CHAPTER 2

CHANNELS OF TECHNOLOGY TRANSFER

2.1 INTRODUCTION

This chapter will provide a detail description of the technology transfer channels that are analyzed in this study. From general readings, eleven technology transfer channels were identified. The recognized eleven technology transfer channels are technical assistance agreement, know-how agreement, license agreement, patent agreement, management agreement, turn-key contract, training abroad for local staffs, visits of foreign experts and long-term contracts of expatriate engineers, engineering services agreement, supply agreement and trade mark agreement. Apart from providing a complete description of each of the technology transfer channels, this chapter will also concentrate on the evaluation of the dominant technology transfer channels. The evaluation will be conducted to identify under which condition these channels will be dominant in a host country.

2.2 DESCRIPTION OF THE TECHNOLOGY TRANSFER CHANNELS

Technology may be defined as knowledge used in the production, commercialization and distribution of goods and services. For the purpose of this study which emphasizes technology as an element in the industrialization process, technology is defined in its broadest sense to mean knowledge or methods that are necessary to carry out or to improve the existing production of goods. It includes entrepreneurial expertise and professional know-how. Hence, it is now widely accepted technological progress as an important element in the process of economic development, and in the attainment of twin objectives of poverty eradication and rapid industrialization of developing nations.

According to a research by Economic and Social Commission for Asia and the Pacific (ESCAP), developing countries are placing increasing emphasis on the acquisition of technological capabilities. One of the efforts in this regard is technology

transfer from developed countries. Due to the structural features of the global technology "industry", Transnational Corporations (TNCs) are generally the major source of industrial technology. Production of technology is costly, risky and involves large scale operations. Thus, only a few large companies, predominantly TNCs, invest in research and development (R&D), especially in relatively advanced and sophisticated technological fields. TNCs drive their dominant position as major technological incubators from their competitive edge in operating large-scale industrial complexes and their strength in global production and commercialization. Therefore, TNCs technologies are generally commercially liable and ready for application due to the resources expended on research and development (ESCAP/UNCTC 1987).

The technology transferred to the developing countries, however, is largely modernization experience and skill associated with standardized production methods. The scope of a typical contract extends to production, management, and, frequently, marketing. The wide variety of production activities transferred to developing countries include: assembly methods, material selection, machine operation, maintenance techniques, provision of technical data, training of personnel, plant layout, selection and installation of equipment, quality and cost controls, and inventory management (Hieneman, Johnson, Pamani and Park 1985).

In general, there are various technology transfer channels or mechanisms adopted to transfer the technology from the TNCs to the host country. According to Bhattasali (1972) purchase of foreign technology through know-how agreement is one of the basic channels of transfer between a developed and a developing country. Moreover, Robin Skelton (1984) exhibited that know-how agreement is a somewhat amorphous concept that may involve a once off hand over of a written secret formula or it may involve a continuing relationship. At the same time, he also noted that trade mark agreement is an insubstantial technology transfer channel compared to know-how agreement. Trade mark agreement's visible manifestation sits merely in appearance in relation to goods or its entry to the Trade Mark Registry.

But Bhattasali (1972) pointed out that, even though a developing country h sufficient infrastructure, and technological bases, it is unable to assimilate and reprodu the know-how in the actual production processes. He further added that even wh elaborate drawings, specifications, process schedules and operation sheets as well detailed instructions on every aspect concerning the technology are made available, th seldom prove enough for installing and operating the new techniques. There must necessary support of technical guidance and supervision by experts, often supplemen by facilities to receive in-plant training for the technicians and engineers in the recipi country. At times, technology is transferred to a developing country through the sale equipment, accompanied by detailed instructions on installation and operation of equipment.

Ng, Hirono and Robert (1986), sharing the same view by concluding t technical assistance agreement, training abroad for local staff, visits of foreign expe and long-term contracts of expatriate engineers as well as engineering servi agreements were valuable in the transfer of problem solving skills that could not handled by local staff. Correspondingly, a study by ESCAP/UNCTC (1987) revea overseas training programmes and on-the-job training as the main mechanism technology transfer. The study concluded that these types of technology transfer chann are important as the absorption capacity as well as trainability for the local fo determines the success of technology transfer.

