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Technological Acquisition and Absorption Via Multinational Companies: The Malaysian Experience

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INTRODUCTION

Technology, not only involve written information but also person-embodied skills, know-how and the adaptation of manufacturing processes to local operating conditions and markets. Therefore, the acquisition of technology by domestic industries can manifest itself in many ways. The more important ones being:

1. exchange of information and personnel through technical cooperation program,
2. direct employment of foreign experts,
3. imports of machinery and equipment and related literature,
4. contractual purchase of a given technology or know-how through licences and agreements for the right or access or use of the particular technology, that is protected by trade-marks, patents, licences,
5. internalized technology transfer from parent companies to subsidiaries overseas as may be embodied in direct foreign investment, and
6. books, journals, and other forms of published information, either in the public domain (for example library) or through private information services companies.

In their quest for technology to establish new industries or to improve existing production processes, domestic industries have resorted to most of the above methods, either singly or in combination. However, there is virtually no data captured in any systematic manner on most of the above forms of technology transfer, not only in Malaysia, but also in most developing countries in general.

Technological development within an economy with a small and

narrow industrial base such as Malaysia is often complex not only because of the impact of direct foreign investment but also the requirement to the fulfill a number of prerequisites. These include the willingness of multinational companies (MNCs) to transfer the desired technology, the appropriate price of the technology and the indigenous capacity to acquire such technology.

Given this background, this paper will principally examine Malaysia's experiences in terms of technological development, and the impact of MNCs operations on such development. In this context Section 2 will examine the general issues related to technology acquisition mainly looking at the issues from the external technological environment. Section 3 will examine the domestic constraints in technology acquisition and adaptation. Section 4 will examine the contribution of MNCs in Malaysia in terms of skill development and manpower training, technology transfer and acquisition, and research and development (R & D). Lastly, Section 5 will highlight the issues that are pertinent in terms of future technological development.

TECHNOLOGY ACQUISITION: GENERAL ISSUES

A number of important issues can be identified concerning technology transfer from the industrial countries to developing countries; and these include:

1. limited choice of technologies in practice
2. imperfect markets for technology transactions
3. technology pricing as a transfer pricing mechanism
4. weak bargaining position of less developed countries (LDC) firms *vis-a-vis* technology suppliers, and
5. restrictive terms and conditions of technology transfer.

LIMITED CHOICE OF TECHNOLOGIES

In spite of the increasing pace of technological developments and their commercialization worldwide, the actual choices open to developing countries as far as usable technologies are concerned may be limited in practice. This is because the bulk of the world's useful technology are concentrated in the hands of a small number of large and powerful corporations in the industrial countries whose domestic laws have granted property status to most forms of technology, thereby conferring

proprietary rights and consequent liberty to impose obligations or restrictions upon those permitted by the owner to make use of the property.

These MNCs actively use the transfer of technology as an element within their broader strategies for global expansion to protect existing markets in the face of restrictions on continuing imports into these markets. This motive is often referred to as 'tariff jumping'.

This concentration of technology-generating capacity arises because most R & D activities are done by large MNCs within the industrial countries. Although the international patent system was intended to protect and encourage innovations, the system seemed to work against the interests of developing countries. According to the World Bank,

> Of the world total, 6% of patents were granted by developing countries, and of these 5/6 are held by foreigners, mostly transnational corporations, and only one sixth by developing country nationals. The commercial value of those held by nationals is relatively small. Among patents issued to foreigners by LDCs, the vast majority (over 90%) are not exploited. Patents thus, for the most part, tend to prevent competition and local innovation, rather than encourage it (World Bank, 1979:65-66).

Given the rapid pace of technological change, countries like Malaysia are in no position to reduce the technological gap between them and the industrial countries. To initiate their operations and stay competitive, therefore, most domestic firms in practice become increasingly dependent upon the technology licensers of the industrial countries for the supply of technoloknow-how. To a large extent, the choice of technologies are basically determined either by large MNCs or technology suppliers in the industrial countries. However, recently there is a growing realization of the existence of technology transfers by the newly industrialized countries, and this serves as an alternative to technology transfer from the industrial countries which had constituted the bulk of the technology imports in the past.

