ANALYSIS OF TRANSFER OF TECHNLOGY PRACTICES AND DEVISING A GENERIC ToT MODEL FOR A DEFENCE R&D ORGANIZATION

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ABSTRACT

Technology transfer is a complicated process to handle with. Acquisition of advanced technology is a dire need of Pakistan in order to remain competitive in the global arena. It is an extremely difficult decision for a company to acquire the appropriate technology in the given circumstances. Transfer of Technology (ToT), being a catchphrase in developing nations is least understood area in its true perspective. Consequently, its interpretation and assimilation varies from country to country. At this point of time, no country can make economic development without acquiring sufficient competency in the field of science and technology.

This study is attempted to analyze prevailing practices in the field of transfer of technology practices in a defense R&D organization in Pakistan. The analysis of the contracts of different transfer of technology projects executed reveal that various difficulties have been faced during the transmission and assimilation of technology to the recipient organization. A generic ToT model of processes has been proposed for the smooth transmission and assimilation of international technology transfer in defense R&D setup in Pakistan.

It is also important to evaluate technology transfer programs on regular intervals to determine their success and incorporate lessons learned for future endeavors. The basic reasons to measure technology transfer results are to provide accountability, facilitate the process of technology transfer, and demonstrate the value of a particular technology transfer project. In quest of acquiring technologies, a fine balance is required between the technology, actual requirement, and resource constraint.

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INTRODUCTION

1.1 Introduction

Transfer of Technology is the process that permits the flow of technology from a source to a receiver. The source in this case is the owner or holder of the knowledge while the recipient is the beneficiary of such knowledge. [1] The transfer of technology is a complex multidisciplinary area of technology management involving technology transfers from overseas developing agencies and internal technology transfers. Emanual (1982) states, "a problem of transfer of knowledge and know-how: therefore a people's education. A broad definition of technology transfer is provided by H. Brooks (1966): transfer of technology is 'the process by which science and technology are diffused throughout the human activity'. It can be considered as either transfer of basic scientific knowledge into technology, or the adaptation of existing technology to its new use.

Dore, (1984) defines technology transfer to developing countries as a process that aims at '*getting knowledge that is only in some foreigners heads into the heads of one's own nationals'*. National Aeronautics and Space Administration (1995) defines it as "the process of providing the technology developed for one organizational purpose to other organizations for other potentially useful purposes." Williams and Gibson (1990) defined TT as the shared responsibility between the source and destination by ensuring that technology is accepted (or at least understood) by someone with the knowledge and resources to apply and/or use the technology. [2]

Alternatively, Kottenstlette & Freeman (1971) argue that; technology transfer is a 'global concept to encompass any transfer of a technology from the environment in which it was generated for original use to another, and usually unintended, secondary environment for subsequent application. Gee (1981) considers technology transfer from the application perspective, arguing that technology transfer may refer to the application of the technology to a new use, or to new user for economic gain. Technology transfer can be

described as a lengthy, complex, and dynamic process, whose success is influenced by various factors originating from different sources (Kumar *et al.* 1999).

The event of TT has become known as a significant decision-making concern to developing countries since the recent past. International TT continues to be a key tonic to industrialization and economic growth in fast growing developing countries. At one point in the history of TT, such transfers took place primarily among western nations (Kedia and Bhagat, 1988). In fact the transfer of technology from USA to developing nations has become an important issue during the last decade (Marton, 1986). On the other hand, many developing countries lack the technology and know-how for managing complex, sophisticated, multidisciplinary projects and, consequently, skill from developed countries will certainly continue to be in demand. [2]

In order to understand the technology and its transfer process certain issues need to be addressed. Theses issues include: nature and elements of technology, its relation to scientific and engineering and its socio cultural context; fundamental bases and mechanisms of technological planning systems; internal aspects of transfer process; and mechanism of technology assessment and the process of technology related decision making. Other issues like; required level of capability and strong financial base to undertake the intricate projects may be the hindrance to developing nations. However, by initiating new ToT projects into local industry can lead to prevail over the upfront shortcomings. It has been observed that many local companies are taking advantage of ToT in terms of technical capabilities, skills, knowledge management. Growth of local industry increases due to technology transfer process and consequently helps industry to meet international standards in the relevant technology.

For developing countries, Industrialization is the only means of reaching socio-economic equivalence with western world. The imported technologies from industrialized countries provide the initial base for industrial development in any developing country. International technology transfer has become imperative to achieve global competitiveness and economic growth for developing countries. It should be noted here

that around 60 per cent of the total world output relating to science and technology was produced by only 11 industrially developed countries: UNESCO (1992). [4]

New technology may be acquired in either of two basic ways: by developing it or importing it (M. Sharif 1986). Developing countries import technology for two fundamental reasons: 1) little R&D investment is required, 2) technical and financial risks are very few. There are two kinds of technology transfer occur: vertical and horizontal (Brooks 1968). Vertical transfer refers to the transfer from more general to the more specific. It encompasses processes by which some new scientific knowledge is used into technology thus resulting in some new technology and its new use. Horizontal transfer occurs through adaptation of technology from one application to another. Example is adaptation of military aircraft to civilian air transport. It does not concern with the intended application. [2]

Market structure and channel of technology import are the two most important determinants identified by the in-house R&D studies in developing countries. An empirical study of Indian manufacturing reveals that larger enterprises undertake proportionately less R&D than smaller ones (Kartak 1985). A number of empirical studies, at both industry level (Kumar 1987; subrahmanian 1987) and firm level Pillai 1979; UNCTAD 1983), confirms that firms importing technology through foreign direct investment are much less concerned with the absorption, adaptation and in-house R&D than their counterparts who import technology under licensing agreements. [3]

However, there are many factors that impact TT process to developing countries. The lack of adequate financial and technological resources, low per capita income, unfair income distribution and lack of hard currency (Kahen & Sayers 1995b) are the factors influencing transfer of technology process in most developing countries. Furthermore, outdated educational system, poor research facilities and academic institutions, insufficient professional foundation for researchers are the main problem domain being faced by the developing countries. And as a result, these countries are also suffering from the very serious problem of ‘brain drain’. [6]

1.2 Research Problem

Technology transfer is a complicated process to handle with. It is extremely difficult decision for a firm or company to acquire the appropriate technology in the given circumstances. Technology transfer and its subsequent absorption vary from country to country, from firm to firm and from time to time. Published literature on technology transfer was studied related to numerous industries. The study is comprised of two portions. The first portion serves to analyze the practices being pursued in the field of technology transfer projects in a defense R&D organization in Pakistan. An appraisal of an existing transfer of technology project as to how it was executed in the scope of its documents especially the agreement clauses for the execution of project is undertaken. Second portion proposes a theoretical generic model of processes for ToT to be followed in defense R&D setup in Pakistan.

It is very important to mention here that intended technology to be acquired is a strategic decision that has a long term impact on the survival, growth and profitability of the firm. Selection of technology is not a simple matter of choice at the organization level as the candidate technology is acquired as per organizational manifesto. Choosing a technology is more than just acquiring the physical paraphernalia for producing something against expected costs, benefits and engineering norms.