A report by the World Bank (1991) further exhibited channels such as licensi agreement; engineers as well as experts movements and contracts with foreign buyers usually adopted to transfer the technology embodied in imported inputs and capi goods. Mascarenhas (1982) explained that license is an agreement by which the licen extends to the licensee a limited right to make use or sell the licensed object for a roya or a consideration. Correspondingly, Julian Lowe and Nick Crawford (1984) presen that licensing agreement is a purchase and sale of process technology designs a marketing expertise. David Mooring (1984) meanwhile describes licensing as primaril commercial technology transfer operation. Further, Tony Purkis (1984) concluded t licensing is an excellent way to speed-up technology progress and accelerates n

product development. Mascarenhas (1982) has also identified turn-key contract as a package of capital, expertise and information of technological knowledge. Finally, Wienert and Slater (1986) added that turn-key contract supply of technology is an explicit component of provision of plants or equipment.

By looking at these various previous studies, eleven channels have been identified as common technology transfer channels in developing countries. These channels are technical assistance agreement, know-how agreement, license agreement, patent, management agreement, turn-key contract, training abroad for local staff, visits of foreign experts and the long-term contracts of expatriate engineers, engineering services agreement, supply agreement and trade mark agreement. This chapter will furnish a detail description of these channels, in order to provide a better understanding of each of the above mentioned technology transfer channels.

2.2.1 Technical Assistance Agreement

One of the recognized technology transfer channels from the general readings is technical assistance agreement. Technical assistance agreement requires an agreement between a foreigner and a domestic public or private entity established under the host country Company Act. This agreement between the two parties would contain details on the terms and conditions of the technology transfer.

The objective of this channel is to provide technical assistance for the installation and operation of machinery as well as production process of a project. Hence, the term technical assistance and technical services here means that the components of the technology, which are transferred to the host country, are basically related to technical information. This is because technical assistance is the basic technology that is needed in the beginning stage of any manufacturing process. Usually, specialized technical information and services are required in the manufacture of products in order for the product to be competitive in the market.

Therefore, technical assistance agreement can be seen as a business deal, whereby the technology transferor will supply scientific as well as technical assistance and services, in addition to training and management assistance. The foreign technology owner will also provide the domestic firm with information on the production techniques and technical specifications of the products. And after receiving feedbacks on the design and quality of the product, the transferor gives assistance on improving the quality of the product. In return for the technical assistance, the technology transferors receive payment for their services.

In the case of technical assistance agreement, the bargaining strength of the technology recipient firm would depend to a large degree on the extent of information that the firm has about the technology acquired. Relevant information would include knowledge on alternative sources that are supplying the same kind of knowledge or technology, the resources that the firm is prepared to expend to obtain these information and how much it knows about the technology that it is buying. In the absence of such information it is possible that different technology suppliers charge different kind of price for the same knowledge (Balasubramanyam 1973).

2.2.2 Know-how Agreement

Know-how agreement transfers technology in a different methodology as compared to technical assistance agreement. Know-how agreement is known as the transfer channel of intellectual property. The know-how agreement usually covers specific information on formula, processes and industrial techniques (MIDA 1995). This agreement emphasizes on the manufacturing techniques or processes rather that the resultant product. Therefore, in the know-how agreement, the volume of technical knowledge that has to be transmitted comes in the form of process sheets, blueprints, and the complexity and technical tolerances of the transplant that govern manufacturing specifications.

Know-how agreement is a kind of technology transfer channels that is selected by the recipient when he needs a technology supplier who is an expert in the field concerned

or the supplier has not disclosed the manufacturing process to the public. It may include technical drawings, specifications and formulae. The recipient should treat the transferred information as strictly confidential. Holding the portion of the know-how information as secret gives its processors some technical and/or marketing advantage. In order to have an effective transfer of technical knowledge under the know-how agreement, both the involved industries are required to own high caliber of engineering and technical personnel at both the dispensing and receiving ends (Branson 1971).