IMPERFECT MARKET FOR TECHNOLOGY TRANSACTIONS

Technology acquisition also can be seen in the context of transactions taking place under very imperfect market conditions generally favoring the technology suppliers. Aside from the oligopolistic nature of technology supply, the ability to choose and assimilate imported technology by countries like Malaysia has also been hampered because of the lack of indigenous technological capability. Manufacturers in

developing countries, given their small pool of highly skilled personnel, often lack sufficient knowledge and information about the technology they hope to acquire and their potential suppliers. Technology suppliers are reluctant to disclose full information about their product to potential buyers until all transactions are completed to protect the proprietary value of the product. Only few industries possess technology that is not universally available. Those that possess new technical information (for example electronic firms), guard such a valuable corporate asset carefully, even from their workforce. Therefore it is not surprising that valuable technological knowledge is not readily given away; it has to be purchased at a cost. Therefore buyers lacking in technical sophistication generally tend to agree to purchase the technology without sufficient knowledge of its eventual functional performance.

Furthermore, a technology purchase is often "packaged" with foreign technical expertise and capital equipment, hence leading to hidden costs and making it more difficult to evaluate the price of each component of the technology. This arises because MNCs assert that technology can be transferred successfully only through a whole "technology package" covering many stages of an investment project and integrating the technology with management, marketing and financial skills (United Nations 1984:18). The "price" as expressed in direct costs may only be a small portion of the full cost, as the sale of the technology is generally accompanied by restrictive conditions that lead to substantial increases in the true costs of purchase.

On the other hand, if the technology being transferred is "packaged", the recipient can overcome the problems associated with market failures, imperfections and uncertainty during the transfer compared if the technology is "unpackaged". As implied above, the costs associated with a high degree of packaging can be substantial, especially pricing various elements freely, extracting profits from sales of peripheral or fictitious technology and the degree of control on the duration of the recipient's dependence on the technology.

In view of the above, the supplier-buyer relationship in international technology markets is basically akin to "bilateral monopoly" where the price tends to be determined through a series of negotiations between two parties (Cho 1988:70-79). If both parties are equal in their relative bargaining positions in the negotiating process, then the final negotiated price would be closer to the price determined in a competitive market. If one party is in a stronger bargaining position, the final negotiated price would deviate from the competitive one.

Thus, where buyers have less than sufficient information and knowledge about the technology, the suppliers would tend to be in a position to capture a greater share of the potential economic rents from the ultimate use of the technology.

The situation is reinforced by other factors such as the inherent strength of the technology sellers and their considerable negotiating and bargaining skills built up through extensive experience in transferring technology. On the other hand, technology importers lacked any significant expertise in acquiring technology and thus they have to bear substantial costs for acquiring advanced technology even at the negotiation stage. However, over time, the relationship between the technology supplier and the recipient changes. The bargaining power of the technology supplier are greater at the beginning of the relationship when the need of its resources and expertise is greatest. Once the facilities are operational, the recipient becomes more familiar, the supplier's services then become less indispensable and there could be a shift in the relationship favoring of the technology recipient.

TECHNOLOGY PRICING AS A TRANSFER MECHANISM

There is ample evidence indicating that a very significant proportion of international trade is intra-firm, giving rise to the possibility of a quantitatively significant element of costs of technology transfer being disguised through the manipulation of transfer pricing (World Bank 1979:28). Vertically integrated firms (that is where the various stages of production from raw materials into finished goods are undertaken by the same firm or its subsidiaries) relocate their profits internationally by using transfer pricing that is under-pricing goods for export while selling them at market prices within foreign markets. The motives for their behavior are to minimize global tax burdens and avoiding political risk.

A large part of international technology transfer actually takes place between parent MNCs and their overseas subsidiaries or joint-ventures. In such cases, the pricing of the technology transferred may not reflect competitive market values, but may instead be dictated by transfer pricing considerations to minimize taxation on corporate income. Thus, in a country like Malaysia where the withholding tax rate on repatriation of royalty payments under technical or licensing agreements is lower than the corporate profit tax rate, technology transfer may be over priced to reduce such taxation.