Several contracts of different transfer of technology projects have been studied in order to find out the transfer of technology channel adopted and the processes carried out in point of fact. It is, therefore, revealed that various difficulties could have been faced during the transmission of technology to the developing countries if vital contract clauses are not taken into consideration. Therefore, entire contract clauses need to be reassessed before its execution as any ambiguity can lead to irreversible damage. This study is attempted to analyze the prevailing approaches in the field of transfer of technology. Any regulatory body and respective policy on transfer of technology is still missing at micro as well as at macro level. For that matter, a theoretical generic model of processes has been proposed for the smooth transmission of technology transfer projects to be followed in defense

R&D organization in Pakistan. It is thus developed by doing research on ToT processes and models already developed by various experts in this field. The constituted body suggested for transfer of technology execution and its subsequent absorption can be helpful in deciding the candidate technology and provide accountability as there is no such system available in Pakistan. The recipient organization solely tackles the whole process of ToT and sometimes substantial financial resources go wasted. Due to non-existent national technological base, there is no one to ask why inappropriate technology is selected and unable to meet the given timelines. There is no standard system for performance measurement of acquired technology that whether the technology enhanced the exports.

1.3 Research Methodology

Transfers of technology projects, in less developed countries like Pakistan, have been considered as the vital means of economic development. For that matter, international technology transfer practices have been explored in a defense R&D organization for technological acquisition and up-gradation. It is therefore realized to address this core area and to develop a clear understanding at first. For this purpose, a comprehensive literature, that is abundantly available, has been reviewed by the help of books, research papers, magazines and internet mainly.

After developing a knowledge base, an organization is chosen where ToT projects have been carried out and doing business in the field of technology transfer. The ToT practices are explored through which modern technology is being adopted by Pakistan. The method used to investigate the target area is a case study as it provides realistic approach by focusing on ToT projects carried out through the channels adopted and/or the agreement types. The documents are explored physically to examine the scope of the projects by discussing with the officials of the R&D facility.

The study is carried out on a local defense industry and analysis is performed on the prevailing practices of technology transfer, strategic management practices. SWOT analysis is also carried out on one of the transferred technology project.

A generic model of processes has been proposed for ToT to a defense R&D organization. For this matter, existing models have been studied and analyzed. A theoretical model is then developed on the basis of previously available models for most appropriate ToT with regard to Pakistan. Finally, some recommendations have been suggested for the smooth transmission of technology transfer to a defense R&D setup in Pakistan.

1.4 Research Objectives

Research objectives are given as follows:

- To analyze the technology transfer practices in a defense R&D organization in Pakistan.
- To highlight the technology transfer disputes come across during the process of its transfer.
- Study of an existing transfer of technology project as to how it was executed in the scope of its documents by studying the technology agreement clauses.
- To propose a generic model of processes for ToT to be followed in a defense R&D organization in Pakistan.
- To make an effort in general to the international technology transfer processes.
- To promote a trend for the future research in this particular field.

Many problems arise in technology transfer due to large number of indirect mechanism involving liaison companies. The importance of technology agreements and implications of clauses in technology agreements for acquisition and development was inadequately treated. While going through the agreement clauses, it is revealed that not much attention was given to theses contract clauses as it should be or according to international patterns. The agreement clauses are taken care of with the passage of time and experience gained thereon.

1.5 Significance of Research

Technology is vital to all developing countries in order to maintain economic development and to promote social, political and cultural spin-off. It provides good understanding and enhances economic ties and prosperity among the nations of the world. This study also provides a selection of indicators related to technology based economic development conditions in the country. It is also intended to highlight the issues, difficulties and problems in Pakistan with regard to technology transfer in the local environment and the role of management in making best use of technology available in order to have sustainable economic development in the country. This study will be helpful to many for future research. It is important for the policy makers to the impact of new technology in forthcoming competition. It is expected that this study shall provide food for thought in order to understand, conceptualize and implement policy appropriate to our country. It can be helpful for senior executives, managers and entrepreneurs in their strategic exercises.

Research significance is as follows;

- Highlights technology transfer issues in local defense R&D setup.
- To urge the relevant authorities towards performance measurement of transferred technology
- Technological self sufficiency will in turn foster economic growth
- Socio-economic progress can be achieved through industrialization

1.6 Scope and Limitations

Technology transfer is a broad subject that covers various types and acquisition methods. However this study is limited to the importance of the technology to the defense R&D establishments only and carried out for academic purpose. The study can help understand the particular subject and provide a strong basis for the impending research endeavors. It should be noted here that this study only targeted respondents from a relatively small

group of professionals who have been employed where international technology transfer is incorporated. The aim was to solicit responses from relevant professionals since this study was concerned with the assessment and respective usefulness of technology transfer processes in a local defense R&D setup. A little amount of research has been done in Pakistan on this particular topic. Only superficial knowledge is available to establish an information base.

1.7 Technology Sources

Generally there are two major sources of technology; *a) Local R&D b) through Foreign countries*. It is neither feasible nor necessary for developing countries to develop all the technology indigenously. They must turn to foreign sources to meet the technological needs of the recurring projects. To get benefits from industrialized and newly industrialized countries on commercial terms, recipient must have ability to evaluate the candidate technology. [2]

1.8 Obstacles to Technology Transfer

Factors like knowledge, know-how, science & technology and management have become crucial in technological development. Transfer of technology cannot be achieved in short period of time. Transfer of sophisticated technology creates major problems for developing countries. At this point of time, due to fierce competition around the globe, developing countries have to absorb the contemporary technology directly. These countries require investment, learning and operational capabilities to achieve this goal. Technology transfer is integral part of continuous development process.

On the other hand, technology transfer can be easily integrated when it takes place between two developed nations. A large portion of input requirement like equipment, skill, information, parts, energy can be easily available in the host country. But in case of developing countries, smooth linkages rarely exist. The necessary support required for the new technology is normally inadequate. Thus a major difference between developed

and developing nations lies in the state of their knowledge bases (M Sharif 1986). Developing countries differ from industrialized societies in terms of their technological capabilities, managerial systems, economic characteristics like market size, tariff protection, per capita income etc., availability of skill, political stability. [2]

Various problems and challenges have been faced in the field of technology by Pakistan. Therefore, to compete in the global arena, it became imperative to develop technological base to safeguard our integrity and sovereignty as a vital interest. Due to inbuilt weaknesses in our indigenous technological capabilities, we had to rely on western world as a compulsion. Technology transfer is the right way forward provided it is appropriately diffused and is pursued as a well organized futuristic plan. There are various projects excelled after adopting ToT from developed nations. The candidate technology becomes liability without logistic support and backup available. It was felt as there was no indigenous base available to back up the technology and there was no institutional process for its absorption due to lack of necessary skill level and infrastructure. The view point is that although the developing countries import new technology and equipment but they have to learn to use these inputs effectively as it is not an easy job. It involves conscious building of technological capabilities in a mix of information, skills and interactions.

It is of great long term importance that the degree to which assimilative capacity can be enhanced in order to upgrade domestic technological capabilities and derive maximum economic benefits from the investment in imported technology. Failure to develop strong assimilative capacity will result in increasing reliance on purely domestic resource as source of new technology, dependence on continual import of technology, combined with less ability to select and master them, and widening of the technological gap.