2.2.3 License Agreement

License agreement may be defined as an agreement by which the licenser extends to the licensee a limited right to make use or sell the licensed object for a consideration royalty. The nature and form of licensing agreements are complex and include a wide variety of commercial, technical and legal arrangements. This technology transfer channels allows for the transfer of technology in the form of product design and production specifications which normally describes the essential components, the form and the nature of the materials used, and the general process of assembly. The production equipment required in the manufacturing process may also be specified in the licensing agreements (Ng, Hirono and Robert 1986).

Licensing type of collaboration agreement usually includes extensive agreements for technical assistance to help the buyer of the technology to learn the process of manufacture (Mascarenhas 1982). Under this channel all rights (except legal title) are transferred to be the licensees in a specified territory to manufacture, use and/or sell a product. In addition, this channel may also include the right (of the licensee) to sub-license to a third party.

In normal license agreements, the licenser gives sells or leases to licensees the right to use certain industrial rights and/or technical expertise including patent, trade mark and technical assistance (MIDA 1995). This channel also affiliates with technical support that are required in manufacturing techniques which, include complete sets of material standards and manufacturing standards, parts and assembled engine inspection,

materials testing, gauge design and associated quality control techniques and guidelines (Branson 1971).

When deciding on a license agreement as a form of technology transfer, both sellers and buyers of technology have several specific options of payoffs (Mascarenhas 1982). They are listed below:

For sellers they are:

1. The earning of additional income from technologies which is at the end of their product life in the domestic market.
2. The opportunity of experiment with a technology which has yet to be proven.
3. In certain cases the gain to goodwill of the host country governments and to obtain some publicity.

For buyers they are:

1. The acquisition of ready-made technology is often easier than investment in research and development(R&D).
2. The opportunity to procure up-to-date technology in some cases.
3. Scope for unpackaging the technology can be built into the agreement.

The actual payoffs to the licenser and the licensee will ultimately depend on the technology package.

In the developing countries license agreement played a very significant role as the channel of technology transfer. This is because licensing involves smaller investment. Furthermore, it can be used as means of entering new markets and also of avoiding some of the risks associated with investment. Finally, for the developing countries, licensing provides both a wider range of options and greater opportunities for learning by doing as well as avoiding the risk of external control over the economy (Mascarenhas 1982).

2.2.4 Patent Agreement

On the contrary, patent agreement is a technology transfer channel that covers exclusive and non-exclusive rights to exploit specific technical inventions. In other words, it accommodates comprehensive information that covers all technical areas and is

very valuable. A patent agreement discloses full information of an invention. In this agreement the inventor is obliged to file a full and detailed description of the invention, which is then published, both to foster further research and to avoid wasteful duplication of effort (Malaysian 1995). Thus, it creates possibility for the interested public to further improve or modify the invention or seeking substitutes.

Normally, patents which people tend to write are related to the ideas in the field of engineering, electronics, physics, chemistry and other technical disciplines which are intended to solve day to day problems in every industry. The advantage of selecting patent as the channel of technology transfer is that it can also provide savings on repetitive research, new ideas and impetus and keep an eye on competitors activity. To protect these inventions, the State through the Patent Law confers the patent owner certain exclusive rights for a limited period.

Firms that are searching for a particular aspect of new technology by selecting patent agreement as technology transfer channel may consult the records from the Patent Offices in the host country to determine if the required technology has been included in the patent specifications. They can also check whether those patents are still in force. If so, they have the option of approaching the patent owner for a license, or of exploring some other technical solutions. Even if the technology in question is not directly disclosed in a patent specification, looking at related patents in similar the field can give new insights into the available technology. Groups of identified patent specifications can be analyzed to find out who are the specialists in the field. This will help to notify potential business partners or potential rivals (Malaysian 1995).

2.2.5 Management Agreement

Management agreement is different from all the four technology transfer channels discussed previously. Management agreement states that foreign firms are not only responsible for providing technical assistance in setting up a new domestic owned plant, but also in running it in the initial stages of the operations. Hence, there exists a significant operational control over the local enterprise by the foreign enterprise.