WEAK BARGAINING POSITION

Developing countries bargaining position against the MNCs and foreign technology suppliers in relation to technology transfer have tended to weaken in recent years due to the intensifying competition among developing countries for direct foreign investment (DFI) in general and "high-tech" investments in particular (See also Djeflat 1988:149-165). In addition, in those "sun-rise" industries marked by very rapid pace of technological change, they lack the ability to catch up and as such are much more vulnerable and dependent upon the technology suppliers especially MNCs to provide the latest improvements regularly. In this respect, writing on the industrialization process in South-East Asia, Yoshihara Kunio observes that,

> The basic reason for the technical weakness of industrial capitalist institutions in the region is the low overall level of technical competence. Because of this, capitalists who aspire to be industrialists have to depend on foreign technology even though it is extremely expensive. There is no effective local substitute for the technology needed for the advanced industrial activities the government is promoting (Kunio 1988:114).

Thus, according to him, none of the Association of South East Asian Nations (ASEAN) can join the Newly Industrialized Countries (NICs) on their own because they lack their own technological bases. Their industrialization has been largely "technologyless" because they failed to commit themselves to progress in science and technology.

RESTRICTIVE TERMS AND CONDITIONS OF TECHNOLOGY TRANSFER

Technology suppliers are often in an advantaged position to dictate the terms and conditions of technology transfer, which are designed to yield high rates of return and to protect the competitive position of the supplier. Such high rates of return may take the form of profits not only earned on equity, but also earned from sales of intermediate goods, capital equipment, spare parts and technical services, not to mention transfer pricing. Thus, although technology may be transferable from an industrial economy to a less developed one, the costs often have been prohibitive, and such costs will, to a large extent, be determined by the technological gap between the two economies and the socio-economic environment in the receiving country (See also Tuma 1987: 403-427).

In this respect, the price paid to obtain any particular technology

also may reflect the lack of technical, financial, legal and commercial expertise required for the acquisition of information about the technology and for the evaluation of the various alternatives which may exist. This disadvantage is particularly felt by the small-scale enterprises which are generally domestically-owned and controlled. Their larger counterparts, on the other hand, tend to have greater access either because of their better organizational ability or because they are established through joint-ventures with foreign MNCs. A similar situation arises for the more industrialized economies, such as Australia (See Parry 1988: 359-365).

DOMESTIC CONSTRAINTS IN TECHNOLOGY ACQUISITION AND ADAPTATION

LACK OF ADAPTIVE CAPACITY

The modification by MNCs of processes and products to suit host country circumstances is dependent on many factors, including the type of technology, the domestic social and economic conditions, and the parent companies' view of how their subsidiaries can function most efficiently and profitably over the long run. In general, fewer foreign-controlled companies appear willing to adapt their products than to modify their processes.

Product adaptation is likely to be greatest among manufactures of import-substitution goods, especially consumer goods. For products which face international rather than country-specific demands, firms may prefer to train service personnel, than to simplify the products. Companies also tend to be reluctant to develop a new product or modify an existing one if the market is not large enough to permit the recovery of costs.

One view is that, imports of technology reduce the need to develop technologies that is imports become substitutes for indigenous technological development. An enterprise may initially turn to imported technologies than develop its own know-how, but subsequently will proceed to adapt these technologies to its local environment. The adaptive activity, in turn, may lead the enterprise to establish in-house R & D units and by that gain the experience required to generate its own technological capabilities. This strategy is called 'import and adapt technology' or IAT (Katrak 1988). Research studies done for Latin American and Indian enterprises by various researcheres provides some

support for the IAT view. However, quantitative impacts of the imported technologies on the indigenous technological activity may have been somewhat limited (Katrak 1988:43).

Technical progress can either be externally induced or be achieved through the process of "learning by doing" which involves the accumulation of experience by the working population at all levels during production. There is no doubt that this process does take place in manufacturing industries, although it may be difficult to conclude that it is widespread and effecting all levels of the occupational hierarchy. It may only affect those who are considered technically skilled but the occupational structure of the manufacturing sector is such that it hinders this kind of technical progress since the semi-skilled and unskilled workers account for almost 40% of the manufacturing labor force (Anuwar Ali 1984:44-59].