The current task faced by Pakistan is to ensure maximum utilization of the existing science and technology resources, acquire foreign technology selectively and join the two in such a way that results in both efficient production and gradual increase in domestic technological capabilities. Such management is complex and interactive as the ability to

evaluate and select the foreign technology suitable to local conditions and industrial development strategy is partly a function of existing technological capabilities, as its effective assimilation.

The industrial sector in Pakistan faces a major dilemma today in the absence of a central technology evaluation and assessment institution, policies to acquire and assimilate foreign technology and to coordinate these with domestic technology development have proved difficult to formulate. Interesting figures available from china indicates that only 68% enterprises concluded the successful technology/equipment import in the Nineties. Out of these, only 4% achieved the design capacity, while 40% reached reasonable capacity levels. As far as the supply of domestic inputs is concerned, 40 percent relied on entirely imported components while the remaining 60 percent half achieved 80-100 percent domestic input supply.

A key determinant of the impact of technology input is the speed and efficiency with which technology has been assimilated and diffused. Assimilation i.e. the efficient and rapid mastery, adaptation, and ultimate improvement of technology acquired from abroad through conscious application of domestic, financial, human and S&T resources. It is clearly a crucial factor in the combination of foreign and domestic technological elements. In Newly Industrialized Countries (NICs), the role of rapidly increasing local content is now considered a prominent feature of assimilation activities and in some cases is seen as synonymous with assimilation. Assimilation is seen as a way of achieving independent innovation capabilities being oblivious to the need for future imports of technology in a particular area. There is now a growing realization of the crucial importance of assimilation to the development of national and enterprise technological capabilities is one aspect, and creating an appropriate administrative and economic environment for efficient production is another. Thus it is not the technology but the management of technology that creates wealth. [5]

1.9 Thesis Layout

Chapter 1 starts with the introduction to the subject of study. Regardless of the realization in pursuit of technology transfer in our national interest, it remains a catchphrase and least understood in its true perspective. Therefore, ***Chapter 2*** provides a literature review of technology transfer and its existing models addressing different sectors. Various models have been studied and help developed a basic concept for the purpose of technology assessment processes. This chapter provides comprehensive knowledge on the subject.

It also serves as background information on this study. It deals with the concept of technology, transfer of technology, its various types, acquisition methodology and stages for successful induction, the role of technology in economic development to give the background for better comprehension of the subject. The history of technology transfer in other countries is described. It also contains channels of technology transfer. Characteristics of foreign direct investment, turnkey contracts, subsidiaries, joint ventures and licensing as a channel of technology acquisition are discussed. These aspects are weighed and matched against international trends and drivers by evaluating the experience of some other countries in commercial domains. An analysis of prevailing practices reveal that all these countries have acquired technology through one or a combination of different modes of ToT at one stage or the other. It also transpires that essential ingredient of ToT include the human resource, infrastructure and training aspects which form the basic building blocks without which ultimate objective of self reliance through indigenization would remain hard to pin down.

Intellectual Property Rights (IPR) on global technology transfer process is also discussed in detail.

Chapter 3 details the research method. It also throws light on the possible methods for studying technology transfer from developed to developing countries. This chapter describes the utilized research instruments, data collection and analysis and desired outcomes.

It presents the study carried out on a local industry and analysis performed on one of the channels of transfer of technology. Various channels were explored and effectiveness of the adopted processes and procedures is ascertained. It also highlights the strengths and weaknesses along with challenges and opportunities of manufacturing establishments to draw useful lessons for future consideration.

Chapter 4 generally reviews the identification of technology practices, policies, needs, evolution of technology transfer policy and identification of technology sources in technology transfer perspective in developing countries.

Chapter 5 presents a generic ToT model of processes to be followed in a defense R&D organization in Pakistan. This theoretical model is based on the previously available models available on ToT. It is developed to ensure the smooth transmission of technology from source to receiver.

Chapter 6 summarizes the entire study and recommendations in the field of technology transfer. It is also based on the fact that ToT remains an important means for achieving economic development for the organization as well as for country. We should consolidate our gains by overcoming the weaknesses based on the lessons learnt from own experiences. Its success lies in the developing human resource and their subsequent training and infrastructure improvement.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

Technology transfer has taken international significance in recent age of economic globalization. It has played crucial role in industrial development and promoted competitiveness of enterprises of developing countries in the international market. Many developing countries have experienced incredible change in technological capabilities. It is observed that developing countries have made considerable improvement by developing technical capabilities and their management through technology transfer initiatives. In a typical local set-up, the execution of international technology transfer is a complex process which is influenced by different factors including technology transfer environment, learning environment, host and recipient characteristics. The benefits of implementing advanced technology are quite significant.

Technology transfer has gained significant importance since recent past. It may be due to the political pressures on the developed countries to find way out and to earn margins in order to retain hegemony over the less developed nations. Developing countries normally are in quest of rapid industrialization and practically this means that they must get access to acquired technical knowledge and existing technology to meet the global competition. Technology transfer is need of the time and beneficial also because foreign exchange can be earned through self reliance thus boosting economic condition of the country. A great amount of remittances can be avoided and can be allocated to other sectors for subsequent development. [7]

The transfer of technology caters the transfer of modern technological tools from most advanced to less developed countries to introduce and promote new production facilities which are not present or available in limited usage in the developing economies. The know-how in this regard includes such things as know-how for conducting feasibility and

market studies, how to choose technologies and for engineering design and plant construction as well as the know-how required in the production process itself. The process know-how is sometime patented, copyrighted or at least kept secret by the parent companies. Process know-how probably gets most attention in the literature on transfer of technology.

The transfer of technology from advanced to underdeveloped countries involves more than just exchange of patented material. The technological dependence of the developing countries is visible in areas like engineering design, choice of techniques, management and marketing. The inability of less developed countries to invent new processes and products are due to lack of necessary skill available. Projects in underdeveloped countries should be able to gain the various kinds of technical know-how required in the all phases of a new venture through direct arrangements with consultants, individuals, plant construction companies, original equipment manufacturers. The recipient enterprise should benefit from services available the open market due to competition in the global market.

The most recipient enterprises undertake technology transfers in above way practically. Most transfer of technology occurs through a third party. Multinational Corporation in the advanced countries supplies a part of the technical knowledge which is in demand in the developing country in the form of a package deal. The liaison company is sometimes simply a contracting group. More often it is a company engaged in the kind of production activities which technology is to be transferred. It arranges the supply of know-how either from its own resources or by subcontracting agencies.

Major problems in technology transfer arise due to the large number of indirect transfer mechanisms involving liaison companies. There are two things come to mind about the indirect mechanisms and need to be explored.

a) Why these recipient companies in the less developed countries use these methods of transfer?
b) The other major concern is regarding the incentives and motivations of the liaison companies and why do they intervene?

There are three factors which account for the importance of indirect mechanisms for technology transfer.