Under this channel foreign management functional controls will be exercised. Functional controls means that the foreign firm exercises discretionary power in the actual operations of the local firm in the area of production planning, organizational detail and input mix. The foreign firm could also exercise an effective control on the local firm's selection of supply sources for materials and components, its market outlets and its pricing policies (Balasubramanyam 1973). The management agreement may also specify the powers of managing directors, remuneration and benefits accruing to such responsibility. Other than the above, it includes other management functions such as financial, technical, administrative and marketing (MIDA 1995).

2.2.6 Turn-key Contract

The practice of transferring technology through turn-key contract is specially related to the countries which are rich in resources but are weak in their scientific and technological potential. Turn-key contract is usually recommended as a channel of technology transfer in the early stages of the development of an industry.

In turn-key contract, the transferor of technology should assist the related local firm in laying the foundation for the indigenous development of the firm by involving local technicians and by assisting in their training. The technology transferred is depending upon the nature of the plant and the level of technology involved. Turn-key contractors may either be technology owners or machinery suppliers or consulting engineering firms (MIDA 1995). This approach is considered as one of the fastest ways of setting up a local subsidiary.

Under this channel, the entire technology will be delivered as a package. In the beginning, a few local managers and engineers will be selected prior to the establishment of the local firm. They then will be sent abroad for training at the multinational headquarters or at the subsidiaries. Subsequently, the trained locals with a team of expatriate managers will be involved in this technology transfer.

At the same time, the supply of technology is an explicit component of machine and equipment together with the production process and product design specifications (Osman, Toh and Anuwar 1986). The agreements also include the furnishing of such related services such as training and help in the start-up of plant operation, particularly in the early stages (Helgard and John 1986).

The type of co-operation frequently extends beyond the delivery and assembly plants and includes exchange of technical data, joint research to improve products, the supply of licenses and joint marketing. One disadvantage for the host country is that such turn-key projects may lead to technological dependence on the multinational firms (MIDA 1995). The variation difference between a turn-key contract and a license is distinguished by Branson as "implanting operational technology" and "importing technical capabilities" to duplicate the technology respectively (Mascarenhas 1982).

2.2.7 Training abroad for local staff

Skill training programmes are selected as a channel of technology transfer in order to produce adequate supply of skilled workers, particularly to meet the needs of the expanding industrial sector. Normally those who are sent abroad were at least at the level of technicians or supervisors. This channel usually emphasizes on training of craftsmen, technicians, supervisors and engineers in the processes of manufacturing and handling of the machines and equipment used in the production (MIDA 1995).

In this channel, well-defined training programmes for the development of special skills in specific industrial operations and technological services will be provided to the local staff. The training may include short-term training programmes such as processing technology information; training of managers and entrepreneurs in the evaluation, negotiation and acquisition of technology, training of R&D personnel in the management of the R&D and evaluation of R&D projects. Special courses will also be provided to technical personnel in fields such as design, production engineering and productivity (UNIDO 1997).

The aim of such programmes are to enable the managerial, supervisory and technical personnel adequately utilize the knowledge and experience that they have gained when they return home and at the same time transfer the knowledge to those who are working under them. This type of training to the indigenous technical staffs, operators and supervisors would provide them the opportunity to familiarize themselves with the installation, operation and maintenance of imported equipment and technology.

In the Japanese controlled firms, these training provided the trainees with exposure to other aspects of work within the firm. For example, administrative or management personnel were instructed on technical activities associated with the production process. The broadening of staff skills is consistent with such Japanese practices as job rotation participatory and decision-making (Ng, Hirono and Robert 1986).

2.2.8 Visits of Foreign Experts and the long-term contracts of Expatriate Engineers

Besides training abroad for local staffs, visits of foreign experts and the long-term contracts of expatriate engineers is also a technology transfer channel that involves personal contacts. The firms that prefer in-house training adopt this channel. In this case the home country's personnel or parent company's personnel are posted to the host countries to provide important information concerning new technology.

This approach is valuable in the transfer of problem solving skills. Foreign engineers are usually brought in to provide solutions on issues that are irresolvable by local expertise. In addition, they also provide in house training programmes for the local engineers and skilled workers. This is likely to occur during the introduction of new machines, new products or new production process. This type of technology transfer channel is a favorite among local firms, which are less reluctant to send their staffs overseas (Ng, Hirono and Robert 1986).