LOW ABSORPTIVE CAPACITY AND RESEARCH AND DEVELOPMENT

Even if there is a willingness on the part of MNCs to accommodate local needs and desires for technology transfer and adaptation, a country's ability to acquire and adapt new technology also depends primarily also on its capacity to absorb new information as defined by local manpower skills, and domestic policies toward technology transfer and information generation and dissemination.

The acquisition of technological capabilities (including production capability, investment technology and innovation capability) does not necessarily follow the importation of foreign technologies. To benefit from international technology transfer, domestic manufacturers must have a minimum proficiency in their technological capability. This proficiency is generally acquired with immense costs through a "learning" process that is often complex and time-consuming.

One major problem in during technology acquisition and is related to the fact that parent companies often insist on using usual machinery suppliers in their own country. Even domestic manufacturers are often reluctant to try domestic technologies if they are available. To them, this may be a much more risky proposition compared with the use of already tested foreign technologies.

While most MNCs' subsidiaries do not undertake R & D because such activities are often handled by the parent companies, those which undertake R & D confine their activities to simple experimental development and application research (Rahim Bidin 1983).

Having established R & D capability, the personnel involved in such activities should become the most important technology acquisition which means that they not only generate new technology on their own but also play the role of catalyst in facilitating transfer or purchase of the most sophisticated technology at a fraction of the market price.

However, this is not to be the case in Malaysia. In the case of electronics industry, for instance, it has been noted that there is a low level of local material content within the industry and the lack of linkages between the free trade zones (FTZ) firms and the non-FTZ firms, although the establishment of new projects (such as the manufacture of fabricated gold wafers and aluminum bonding wires, ceramic packages, lead frames and gold preforms, ferrite rods and cassette mechanisms) could bring about the desired backward and forward integration within the industry (See MIDA 1986-87:169).

EQUITY PARTICIPATION AND MANAGEMENT CONTROL

Equity ownership by Malaysian interests in companies where MNCs are participating does not necessarily mean management control. With some exceptions, nearly all the MNC's operations in our case studies appear to be effectively controlled by expatriates, who are personnel from the parent companies. This is particularly apparent in companies,

1. which are dependent on the foreign partner to provide the technical know-how (generally accompanied by a license or technical assistance agreement), and
2. which are dependent on the foreign partner to provide market access.

With regard to this, it may be illustrative to quote the Commonwealth Working Group Report on Technological Change:

> Joint ventures, in which foreign companies help local enterprises to set up production through minority shareholding, are being actively promoted by a number of developing country governments. The latter's aim, thereby, to achieve technology transfer from a foreign investor and access to foreign markets without losing indigenous control. Many governments are unsuccessful in this aim, since the foreign companies exercise control despite their minority shareholding. Most successful joint ventures appear to have been restricted to industries producing for the domestic market rather than for export, or in mature industries rather than in newer ones. Moreover, there is less likelihood of an effective technology transfer being made than with wholly or majority owned subsidiaries (Commonwealth Working Group Report 1985:109-110).

In the Malaysian context, however, a trend towards indigenization of management, particularly at the second rung, has been observed among some MNCs. Although most of the key posts are still held by expatriates, efforts have been made to "Malaysianise" the next-in-line senior positions. This is generally practiced by United States of Amereica and Europe-based MNCs to minimize the costs of employing expatriates. However, there is a tendency among Japanese companies to retain a higher proportion of expatriates at the senior level.

The above, also can be related to the extent of local decision-making autonomy versus the global strategic framework of MNCs operating in Malaysia. This issue has a crucial bearing on local MNCs' investment and operating behavior. Obviously, a MNC with somewhat centralized systems of decision-making will be less susceptible to leverage by local factors than one which practices a more decentralized style of management.

Decision-making at the firm level covers various aspects, the major relevant ones including future investment decisions including capacity expansion and product diversification identification of technology and sourcing of capital equipment and machinery, sourcing of raw materials, components and intermediate products, and marketing channels and policies.