At first, there is a huge problem for end user enterprises in the less developed countries as these companies do not hold a technological know how base and sound knowledge to start a new venture involving a great amount of capital. It is also more important to handle the knowledge to use in an economically effective way. In order to do this the technology recipient company must have the excellent managerial and entrepreneurial skills to make decisions on the basis of feasibility and engineering studies. It must be able to manage the experts, consultants, equipment suppliers which are involved in the construction phase. In other words over the problem is not solved by acquiring technology but its subsequent utilization and absorption becomes an issue in this situation. In other words corporate skills are very frequently lacking in enterprises in the less developed countries. Because of these deficiencies recipient enterprises often have to rely on the intermediary role of production companies in the advanced countries.

Secondly, such trend appears to be reinforced in those cases where the process technology is transferred to private ownership. If the process technology is highly differentiated the recipient company will enter into a contractual agreement for the whole transfer process with the process supplier. The supplier will subcontract its equipment supplier and plant erection agencies to install the new production facilities.

Another important factor is where the recipient company is seeking rights to the brand-names and trademarks of the supplier. The supplier often has incentives to control the transfer and post transfer activities as well. The supplier may have comprehensive contractual control over much of the transfer operation in this regard.

These factors describe the fact that many technology transfer processes are actually carried out by various contractual agreements involving production companies in the advanced countries. Direct investments to set up completely owned subsidiaries are one such form of transfer. Licensing agreements are another form of transfer process.

The setup in which technology transfer actually takes place leads to a number of negative consequences. Most of these negative aspects crop up due to mediator use their technological monopolies and these become constraints also. As a result many technology agreements have dimensions which have anti-developmental effect.

The most important clauses which need to be carefully read in transfer agreements are:

(i) Clauses which limit sales of the new product to the domestic markets of the underdeveloped country itself. These clauses reflect the strategic requirements of the multinational companies that dominate in transfer operations. These clauses are intended to prevent competition in third markets.

(ii) Clauses that bind the recipient company to the technology supplier.

There are some problems other than the restrictions. One such problem occurs in the first place for protection of the domestic market in underdeveloped countries. Export restrictions in transfer agreements have no considerable impact on export business of less developed countries in manufacturing sectors and are often included as an unnecessary preventative measure. Anyhow the local enterprises are not competitive at international level.

The suppliers of technological equipments are reluctant to make transfers on regular basis due to erratic behavior of markets in the underdeveloped country. Finally the problem is to choose the appropriate technology and its consequent assimilation. The channels actually followed for the purpose of technology transfer process can limit the possibilities of making a choice of technology in specific application area. The supplier company has

to weigh the costs of its scientists and technicians to produce adapted techniques instead of using them for some innovations which will help to sustain competitive advantages in industrialized markets.

The main concern is to anticipate some uncertainties on various approaches to the subject of technology transfer. Technology transfer policies need to do a more than just simply to start the kind of activity.

A number of the problems encountered in technology transfer operations occur due to import related policies that are not very clear and transfer operations have more positive effects on export promotion if protection policies were more selective. The outcome of technologically transferred products might have some serious reservations in the less developed economies. An effective policy on technological transfer really implies more clearly defined policies on its absorption. It appears hard to achieve and an endless source of political difficulties.

2.2 The Anatomy of Technology Transfer [8]

Technology transfer is not a new phenomenon. A general definition of technology transfer is the movement of technology into new perspective. The two broad categories of technology transfer are; the transfer of commercial assets and the transfer of noncommercial assets. The transfer of non-commercial assets involves the training and the R&D subsystems and is therefore only indirectly related to the production activities. Most technical assistance agreements are transfers of non-commercial assets.

The primary concept of technology transfer was to transform the results of R&D done in the basic sciences into commercial application for the well being of society. This movement of knowledge is now called vertical technology transfer. However, technology transfer is now universally used to mean the movement of technology from one country to another which is also called horizontal technology transfer.

In the past the direction of technology transfer was often from East to West. Now a days most of the debate in technology transfer centers on the North-South technology transfer. It must be kept in mind that technology transfer between industrialized countries is of a greater magnitude. The main sources of technology are the US, UK, Federal Republic of Germany and Japan at present. The main channels used are the transnational corporations (TNCs) which account for 80-90 per cent of technology transfers.

The various formal methods used in technology transfer are shown in figure 2.1. Direct forms of transfer include the direct purchase of capital goods and equipment, training of manpower in specific technologies, and hiring of foreign experts and consulting firms. The indirect mechanisms consist of the establishment of completely owned subsidiaries of foreign companies, turnkey construction of plants and facilities, joint ventures with local companies, and shift in national policy on the industry issues and the policies of the technology suppliers. There are no set patterns or established rules for doing best deal. Final analysis is that the technology transfer is the result of a negotiation process. The most crucial element is the ability to bargain in order to get the best terms including the assurance that technology will really be transferred.

The history of technological hegemony is traced back to empirical scientific research done by only few transnational corporations of few countries. Out of the 110 significant innovations identified by the OECD in the twentieth century, 60 per cent originated from the US, 14 per cent from the UK and 11 per cent from Germany.

It is seen that technology transfer is taking place at rapid pace in the developing countries of Asia. The experiences of Japan and the newly industrializing countries of Asia suggest that technology transfer plays an important role in the process of industrialization. This is a bitter reality and a point of concern that most modern technology is being controlled by few firms from a few countries. The developing countries have become captive clients to the dangers of monopolistic pricing, technological dependence, and obsolete technology.

It is a fact that technology transfer has a political dimension too because the technological independence will in turn enhance the economic system of the country. The basic dilemma of the third world is the existence of a modern, urban, and affluent sector along with rural and poor part. This is due to the result of introducing capital demanding industries into an environment of unemployment and poverty with a feudal driven economy. Unplanned technology transfers continue to highlight the worst features of the third world. It is not surprising that attempts to manage the terms of technology transfer will be resisted by local and international vested interests.

It can be assumed that technology transfer can be an effective instrument to enhance the foreign policy of a developed country. On the other hand, the open technology transfer to strategically vital countries like North Korea and Turkey suggests that there are certain other applications are in progress other than commercial aspects. In the process of technology transfer negotiations, the developing countries have to take these hidden factors into consideration while in the transaction process. One of the dangers that come across is that the technology transfer sometimes leads to continued technological dependence.