The content of services in this channel are technical support on assessing raw materials, locating and preparing the plant site, recruiting personnel, obtaining

government and municipal clearance, procuring construction materials and equipment, construction buildings, installing machines, training operators and commissioning of the plant (MIDA 1995).

2.2.9 Engineering Services Agreement

Engineering service agreement is a short-term engineering service contract. This agreement stipulates that the service supplier needs to perform a list of technical work. Engineering services agreement require substantial engineering innovations but the supplier does not place any extensive restraints on the client regarding site, volume of production and disclosure of improvement (MIDA 1995).

Engineering services agreement is widely used when the license agreement authorizes the use of specific patented procedure, but carry with them no instructions, documentation or technical assistance. Hence, in order to obtain the missing information the host country firm has to make another separate agreement in the form of engineering services agreement. Thus, a technical personnel would be stationed temporarily in the host country to divulge information on specific operations (UNIDO 1977).

Furthermore, this channel will be adopted when inventing new products or modification of existing products since engineering firms have considerable knowledge of available technology. Generally, these engineering firms will undertake, for a fee, to search for the most suitable technology according to the needs of the seeking company. Engineering firms conducting international operations are often excellent sources of information. Therefore, the above mentioned channel is appropriate to be used in the advanced stages of acquiring new technology (UNIDO 1977).

2.2.10 Supply Agreement

Supply agreement is essential for developing countries, which have purchased know-how technology. Most developing countries having purchased the know-how technology realize they lack the necessary machinery for fabrication and critical

equipment for manufacturing. In such a situation, the developing countries are shackled with know-how technology, which are absolutely redundant to them. Hence, the supply agreement with all its machines and equipment plays a critical role here.

The equipment purchased under this agreement is often for plant modernization, or for setting up lines of technology. Since that equipment is easy to operate and maintain, the host country would not require guidance from the supplier countries. Assuming of course that competent technical support is available from the local sector or local professional consultants. The supply agreement is extensively used and is valuable channel of technology transfer (Mascarenhas 1982).

The duties of supply agreements are basically to ensure the supply of equipment, raw materials or components needed in the finished products. The binding legalities in the agreement ensure that the supply of critical raw materials and components are not disrupted. It is also quite common to have an escalation clauses or formula in which the fluctuation in prices of these raw materials and components are considered accordingly (MIDA 1995).

2.2.11 Trade Mark Agreement

Trade mark agreements cover the exclusive or non-exclusive rights to use certain registered and well known propriety trade marks or names. Trade marks are distinctive visual and sometimes aural devices, words or emblems(symbols) or a combination of them, that a firm applies to the goods it trades in, or to the services it performs, to indicate to the public that they are the firm's goods and services.

Trade marks play an important role in market place, since with their aid the consumer learns to distinguish between products of different manufacturers. Trade marks also serve to assure the public the consistency of quality. At the same time trade mark provides a great deal of assistance in marketing as a means of safeguarding the international reputation of the trade names owner.

Like patents, the trade mark constitute a property right. Normally there are distinct statuses in nearly every country that govern the ownership, registration and use of trade marks (MIDA 1995). Trade mark agreement is usually paid on the basis of the trade mark owner's invoicing for the product manufacture under the agreement.

2.3 EVALUATION ON THE DOMINANT TECHNOLOGY TRANSFER CHANNELS

The preceding part of this chapter has described the technology transfer channels that are adopted in the developing countries industries. In order to identify the dominant technology transfer channels, the prevailing conditions of the host country are the major contributing factors. These conditions are mainly the host country's technical capabilities, the product type and the host government's policy as well as support in the technology acquisition process. The evaluation of the dominant technology transfer channels will be conducted based on these three main conditions. Firstly, by looking at the product type of the host country's industry. Secondly, based on the technical capability of the host country. And finally, subject to the host country's government policies as well as financial aid.