The experience of South Korea may be pertinent here (Yu 1988). In the case of South Korea's electronics industry, as exemplified by the achievements of its leading manufacturers such as Samsung and Goldstar, the evolutionary process of technology development has gone several phases, including:

Phase I: Mastering simple assembly techniques from completely knocked-down (CKD) of imported model.

Phase II: Replacing some parts or components of its own choice from sources other than the company that supplies full CKD kits, or modifying the engineering and cosmetic design of the imported model.

Phase III: Introducing new products with its own engineering force through reverse engineering process without relying directly on foreign firms;

Phase IV: Applying reverse engineering process innovatively;

Phase V: Reaching the stage of technological competence where innovation starts to appear throughout the company for new products or new production process.

In the case of Samsung, for instance, it was already at Phase III by 1977 when the production of color television receivers was initiated. The product development and designing was mainly the work of its own engineers rather than relying on direct technical assistance from the industrial countries. This reverse engineering process, was sustained since technological capability within the company such that its own R & D activities had become a viable force, pioneering its technological progress further. As Samsung's production volume increased substantially, the learning curve effect allowed the company to develop even further, reaching Phase IV in 1985 when it introduced 16-bit personal computer and in 1986 the digital audio tape. Finally it reached Phase V after 15 years since it started with Phase I in 1972.

Samsung's development has far-reaching implications. Samsung is about to join the major league in the consumer electronics industry in the world, exposing it to greater competition than before. Secondly, the company has to commit itself to even more R & D activities for maintaining competitive advantage and perhaps for survival itself.

TECHNOLOGY SOURCING

In terms of technology identification and the sourcing of capital equipment and machinery, the case studies earlier indicate that it is generally the parent companies that make the decisions or give technical advice to local subsidiaries on these matters. It is often in the interest of the parent companies to maintain this type of relationship, as in some cases, the parent companies are also the technology suppliers. This situation may also apply to local subsidiaries at the initial stage when they still lack the expertise to determine their need for technology, capital equipment and machinery. Finally, several MNCs' operations in Malaysia were found to be taking over "used" equipment from other affiliate operations of their parent companies.

Several exceptional cases does exist, however, where the power of decision making to source equipment and machineries have been decentralized to the local operations. One Japanese MNC interviewed, for example, has opted for American machinery though one of its affiliate companies in Japan was lobbying to sell its machinery to them. In the case of one MNC joint-venture, the process technology is sourced completely independent of the parent company through an evaluation committee set up by the local firm.

SOURCING OF RAW MATERIALS, COMPONENTS AND INTERMEDIATE INPUTS.

The case studies show that most of the MNCs are totally independent of their parent companies in terms of sourcing decisions except for those MNCs which practice bulk-purchasing for their subsidiaries. Most local MNCs indicate that they try to buy from the cheapest source, if possible, from Malaysian suppliers. The relatively poor performance in terms of local sourcing by many MNCs is blamed on the lack of price competitiveness or quality or reliability of local suppliers. Indeed, a common complaint made by the MNCs is that there is a shortage of domestic ancillary services and industries.

LACK OF INTER-INDUSTRY LINKAGES

Except for the resource-based operations (rubber, wood and palm oil), there is little evidence to show that the companies in our case studies interviewed have managed to acquire significant proportion of their raw material or intermediate input requirements from domestic sources (although some efforts have been made by some of them to increase such purchases). Subcontracting systems involving a stable ancillary supplier-purchaser relationship, are yet not well developed. This state of affairs may not be totally due to their fault because there are several inhibiting factors making inter-industry linkages minimal. These factors include,

1. The nature of some of the industries represented by the selected companies still require a large proportion of their raw materials and other inputs from overseas as these inputs, not available locally, represent "work in progress", to be further processed (for example semiconductor components, chemical resins, dairy produce);

2. There are certain tie-ups between the local subsidiaries and their parent companies or other affiliate companies overseas for the bulk procurement of raw materials and other inputs for reasons of economies of scale; and

3. For most of the case studies, the question of the quality and reliability of local raw materials supply and ancillary services always crop up. Often local MNC operations may have little choice but to obtain their raw material and other inputs from or through their parent companies to maintain quality.