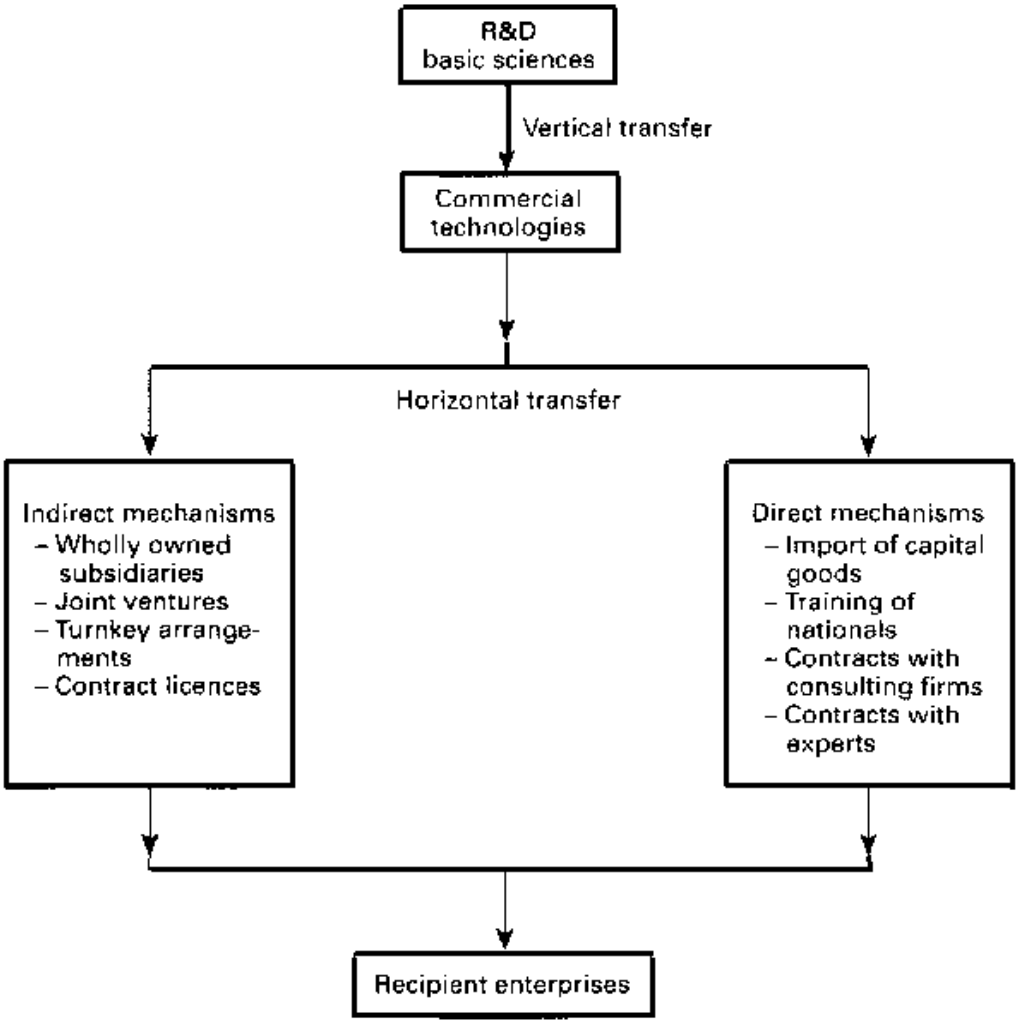

Fig 2.1: The Anatomy of Technology Transfer [8]

2.3 TECHNOLOGY TRANSFER: AN OVERVIEW

Transfer of Technology (ToT), being a catchphrase in less developed nations is least understood area in its true perspective. Consequently, its interpretation and adaptation varies from country to country. Therefore, technology pursuance becomes misdirected within the given resource at times. At this point of time, no country can make economic progress and prosperity without acquiring sufficient competency in the field of science and technology. It is more important for countries like Pakistan to understand its true perspective and intricacies so that best possible dividend can be drawn from it. The importance of international technology transfer for economic development can hardly be overstated. Both the acquisition of technology and its diffusion foster productivity growth.

This portion mainly describes the concepts of technology, technology transfer, and a brief history, its various types, acquisition of methodology and stages for successful induction, the role of technology in economic development to give the background for better comprehension of the subject. The history of technology transfer in other countries is described. This chapter is designed to provide background of concepts discussed in this study.

2.3.1 TECHNOLOGY

Technology can be defined as a study of human use the environment to meet their needs. Technology is one way that organizations use knowledge and experience to achieve efficient, effective and timely use of its available resources (Meissner, 1988). Technology is defined as the methods that are necessary to carry out or improve upon existing production and distribution of goods and services (Santikarn, 1981). Technology is the understanding and application of scientific knowledge, technical information, know how, exclusive manufacturing equipment, end products and essential test equipment to research, develop, produce, and use state of the art items or systems. Technology transfer

is a multidimensional process through which innovation is disseminated. Technology has become a key to competitiveness and an engine for economic growth. [9]

2.3.2 KNOW-HOW

The acquired knowledge or technical skill regarding how to do things. It consists of not only theoretical knowledge but also practical knowledge which subsequently can be incorporated into physical state where it can be used in production operation of an industrial unit. It is assumed to be tested, improved and perfected in supplier's enterprise prior to being communicated (WIPO, 1977). [10]

2.3.3 TRANSFER OF TECHNOLOGY

It is the process that permits the flow of technology from source to receiver. The source in this case is the holder of technology and knowledge while the recipient is the beneficiary of such knowledge. It is a planned process which trigger off by technological gap. The source can be an individual, a company or a country.

International technology transfer caters the transfer across national boundaries usually from an industrialized country to developing country. Another form is the intra firm transfer in which transfer occurs from one industrial sector or firm to another location. ToT is a multifaceted process involving intellectual property rights, know how, trade and technical policies, investment flow and competition policies. [9]

2.3.4 CHANNELS OF TECHNOLOGY TRANSFER

Numerous channels exist through which ITT may occur. Most of the technology transfer has been between developed and developing countries through commercial TT by private sector. Trade in goods and services is one. All exports bear some potential for transmitting technological information. Imported capital goods and technological inputs can directly improve productivity by being used in production processes. Another

channel is foreign direct investment (FDI). Multinational enterprises (MNEs) generally transfer technological information to their subsidiaries. [11]

Technology licensing is another major channel. This may occur among firms, joint ventures, or between firms. Licensing and FDI are often substitutes. Which form is preferable to technology owners depends on many factors, including the strength of IPR protection. Patents, trade secrets, copyrights, and trademarks can all serve as direct facilitators of knowledge transfers.

The technology transactions in the market can be prevented from progress by three major problems:

i. Partial information
ii. Market power
iii. Peripherals

i. Partial Information

Technology transfer entails exchange of information between the host and receiver. The host cannot fully reveal their knowledge bank for the trade agreement creating a well known problem of vague information to the buyers and the latter one cannot fully determine the value of the information before buying it due to lack of knowhow and technical skills. This can lead to large transactions costs that suppress the market based technology transfer. In the international perspective information problems are very much stern and the enforcement of contracts is more difficult to achieve. There is a theory of the multinational firm that such firms establish foreign subsidiaries because of the difficulty of using markets to make profit from their proprietary technologies. [11]

ii. Market Control

Owners of new technologies have substantial market control resulting from lead time and patents and intellectual property rights. This suggests that the price of technology will

exceed the subsidiary cost. This deviation between price and cost allows innovators to profit from their innovation and it implies a reduction in national welfare of those importing technologies.

iii. Peripherals

The costs and benefits of technology trade must be integral part of the economic system and subsystems for both of the countries involved in direct trade. A major share of benefits to recipient countries of ITT is likely to crop up due to other side effects. Positive side effects exist whenever technological information is dissolved into the wider economy and the technology provider cannot take out the economic value of that diffusion. Side effects can occur in the form of imitation, trade, licensing, and FDI.

These market failures indicate a potential for policies to increase welfare by encouraging ITT. To make it more effective policy must have to take care of the incentives of private agents that possess innovative technologies in the right way. Actually, the potential for welfare improving policy may not be realized due to mistakes.