In the evaluation based on the host country's industry product type, the study will look into the phases when a particular technology transfer channel becomes dominant in the production of a product. When the host country firm needs the technology that is relatively new, it needs the owner's permission or assistance or both to produce the product lawfully. Thus, the relevant technology transfer channels are trade mark agreement and patent (David 1984). When the technology is new, it is closely held, and countries wanting the technology are under pressure to accept the firm's terms and conditions, which have often required the establishment of a wholly owned subsidiary. But as time goes by, the technology becomes more widely known, and the host country can take advantage of competition among technologically capable firms to obtain licenses. Eventually, the technology may become available in plants that can be acquired by the host country on turn-key contract or engineering agreement basis from independent engineering firms (ESCAP/UNCTC 1987).

In the UNCTC (1994) case study, trade mark and patent agreement played a dominant role as technology transfer channel for branded food and beverage processing, man-made fibres, pharmaceuticals, automobile production, consumer electrical products and electrical power equipment. Such industries had developed barriers for entry, through patented basic process technologies in the industries and the strategies of product differentiation marked by large research and development budgets as well as heavy promotional expenditures for brand-name. The study by Mingsarn (1981) too presented that patent and trade mark are dominantly adopted when the host country firm would like to produce products with well-known brand names, namely, shoes and beverages, such as Charles Jourdan and Greenspot respectively. In the beverages industries, the principal or active ingredients are not produced locally, and production techniques involved only the blending of chemical ingredients according to specified formulas. In the case of shoe production, only trademark and designs were provided.

Meanwhile, if the technology of a product had reached a relatively mature stage and a number of suppliers are available in different countries, channels such as licensing, turn-key contract, engineering agreements, supply agreement as well as training are dominant. It is evident as stated in the study by UNCTC (1994) on "Determinants of the form of technology transfer" showed, the above mentioned channels were dominant in textile industry, offshore semiconductor assembly, automobile assembly as well as fertilizers industry, industries where their technology had reached a relatively mature stage.

Technical capability of the host country industry is also one of the major conditions for a channel to be dominant in the industry. Technical capability of an industry is measured based on the availability of skilled as well as semi-skilled labours to acquire skills regarding technical, managerial and institutions that are necessary for productive enterprises to utilize equipment and technical information efficiently. In a study conducted by Sanjaya Lall's (1993) it showed that without technical capabilities, a host country lacks in investment capabilities, production capabilities as well as linkage capabilities. This is because technical capabilities are the skills and information needed to

identify feasible investment projects, locate and purchase technologies, design and engineer the plant, and manage the construction, commissioning and start-up. Furthermore, technical capabilities are skills and knowledge needed for the production and improvement of plant and also skills needed to establish and maintain production and technological links with other firms and institutions.

Lack of technical capabilities will occur in countries that experience shortage of skilled as well as semi-skilled labour. The occurrence of such shortages are due to limited technical as well as vocational education centres because of delayed attention given to such education field by the host country. Thus, lack of appropriate skills occur in the country since the vocational school leavers lacked practical skills, their training being too general. Besides, the technical students in the developing countries rarely participate in the international skill formation competitions. Therefore, one of the underlying goals of encouraging domestic production is to strengthen these skills or to create an extra channel for the fast accumulation of skills at the expense of private sector outside formal educational systems (Mingsarn 1981). Thus the dominant channels under these circumstances are technical assistance agreement, training abroad for local staff, license agreement, management agreement, trade mark agreement, turn-key contract, visits of foreign experts and long-term contract with expatriate engineers and engineering services that provides training for the local labours in obtaining the appropriate skills.

The adaptation of these technology transfer channels as result of lack of technical capabilities is evident in the analysis of technological development in Ghanaian enterprises (Lall, Navaretti, Teitel, Wignaraja 1994). The study showed that the shortage of skilled labours experienced in the country is because technical institutions such as Kumasi University of Science and Technology and the Kumasi Technical Institute are very few in number and their output is still limited in relation to the country's need. Thus, to gain foreign technology the country relied on foreign experts as "teachers" who can demonstrate the practical ways of upgrading production methods with better skills. Furthermore, an analysis of engineering and technical assistance consultancy contracts by the United Nations Centre on Transnational Corporations (1986) showed that channels such as technical assistance agreement, license agreement, visits of foreign experts and