There is also some indication that several local MNC operations

has expanded over the years through upstream and downstream integration, rather than horizontal diversification. Notable cases are the introduction of testing operations and the proposed introduction of wafer fabrication by several semiconductor component manufacturers. Such front-end and backend integration results in internalized inter-industry linkages than linkages with third parties.

CONTRIBUTION OF MNCS: PERCEPTIONS AND REALITIES

Through our case studies of selected MNCs, an attempt was made to collect micro-level information concerning the nature and extent of technology transfer out by these MNCs. Based on these case studies, a number of observations can be made relating to some critical issues made in the preceding sections; and these cover the following areas of,

1. skill development and manpower training,
2. technology transfer and acquisition
3. Research & Development

SKILL DEVELOPMENT AND MANPOWER TRAINING

With some exceptions, nearly all the companies covered in our case studies appear to have contributed significantly towards enhancing technical skills. The electronics MNCs in particular, have contributed significantly in terms of skill upgrading and retraining. Over the last 10 to 15 years, the semiconductor industry has evolved from labor-intensive assembly and testing operations to operations involving quite a high degree of automation. From manual assembly to "scope" work, the labor skills have shifted towards the operation of automation equipment, and a greater degree of industrial engineering and even some amount of R & D.

Most of the skill development is generally done through on-the-job training at the local plant. In the case of higher skills for technicians, supervisors and engineers, some amount of training at the overseas plants of the parent companies has also occurred and the number of personnel involved vary from company to company. Training at the local plants generally requires the sending of expatriate personnel from the parent companies or their affiliates who are attached at the local plants for varying periods; between one to three months. This is deemed essential by most of the MNCs especially at the initial stages of

production or when new product lines are introduced in the plant. The other approach is to send local personnel to the parent companies to acquire the necessary skills.

TECHNOLOGY TRANSFER AND ACQUISITION

The case studies indicate that there is a significant amount of technology transfer and acquisition taking place through a number of approaches introduced by the MNCs. For technology transfer, it includes,

1. introduction of new technologies and replacement or upgrading of existing machinery and equipment,
2. employment of expatriate expertise at the engineering and technical levels at varying periods of time especially at the initial stages, and
3. training of local personnel at the parent companies or affiliates overseas normally for periods of between one to three months.

For technology acquisition, this is mainly done at the factory level and special in-house training courses conducted by the companies from time to time. It is observed that there has been considerable introduction of new technologies into the various Malaysian operations by the MNCs. This is particularly so in the technology-intensive industry of electronics. However, these technologies still do not represent the "state-of-the-art" but rather older generation of technologies already found obsolescent in the industrial countries.

The need to acquire technology from the MNCs becomes more apparent when local companies want to diversify their products or be involved in downstream activities. An important aspect of technology acquisition relates to the ability of existing MNCs in Malaysia (either as subsidiaries or joint-venture companies) to have access to technology available at the parent companies, thus lowering the costs of technology search. The above observations notwithstanding, it is not an easy task to independently evaluate the actual extent of technology transfer and acquisition that have been realized within the MNCs' subsidiaries or their joint-ventures. A truly independent measurement of their impact cannot be made unless detailed information is obtained on factors such as,

1. the specific types of technical know-how that have been imparted,
2. the background of the expatriate expertise sent to train local personnel,

3. the background of the local personnel being sent for training, and
4. the nature of training programs, and the outcome of the training program.

In view of the lack of experienced and well-qualified staff in the area of technology transfer, the authorities currently do not have a systematic and independent monitoring system regarding the actual state and progress is usually only requested when a MNC applied for extension of an expiring technical assistance or licensing agreement. Even in this case, it is difficult to verify or assess the technology content, unless one examines their submissions at the micro level.

RESEARCH AND DEVELOPMENT

The Industrial Master Plan (1986-95) has duly emphasized that R & D activities are extremely crucial to enhance the industrialization drive, particularly in terms of export-led growth. The case studies earlier revealed that R & D activities by the MNC subsidiaries or joint-venture firms are generally minimal and mostly confined to quality control and testing activities.