2.3.5 General Channels

This type of transfer generally includes education, training, publication, conferences, study missions, and exchange of visits and forms the elementary level of transfer. The technology transfer is done unintentionally and may proceed without continued involvement of the source. Information is made available in the public domain with limited or no restriction on its use. The information is harnessed by users and applied to their purposes. [12]

2.3.6 Reverse Engineering Channels

There is no active contribution of source in this case. The beneficiary of technology is capable enough to either crack the code in terms of any software or understand the design

concepts of technology and develop the capability to duplicate it in same way. This is possible provided the host has the knowledge to do this or employs personnel of source keeping legal aspect of intellectual property rights in view. The product design and development is achieved by taking an existing product to pieces and analyzing its parts. The main drivers in these types of technology transfer tend to be acquirers by taking an active role in searching, identifying, and obtaining available knowledge without relying on assistance from any sources of that knowledge.

2.3.7 Planned Channels

In this situation, transfer is done intentionally through a process and with the consent of technology owner which can be implemented through single or combination of its various modes like foreign direct investment (FDI), Licensing, Joint venture, Turnkey projects, and Joint R&D projects.

Following planned channels have been used for international technology transfer. [9]

i. ***Licensing*** enables the recipient to get the right to use technology from the host depending upon the payment terms and conditions set upon.
ii. ***Franchise*** is also a form of licensing. In this channel, the host continues to support the recipient in terms of raw material supply, marketing and training. This channel is most commonly used in service organizations and food chains.
iii. ***Joint Venture*** comes into force when two or more companies combine their interest to share knowledge and resources to develop technology or product. International joint ventures are frequently used by recipients to acquire technology and by sources of technology to gain access to local markets and distribution skills.
iv. ***Turnkey project*** is equivalent to buying or selling equipment but on the larger scale of an entire plant. A country buys a complete project from another country and the project is delivered ready to operate.
v. ***Foreign Direct Investment*** is done by multinational corporation MNC that decides to operate overseas. Technology, in this case, remains within the

boundaries of firm and completely controlled by the same firm. This type of investment is advantageous for both the parties. Investor gain access to cheap labor force, natural resources or market while on the other side the host receives the technological knowhow, employment opportunities, infrastructure development, tax advantage.

vi. ***Technical consortium and joint R&D project*** involves the collaboration of two or more entities in a large venture as the resources of one are inadequate to affect the direction of technological change. This type of venture takes place between two countries or conglomerates. Both nations need to combine their technical and financial resources in order to develop an extensive technology. For example a consortium was made between France and England to develop supersonic plane.

American industry has also changed their way of doing business, moving through continuous competition and closed technology mode of operation to more flexible mode. Examples are cooperation between IBM, Apple and Motorola to produce power chip for PC's.

2.3.8 Technology License Agreements and Joint Ventures

Technology transfer has been taking place on a significant scale through licensing agreements and joint ventures. There has been a rapid growth of joint ventures, encouraged by Government restrictions on foreign investment and foreign trade or the perceived advantages of such ventu5res. When foreign capital participation in joint ventures is below 50 per cent, technological agreements assume considerable significance. [12]

Moreover, international technology transfer can be distinguished between horizontal and vertical transfers. Horizontal technology transfer consists of the movement of an established technology from one operational environment to another (for instance from one company to another).

Vertical technology transfer, in contrast, refers to the transmission of new technologies from their generation during research and development activities in science

and technology organizations, for instance, to application in the industrial and agricultural sectors.

2.3.9 Non-Commercial Channels

Another way of transferring technology to developing countries is through non-commercial channels, including initiatives and development projects taken by international organizations, developed-country governments and aid agencies and nongovernmental organizations. For example, international research centers like the Consultative Group on International Agricultural Research centers transfer technologies to local research institutes, farmers and firms in developing countries. Development agencies in industrialized nations can also help finance training, equipment purchase etc.

ITT flows depend on many factors, including proximity to markets, size, growth, competition conditions, human capital basis, governance, and infrastructure. Many of these variables are affected by policy. Determining the optimal policy to maximize ITT is difficult. Despite an abundance of research on the channels of ITT, there is still much uncertainty regarding the extent of market failures and potential spillovers associated with alternative channels of ITT, greatly complicating the identification of good policies.

Licensing is an important source of technical transformation, successful transfer generally requires capacity to learn and adaptive investments by local firms to apply technologies. Poor countries are most likely to achieve these gains by taking advantage of mature technologies in the public domain or available cheaply. Thus, policy could aim at improving information flows for domestic enterprises about such technologies.
A secondary priority in low-income nations could be programs to build skills and R&D capacity. FDI is likely to be particularly important for LDCs. The weak investment climates that prevail in many of these countries may justify a temporary case for encouragement of FDI inflows to these countries.

2.4 ToT Trends – Other Countries

Before reviewing the internal practices of technology transfer, it is imperative to carry out an appraisal of how some other countries have done so far utilizing its various modes. These countries have shown remarkable economic growth due to their conscious development policies, timely structural reforms, conducive environment for technology advancement, and emphasis on human resource development. Chinese experience has been given more importance due to its conspicuous progress. While other countries are included in order to draw important lessons and implications of application to local environment.

2.4.1 CHINA

Progression of Chinese industry is an inspiration for any developing country but in particular for Pakistan as there is a large commonality of circumstances, essentials and compulsions which serve as a way forward. China has set up a special fund to encourage the import and export of technologies, besides R&D projects of a specialized nature in new areas. China's extraordinary economic growth is inspiring research from a wide spectrum of fields to explain the main drivers for growth and compelled peoples to scratch heads.

The Chinese government is currently emphasizing on developing indigenous scientific and technological capacity. In order to speed up the strengthening the base of science and technology capabilities the government is promoting extraordinary measures designed to increase the diffusion of technology within China. Special attention is being given to strengthening the links between the academic, industrial, and defense sectors. In addition, the government is experimenting with policies commonly used in the West that encourage decentralization and the taking of local initiative. [13]

Bin, Guo (2008) analyzed the Chinese manufacturing enterprises as follows;[14]

“Through an industrial analysis of Chinese large and medium sized manufacturing enterprises over the period of 1996–2001, this article investigated the direct and interactive contributions of four technology acquisition channels to industry performances in terms of innovation performance and productivity. These channels include indigenous R&D, foreign technology transfer, intra firm technology transfer, and inter industry R&D spillover. It is found from an evidence of an important role of inter industry R&D spillover in shaping and improving industry performance in China, which has been neglected by previous empirical studies concerned with Chinese industrial firms. The empirical results indicate that inter industry R&D spillover and foreign technology transfer make significant contributions to both labor productivity and the level of total factor productivity in Chinese manufacturing industries. It is also come to know that indigenous R&D and inter industry R&D spillover have a balancing relationship in shaping innovation performance and total factor productivity in Chinese industry and that indigenous R&D relates to foreign technology transfer as a complement for labor productivity. Finally, on the mixed results among existing literature in the context of developing countries, this article argues that the commonly followed strategy in technology development, combined with government regulations will play an essential role in determining the relationship between indigenous R&D and foreign technology transfer”.