long-term contract of expatriate engineers as well as engineering services agreement play crucial roles in transferring technology to those host countries lacking in skilled manpower. Moreover, Hieneman, Johnson, Pamani and Park (1985) in their study on "Technology Transfer from Japan to Southeast Asia" indicated that these type of channels were dominantly practised by the Japanese in transferring technology to the developing nations of the Southeast Asia that have shortage of expertise. In line with this, the study by Mascarenhas (1982) stated that the host country in its initial stage of industrial development is dependent on the home country for capital, expertise and information turn-key contract as the dominant channel. Mingsarn (1981) proved that a few of Thailand industries relied on foreign technical assistance due to lack of capable manpower in handling the imported machinery. For example, a local food producer asked an Australian supplier to stay back for four months after the factory was completed to train local operators. Top technicians were sent to an Australian mill for training. A machinery supplier for a vehicle component parts producer, dispatched it's local technicians to United States and Japan for intensive training. Engineers of a local petrochemical firm were sent to Germany, South America and Japan for training as well. A German supplier of dyes gave short-term training scholarships to the local staff of government-owned mills. In Motors Philippines, the local managers still lack in adequate technical capacity for certain jobs, and those where the degree or magnitude of the task involved are so difficult and complex, that experience and expertise have to be availed of by the company (Bernardo1977). In addition, Bhattasali (1972) exhibited that lack of skilled manpower among developing countries made it necessary for them to rely on technical guidance as well as supervision by foreign experts including receiving in-plant training for technicians and engineers.

On the contrary, the host country with sufficient technical capabilities, whereby, it has the adequate number of related skilled manpower through its advanced education system, usually would only import the necessary technology information from the home country. In such cases, the dominant technology transfer channels will be know-how agreement, patent agreement and supply agreement. The study by Hieneman, Johnson, Pamani and Park (1985) showed that Japanese technology transfer to the advanced countries that have sufficient skilled manpower generally consists of patented high level

technology. Bhattasali (1972) shares the same view by proposing that basic technology transfer channels between two developed countries are purchase of the technology information and related equipment.

The final condition to identify the dominant technology transfer channel is the host country's government policy and support. The joint study on Technology Transfer under Alternative Arrangements with Multinational Corporations by the Economic and Social Commission for Asia and Pacific (ESCAP) and United Nations Centre on Transnational Corporations (UNCTC) concluded that host government policies have critical effects on the dominance of a technology transfer channel in an industry. One of the important roles played by the host government is by creating an appropriate policy to accelerate the pace of technology transfer as well as encourage domestic research and development activity. This policy may involve localization of personnel and components.

Benardo (1977) in his findings showed that the Philippines government's enforced "Progressive Car Manufacturing Programme (PCMP)", a long-range plan developed for the rational and orderly growth of the domestic automotive industry, by providing guidelines specifying minimum domestic content percentage for assemblers. By forcing the firm to produce components locally, the government induced the firm to acquire the technology as soon as possible. As a result, the Motors Philippines has 17 engineering staff involved in R&D, particularly in the design, development and testing of new local products, in close consultation with suppliers of indigenous building materials.

Moreover, the policy of replacement of foreign personnel by local personnel in the Motors Manufacturing Company in Philippines ensured the company provided on the job training for simpler types of work. On the other hand, for difficult skills, experts from their parent company, particularly service engineers are brought in to train the local personnel in order for them to undertake the operations. The company workers have also been sent to Brazil for instructions on transmission system. Furthermore, the company with the help of its parent company established an automotive institute in Philippines, which offers work-and-study college degree programmes with familiarization on actual plant operations, modular training and etc. On a similar line, The Ministry of Manpower

of Indonesia has contributed to hastening the process of replacement of expatriates by Indonesian nationals by limiting their numbers and duration of stay. Under the policy, the expert expatriates had to leave Indonesia after two years and periodically return for a short period of time to review the technical progress of the company and to give advise on how to improve the technical progress. By limiting the number and duration of stay of expatriates, the government can indirectly force the firm to set up its own training programme (ESCAP 1987).