Several factors discouraging R & D activities have been identified. The factors are;

1. there is a tendency to avoid duplication with the parent companies or their regional headquarters or affiliates which have established R & D infrastructures; consequently, the amount of allocation given to R & D activities is typically small (See also Ozawa 1982:7-53);
2. it would be too costly for the local company to establish R & D infrastructures given the long term nature of investments;
3. there is a lack of well-qualified and experienced people to do R & D and it would be costly to train them in specialized areas; and
4. there is very little interfacing with the public sector research agencies and virtually no contact with local universities for R & D purposes. The MNCs interviewed have the tendency to depend on their parent companies to provide the R & D inputs.

In the context of the MNCs, however, the critical issue is centered upon the conflict between their global perspective and the local interests. In the short and medium term (except for a very small number), it would be very difficult to induce them to establish R & D facilities

locally. A perception commonly held is that Malaysia is far down the ranking of MNCs as a location for regional R & D center. In the Asian-Pacific region, the four NICs (Hong Kong, South Korea, Taiwan and Singapore) are the preferred centers. Even where the ASEAN market is of sufficient importance to the particular MNCs, the preferred choice would still not be Malaysia as Singapore provides much better incentive and more historically established.

Another major problem cited by many of the companies interviewed is the difficulty of coordinating R & D activities that are geographically separated. It is emphasized that R & D work is subject to very high economies of scale, and that decentralized R & D poses great difficulties to the management. Finally, Malaysia's domestic market is too small to justify special R & D work to customize products to the local market and cultural requirements.

NEW DIRECTION FOR TECHNOLOGICAL ENHANCEMENT

HUMAN RESOURCE DEVELOPMENT AND RESERACH AND DEVELOPMENT

From the above observations concerning the mechanisms of technology transfer through MNCs, two policy implications emerge which should be given immediate attention. The policy implications are:

1. ***Manpower Training*** At the present stage of Malaysia's industrial development, manpower training must be reviewed as an integral part of the technology transfer process. Most Malaysian subsidiaries of MNCs (as well as Malaysian companies purchasing technologies from MNCs through licensing agreements) are at the "learning stage" to absorb the transferred technology rather than at the stage of product improvement or innovation. So, any integral program of manpower training is critical to enable local engineers and technicians to assimilate the skills to exploit fully the transferred technology. In this regard, the government should seriously consider incorporating manpower training provision as a criterion for evaluating and approving direct foreign investment in the future.

For domestic market-oriented investments, and more particularly for projects involving significant public procurement, the firms concerned should be asked to commit to a particular level of on-going manpower training commensuring with the requirements to operate fully and manage the transferred technology. This training can be in the

form of formal training programs at overseas offices belonging to the MNCs' group, through in-house training, or through setting up of a full-fledge training institute that can offer training for both employees of the firms as well as other workers. This concept of manpower training, if implemented through carefully designed guidelines, will help to improve the rate of skill development in the country.

2. ***Research and Development Efforts*** Despite the significant amount of new technologies that are continuously introduced into the manufacturing sector, there has been very little efforts by local R & D institutions (the universities and the various government R & D centers) to work with these MNCs to accelerate further the pace of technology acquisition and adaptation. INTEL has a close relationship between the academic institution such as Universiti Sains Malaysia (USM) in Penang and the semiconductor industry. Some specialized testing is done in the university's laboratories. With closer contact between industry and research institutions, R & D could be engendered. In view of the global corporate policies of many of these MNCs to limit their R & D allocations in countries like Malaysia, it is up to the domestic R & D institutions to take greater initiatives to offer their services to the MNCs, receiving in return, the benefits of access to the new technologies, exposure to the practical problems and needs of the marketplace, and opportunities to learn from the skills and knowledge of those in the field.

In this regard, the government should look into ways and means to encourage and promote greater university or R & D institution linkage with the MNCs in the immediate future. Undoubtedly, there are a number of problems that have to be surmounted given the different needs and objectives of domestic R & D and those of the MNCs. However, given the experiences of the industrial countries, one must note that contact mechanisms via personal communication activities and technical collaboration are the key factors in the rapid diffusion of high-technology research results in Japan and the United States (Cutler 1989:17-24).