Even though China's concern with technology transfer is very recent but it appears that the new technology transfer policies are having an immediate positive effect. Attempts by the China to acquire foreign technology are significant and well known to the world. A basis of its commercial relations with Western countries is the acquisition of machinery and know-how from the scientifically and technologically advanced countries. It is also investing heavily in strengthening the scientific and technological capacity of its manpower pool by sending tens of thousands of students abroad to study scientific, technological and managerial subjects. A great amount of attention has focused on the international transfer of technology to China and very little is known in the West about China's large scale effort to enhance the diffusion of scientific and technological capabilities within the borders of the country. In examining technology transfer within

China we must always keep in mind one very important great fact that there was little or no technology transfer in China from the middle 1960s until the late 1970s and early 1980s.

On the one hand, China's state-owned enterprises are characterized by state coordination, bank financing, insulation from the stock market fluctuations, and incremental productivity-enhancing innovations. On the other hand, China's private enterprises are characterized by private ownership, hard budget constraints, profit maximization, and more risky radical innovation. The boundary between the state sector and private sector is clear. This dual system is contrasted with those in liberal market economies like the US and the UK and those in coordinated market economies like Germany and Japan where only one system dominates.

With regards to defense industry, Chinese concentrated on reorganizing the defense R&D and industrial base to integrate civilian and military industry. Already established industrial base helped their industry to develop weapons suitable for international arms market and exports to friendly countries. It was followed by pursuance of technology transfer and co-production agreements with western defense companies. Co-Production of Rolls Royce engine in 1995, inflow of Japanese composite materials, high temperature furnace from Germany, high precision machine tool from US are some of the examples.

It was also realized that another reason for lagging technology was lack of coordination between research institutes and production enterprises. This was overcome in 1985 through "Resolution on the reform of the science and technology management system" to redirect science and technology towards economic progress. Cooperation among universities, research institutes, and production facilities was emphasized. Chinese industry was still behind in technologies like space and electronics but it has now started import of selected technology from west. Communication satellites such as Chinastar, and ChinaSat, co-manufactured by M/s Hughes and Loral of US, computer switching components, high temperature furnaces are few examples in this regard. [15]

2.4.2 SOUTH AFRICA

South Africa is another example of successful model of ToT. Department of Defense (DOD) and defense related industry has been the largest investor in R&D in South Africa. It has shown that defense related equipment can be used for successful civilian applications and in line with the international trends. This has also shown significant value addition and contributed to growth in both technology and returns in overall economy of the country as a dividend. Government is determined to develop R&D setups to gain maximum advantages of ToT for its subsequent novel applications. The establishment of these centers is achieved by linking of private, public and academia with the objective to enhance the advanced technologies.

The government is playing a pivotal role in ensuring that technology transfer is facilitated and promoted by coordination of its various departments. Department of Trade and Industries (DTI) looks after the technology transfer programs. The aim is to assist companies to find out technology, negotiate agreements and finance technology and also assist developers of technology to market their technology. Private sector is also playing a vital role that facilitates a large proportion of technology transfer through normal market mechanisms and is generally the holders of intellectual property related to specific technologies. [16]

An example of how technology transfer is facilitated in the energy sector is presented. South Africa's energy economy is largely coal based. Approximately 75% of primary energy comes from coal and it is 92% of Total electricity generated. Hydro, Gas, Nuclear and Renewables are other energy resources. Successful technology transfer takes place only when priorities of relevant sector coincide with national policies and requirements. Eskom-Shell Homes Initiative is the perfect example of successful technology transfer. The purpose was the electrification of remote areas. These two companies joined together to meet the program objectives to provide non-grid electricity substituting it by photovoltaic systems. A joint venture company was established between these two with an intention to install 6000 systems within a period of 12 months. Both companies loaned

50% of required capital to Joint Venture Company. It was successful as the need was there and aligned with national and regional priorities. [24]

2.4.3 **THAILAND** [17]

Thailand has successfully acquired and adapted foreign technology to build its productive capacity and integrate into the global economy. The Thai economy grew annually at an average rate of between 7.3 per cent and 7.8 per cent during the last four decades. The rapid economic growth played a key role in reducing poverty, and increasing industrial output and exports. The gross national product per capita increased 35 times between 1961 and 1998. The electronics industry has been crucial to the growth of manufactured exports. Electronics account for about 30 per cent of Total exports. For example, computers and computer parts and integrated circuits were the top two major export items and accounted for about 11 per cent and 5 per cent of the total export value in 2002.[18] Currently, Thailand is among the top five major exporters of computer related products and a major player in the global market for several products such as hard disk drives, keyboards and printed circuit boards.

To see an example of these modern international policies in action, we turn our attention to Thailand's experience in international technology transfer. Thailand had no laws regarding patents until its Patent Act of 1979. Thailand, a developing country during that time, clearly favored patents as a medium for economic growth rather than a source of legal rights for inventors and these ideals were reflected in the Patent Act. The Act limited patents exclusively to inventions of industrial application. This meant machinery and electronics and effectively excluded pharmaceuticals from patent protection. [19]

After 1979, a trickle of foreign direct investment mostly from the United States started to make its way to Thailand. Since by western standards, Thailand's patent laws were still quite weak, the technology transfer occurred was of very low quality because companies could not risk bringing advanced technologies into such a fragile legal environment.

However, Thailand became quite dependent on technologies transferred from the western world.

Drug companies in the United States were furious over their exclusion from protection in Thailand and filed a complaint with the United States government in 1989. Subsequently, the government opened an investigation into the matter and put heavy political and economic pressure on Thailand to amend its laws in 1990. Members of Thailand's government were reluctant to comply but had no choice because of the threat of trade sanctions by the United States as Thailand depended upon heavily for modern technology.

In 1992, Thailand enacted Patent Act Number Two which provided much stronger international patent protection. Specifically as a result of pressure exerted from the United States. The Act expanded the domain of patentable subject matter thus increasing the duration of patents from 15 to 20 years and gave stronger enforcement rights to patent holders, and extended patent protection to drugs patented after September of 1992. The protection of drug patents was later extended to include those patented after 1986 in an effort to pacify the still unsatisfied pharmaceutical companies of the United States. [20]

After the second patent act, Thailand experienced an increase in technology transfer and FDI. However, most ventures to date have been turnkey projects where technology is imported and controlled by foreign experts for a limited purpose. As expected, this has failed to promote growth in domestic technology R&D.

Thailand has taken several other initiatives to attract foreign technology and investment. One such initiative was creation of Board of Investment to reduce the risks associated with investments, to reduce initial investment costs, and to improve the overall rate of return on investment. Foreign firms which engage in investment supported by the board of investment are eligible for special benefits including permission to bring foreign technicians and experts into the country and a big reduction in import tariffs. However,

with this initiative it seems that Thailand has again failed to address the extremely important issue of facilitating the growth of domestic R&D. [19]

The government policy shows that they do not understand that meaningful technology transfer requires not only that the recipient acquire technology but also that the recipient accumulates the knowledge necessary to master the technology. In other words, there should be market mechanisms by which there can be a transfer of knowledge to the private sector, as well as technology. The need for this knowledge transfer is evident in Thailand was the technical level of expertise is much lower on the receiving end than on the providing end. [17]

Since the government's policies do not address this issue so Thailand remains to critically dependent on technology from industrialized nations. The long term success of Thailand's domestic high-tech industry depends upon the foresight of their leaders to find ways to assimilate advanced external technologies into their domestic research community so that they may build up a necessary base from which to grow their own ideas and technology. Consequently the international policies regarding intellectual property rights are of little help in achieving these goals.