Another host country government policy may be in the form of control over foreign share of equity in local industries. Control can frequently be exercised, particularly in the form where the dominant technology supplier holds little or no equity. It seems that most industries in Algeria and Iraq adopt "unpackaging" purely technical aid contracts as an alternatives to turn-key plants in order to reduce TNE participation in equity share. Further, added that licensing and management contracts also have seldom been the preferable choice under such policy (Usui1977). Non-equity forms of technology transfer may be preferable if the host government intends to impose tighter control on equity ownership (Edward 1994). For example, in India when its government tried to limit the operation of foreign capital and insisted on the role for Indian capital and personnel in the operations, the know-how agreement, supply agreement technical assistance as well as short-term engineering agreement were employed (Subramanyam 1973). Similarly, the study conducted by ESCAP (1987) showed these channels as also being dominant in Indonesia and Republic of Korea as their governments under the existing regulations, do not allow any wholly owned TNC subsidiaries. On the other hand, the host governments do not have controls over equity ownership in channels like trade mark, patent, management agreement and turn-key projects because they are mainly associated with direct foreign investment (Mingsarn 1981).

In the study done by ESCAP/UNCTC (1987) on technology transfer under alternative arrangements with transnational corporations pointed out that, in addition to the adaptation of appropriate government policies, other forms of government assistance may also be important to ensure the effectiveness of a technology transfer channel. They are funds and public funded research institutes. If the assistance available in the host

country comes in the form of technical assistance fund, human resource development fund, creating public funded research institutes and subsidizing locally conducted research, the effective technology transfer channels are technical assistance agreement, training abroad for local staffs, visits of foreign experts and long-term contracts of expatriate engineers, engineering services agreement, know-how agreement and supply agreement. Such transfer channels are effective as the available assistance is related to training and research and development fields. A study conducted by Ng, Hirono and Robert (1986) on technology and skills in ASEAN showed that the Skills Development Fund in Singapore has led to employers adopting training as their effective technology transfer channel. Training related technology transfer channels dominance are further strengthened with the Joint Government Scheme (JITS) in Singapore.

2.4 CONCLUSION

In the developing counties, where industrialization is in progress, the process of technological development is crucial. Thus, technological development through imported technology is transferred through the channels discussed in this chapter. In analyzing the dominance of these technology transfer channels in the host country, apart from the foreign firms' willingness to transfer technology, the host country's ability to absorb and utilize it, is also an important determinant of the extend of knowledge transmitted. The ability to adjust the technology to suit the smaller scales of local production and the product itself to local market is vital. The success of a technology transfer through any of the technology transfer channels as described in this chapter is evaluated upon the availability of technical capabilities in the host country. Further, the suitability of a particular type of transfer channel may also depend on the government policy as well as incentives, product type and technical capabilities of the host country.

Technology transfer is an extremely complex process involving the successful acquisition of various skills. For this reason, it requires the active participation from firms, employees and government in the receiving end. Clearly, technology transfer will only succeed if the recipient firm has developed its absorptive capacity. This refers not only to the provisions of adequate facilities, machinery and equipment but more

importantly to the development of human resources such as upgrading of the education system in order to create more skilled workers and engineers. In fact, the absorption capacity of a firm depends very much on its operational level as embodied in the firms' technical skills and managerial capabilities. A low level of technological, managerial and scientific skills of the recipient enterprises hinders the process of technology transfer in such enterprises. Therefore, the selection of a suitable technology transfer channel in an industry depended on its technical capabilities.

The significance of appropriate host government's policy as well as support is also a most important condition in ensuring a dominant technology transfer channel in an industry. Unless the host government adopts an appropriate policy to ensure an effective transfer of technology as well as provides the necessary support for adopted technology transfer channels, the local firm is unlikely to overcome many of the obstacles which, impedes the transfer of technology. The appropriate policy may involve localization of personnel and components as well as equity control while the support may come from public funded research institutes.

Finally, there are some industries where, although domestic markets in developing countries are large in relation to the scale of production, barriers to entry are low because the technology is mature and standardized. In such cases, technology imports take place through machinery sales and in other forms such as the movements of entrepreneurs, engineers, technicians and technical literature. Where else, the role of patent, trade mark and turn-key contract is important in a product with relatively new technology in the technology market.