Some of the possibilities include, greater linkage between USM and the electronics-based MNCs in the Northwest region. Malaysian Institute of Microelectronics Systems (MIMOS) should also seriously consider expanding its R & D activities in this region rather than concentrating in the Klang Valley area alone. Also there is a need for greater linkage between the palm oil processing and petrochemical-based MNCs and Universiti Teknologi Malaysia in the southern region.

SELECTING APPROPRIATE TECHNOLOGIES

Technology is often perceived by many LDCs as singular and as such it is assumed that it can either be imported or developed indigenously. Such perceptions are erroneous as technology is not singular for it consists, of technology information, technology measures and technology understanding. A critical technology question then becomes which elements to import and which to create domestically. Atkinson and Stiglitz (1969) for instance, have proposed that developing countries support infant technologies rather than infant industries to encourage the development of indigenous technology. This proposition, however, assumes a priori that these countries have the necessary competence to decide on the choice of appropriate techniques. In reality, this is not so and it is one area which must be seriously addressed.

Wholesale importation of technology without efforts to screen, control and absorb it usually stifles the growth of indigenous technology capabilities. Accordingly, a selective approach to the import of technology is essential to indigenous technological development. Such a selective importation policy was successfully adopted by Japan between 1868 and the 1950s. However, it must also be noted that this deliberate selective policy was adopted alongside other parallel measures to develop indigenous technology as well as intensive efforts to import appropriate technologies. A well-coordinated infrastructure is required to effectively pursue the selective technology policy and this must include the adoption of a clear criteria regarding technologies that can be imported or otherwise.

An important component of the Science and Technology (S & T) infrastructure must include an effective S & T information network as the role of information managers is crucial in overcoming the problems related to increasingly complex technology transfers. Basically, this network must be able to obtain complete and reliable information on technology transfer processes; to assist in the selection of appropriate technology and market evaluation; and to contribute to the assessment of the effects of government policies and practices on the technology transfer (See Farkas-Conn 1988:47-56).

A COMPREHENSIVE APPROACH TOWARDS SCIENCE AND TECHNOLOGY DEVELOPMENT

In the long-run, a more systematic and comprehensive approach to the issue of technology transfer acceleration is clearly needed. Despite

many constraints discussed earlier, it is clear that, if Malaysia were to achieve its ambitious IMP targets, both its domestic manufactures and their foreign counterparts operating must be encouraged to adopt a more aggressive approach towards raising their technological capabilities. Several broad policy recommendations have been put forward by the IMP but there is little that deals specifically with the issue of increasing the effectiveness of technology transfer through MNCs.

There is little doubt that government affirmative policies play a crucial role in enhancing indigenous technological capability. Increasing the latter would ultimately allow improvements in the productivity of domestic R & D efforts, and therefore the level of technology acquisition and adaptation. In this respect, the role of the Ministry of Science, Technology and Environment in promoting technology transfer needs to be considered, besides that of the Ministry of Trade and Industry. It is indeed timely that the Coordinating Council for Industrial Technology Transfer in October 1987 decided to initiate a Plan of Action for Industrial Technology Development in support of the implementation of the IMP. Under this new initiative a number of studies are currently being undertaken with the following objectives,

1. to assess the state-of-the-art of industrial technologies in the country;
2. to assess the effectiveness of current programs designed to promote innovation in industrial technology;
3. to identify the constraints and problems hindering domestic industrial technology development;
4. to identify the existing level of technology within individual industrial sectors and also key technologies crucial to the development of relevant sectors, and assess their respective strategic importance;
5. to formulate selective sectoral technology plans in line with the priority or product groups identified for each sector in the IMP;
6. to formulate technology enhancement programs for the various product groups; and
7. to establish concrete technology development strategies with the view to promoting systematic technological development.

CONCLUSION

The knowledge acquired through a technology transfer mechanism helps to generate indigenous capacity to adopt and shape the path of technical change at least in the short run. However, there is a need to find mechanisms that would ensure effective transfer of 'know-how' and 'know why' amongst domestic industries in the long term. This must be matched with their local firms' capacity to absorb, adapt, upgrade and innovate the acquired imported technology. To be meaningful, the technology import policy must encourage and enhance the development of indigenous technological capacity. Only then the industrial sector look forward to a higher level of technology development and growth.

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