). In an integrated system (Koike and Inoki, 1990), the same employees are recommended and trained to handle both the manufacturing and maintenance stages and even the production control stage. To effectively train workers through this method, there must be sufficient numbers of skilled and experienced workers specialized in their respective skill areas who are willing to cooperate and offer consultation and guidance to junior workers doing a job together as a team.

OJT takes place through five distinguishable learning processes. The first learning process calls for a new employee to *observe* how a senior employee performs a task. The trainee then tries to *imitate* the operational steps as those of the senior worker, guided by some key check points. These two steps can be done concurrently, back and forth as in trial and error. When an acceptable result is recognized by a senior worker, the trainee proceeds to make numerous *repetitions* of the steps to reinforce the lessons learned.

With confidence seeping in, the trainee begins to make *adaptations* of the procedures learned to better fit his/her preference. Adaptation involves some modifications to the idiosyncrasies of fellow workers, machines or assembly lines. The result is that the trainee's work style is created. At the *consolidation* stage, the trainee is almost thoroughly sure of the complete procedures and the expected output. The trainee consolidates the lessons learned and proceeds to accumulate experience with various machines and assembly lines. Polishing up the skills, the trainee is ready to take on another task that could be slightly more difficult and complex than the previous one⁷⁾. These learning processes should include the

manufacturing operations and maintenance operations as well.

In steps one and two, the trainee feels somewhat controlled by senior workers who may have to spell out specifically what is to be done. There are thus shades of the "X" type of employee being assumed (McGregor, 1960). At the reinforcement stage, the trainee experiences a transitional phase of knowing approximately what is to be done, and of being directed as to what is to be done. As experience is accumulated, skills become enhanced, and the trainee takes the shape of a "Y" type of employee to exercise initiative.

Much literature reveals that OJT is commonly used in the Asean countries (Yamashita, 1991; Ng, Hirono, and Siy, 1986). This is a positive sign. But this sign should not mean that by having fewer expatriates around assures technology has been successfully adapted. However, the presence of expatriates could shine a light on Asean countries to know the fact that in the Meiji era in Japan, European skilled workers were purposefully invited to supervise the Japanese workers and asked to train them until the entire operation could be safely handed over to them, so that foreign experts can leave at any moment. The ministries concerned spent large proportions of their budgets to keep these foreign experts around for decades (Inkster, 1991).

Meanwhile workers cannot be assumed to be automatically motivated to upgrade their skills. Along the way, an appropriate system of promotion and remuneration has to accompany the process of technology development. The primary basis for OJT effectiveness is the long term tenure of the workers achieved within the group context organized as a team. Asean could well be in an economic growth stage capable of developing the team organization and the long term employment proto-type of the Japanese economy in the 1960s.

At the firm level, employment cycles are predicted to stabilize as job hopping tapers off in the Asean countries. The job-hopping rate of less than 10% is considered not a big problem in Asean when compared to the acute rate in Meiji Japan that reached over 100% in the worse cases. It is

here that the transfer of Japanese practices in management personnel can play a crucial supporting role. It is mentioned that seniority promotion and wage systems already exist in Asean (Koike and Inoki, 1990).

The government has a prime role to play in the development of worker skills (Anuwar, 1992). Besides setting up training institutions such as vocational schools, the dedicated government can instill a spirit of development to mobilize worker motivation towards a national goal. Japan did this with a "Catch up with the West" slogan, and Korea had done so with "Catch up with Japan" propaganda. Malaysia is doing something similar with her "Vision 2020" calling her citizens to make Malaysia an advanced nation by the year 2020 (Sixth Malaysia Plan).

Concluding remarks

This paper suggests that technology is composed of three major knowledge components as illustrated in Figure 1; individualized, physicalized, and informationalized knowledge. The most critical component is the individualized knowledge, of which skills form the core, and this is the most difficult to develop. Technology transfers immediately result in an enlargement of the other two components, but not the first component. Asean countries must acknowledge the realities of technology transfers which are generally treated as business transactions by suppliers of the capital. Such a buyer-seller relationship calls for the suppliers not to transfer anything that is beyond the business necessity.

Asean countries hence cannot just depend on static transfers to lead them towards industrialization. If technology transfer is the job of supplier nations, then its development must be regarded as the job of Asean countries. Technology takes a long time to develop, and Asean countries has to pay this time-price as she goes along. To create a willingness in learning skills at the grassroots level, local firms should develop a system of long term employment and a remuneration system to pay for the skill enhancement. The government, besides establishing training centers, is encour-

aged to launch a nationwide propaganda to instill a sense of achievement motives in employees.

Indeed, Asean countries face a formidable task in their aspirations to up-skill their technology. In this continual process, Asean has to rely on exports of her products to up-grade her technology. In this area, she faces not only restrictive import tariffs from developed nations, but also rivals from NIEs, and other equally development-hungry nations like China, Vietnam, Mexico, Brazil, and East European countries. As an alternative to head-on competition or protective tariffs, Asean countries can opt to export to markets of fellow third world nations in Asia, Africa, and South America.

Notes

- 1) Needless to say, technology transfers occur among developed nations as well. See for example, A. Wad (Ed.) *Science, technology, and development*, Westview press, 1988.
- 2) MNCs and DFIs are not necessarily synonymous. Since 1990, DFIs entering Asean are increasingly sourced by small and medium enterprises from investing nations such as NIEs.
- 3) Major theories explaining this phenomenon are the product life cycle theory presented by R. Vernon's "International investment and international trade in the product life cycle", *Quarterly Journal of Economics*, 80: 190-207, 1966; and the "flying geese theory" by Akamatsu. Other theories are the theory of comparative advantage and the theory of interest rate differentials.
- 4) In 1991, the average growth rates for developing countries, industrialized countries, and the world were 3.4%, 0.7%, and 0.4% respectively. For Asean countries, the rate was 6.1%. See Overseas Economic Data Monthly, August 8, 1993, Economic Planning Agency, Japan, p.94 (in Japanese).
- 5) Asean countries refer to Thailand, Malaysia, Singapore, Indonesia, and Philippines.
- 6) An interview with a major wood processing machinery manufacturer in central Japan.
- 7) An interview with a major molding manufac-

turer based in the central Japan region.

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