2.4.4 SINGAPORE

Many lessons can be learnt from Singapore successful efforts for economic development. The Prime Minister Lee Quan Yu presented essential basis for development during leadership meeting held in Singapore in November 1993.

i. Establish and maintain the clean and effective government that is well respected by the people. Eliminate corruption by rewarding officials adequately.
ii. Avoid internal squabbles for national unity.
iii. Build on areas of strength.
iv. Encourage savings to increase investment and avoid external debts.
v. Encourage local industry to create economic opportunities and keep people from emigrating to large cities.

vi. Do not waste funds on huge projects.
vii. Encourage investment by both small investors and multinationals.
viii. Promote education
ix. Develop strategies for technology transfer.

Singapore has become a regional business services hub in Southeast Asian region. It selected niche industries for specialization including electronics d computers, shipping, petroleum refining and aerospace industry (Wong 1995). It also serves as regional marketing and technical support center, business and financial center, and regional headquarters for multinational companies (MNCs). [9]

2.4.5 JAPAN

Although Japan has achieved technological self reliance but it is not playing leading role in all fields of technological development. The institutionalization of science and technology has been occurring since World War I and governments of both the developed and developing countries spending tremendously for the promotion of technology. Japan has specialized for improving people's lives, for commercial purposes. [21]

2.4.5.1 Technology Development Policy

Nakaoka (1986) points out surprising similarities to development in the west in tracing the history of modern technology in Japan. Japanese technological development has been unique and it constitutes a part of a worldwide trend in technology development and therefore no country need follow rigidly the particular developmental pattern of any one country rather each should choose the one most suited to its special needs and conditions. Focusing on the Japanese iron manufacturing and cotton spinning technologies, Nakaoka concentrated on management, labor, supporting technologies, and related services. He examined Japan's lag in comparison with the development stage of iron manufacturing technology in the West when Japan started and how it caught up with the West. He emphasizes that the existing large stock of skills and accumulated technology in Japanese

traditional iron manufacturing was of critical importance in spite of the fact that the scale of production was small and equipment was primitive.

2.5 Analysis of ITT Models

A large amount of published literature is available on the ITT processes and various models have been presented addressing different sectors including manufacturing and business. The objective of this portion of the study is to develop basic knowledge for concept building.

2.5.1 The Mexican Model [22]

The model produced for technology transfer with a view to address the recipient of technology. Technological explosions have been witnessed as the time is passing and lots of indigenous efforts have been made to attain self reliance in technological field of science and engineering. This model was envisaged from a review of existing literature in the field of technology transfer. This model is intended to address the technology transfer and innovation environment in the market of Mexico and also to provoke the research and incubation centers. The model shows no linkage between academia and industry and to achieve indigenization, this gap must be plugged in. Different mutual academia-industry programs have been in practice but these are insufficient for making rapid progress. These programs have to meet local as well as global market needs. This model is also intended for technology incubation centers to develop basis for the new technology development and its subsequent novel use. However, it is not only the responsibility of the academia and industry to accelerate the pace of such activities but the government should play main role in order to promote the indigenous capabilities in technology and scientific knowledge. The typical technology transfer model for most Mexican companies is presented in the figure 2.2

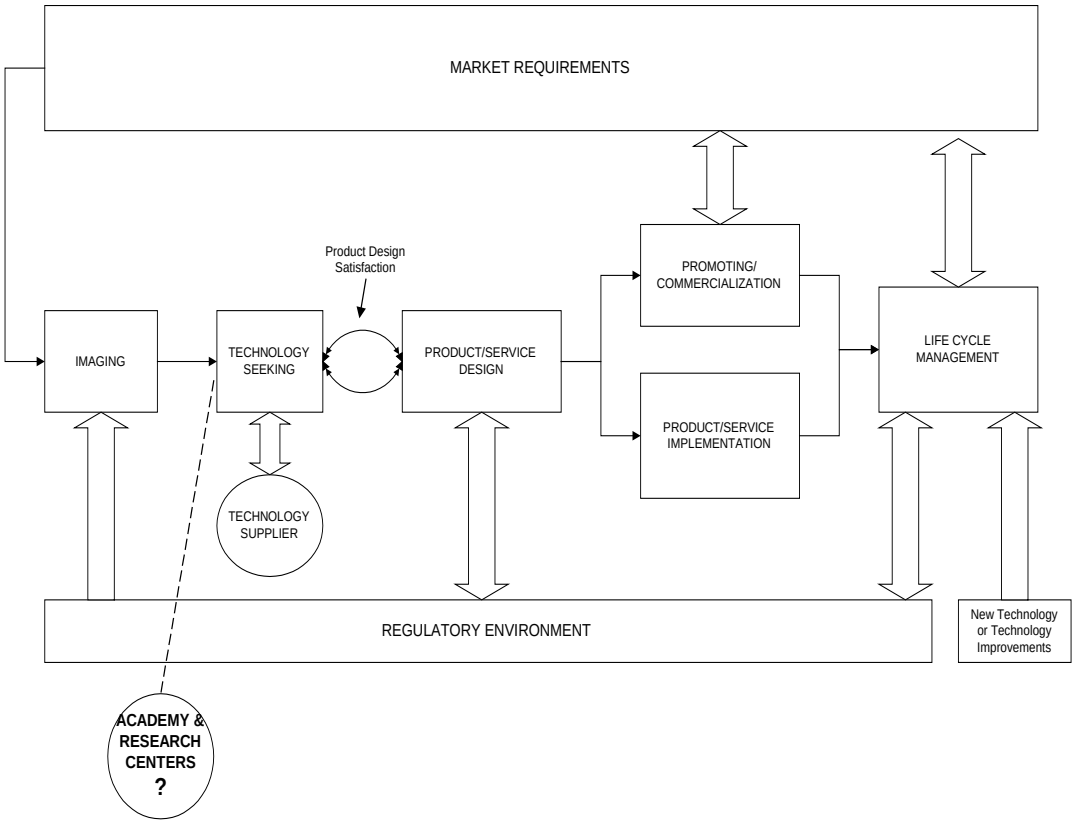

Figure 2.2: Technology transfer model from importer view point [22]

This model provides a generalized concept for technology transfer for firms in Mexico.

- *Market:* Customers drive the market for subsequent use of their unsatisfied needs. The needs range from the very basic one to so intricate and sophisticated as available in any developed country with a good understanding of the product market.
- *Imaging:* Imaging is the next stage according to model. Customer needs as well as political and economical aspects are considered in order to anticipate the product feasibility once solution and process is defined.
- *Joint venture* is in vogue in Mexico between the local enterprise and the foreign company. Foreign company provides the core technology and its respective training while the local entity takes care of administrative aspect including human resources, skills, taxes, finances, etc.
- One of the very important aspects is the *naturalization* of the technology. The candidate technology must fulfill the market requirements and regulatory aspects such as technical specifications and security standards set already. So there is an important loop going back and forth until the technology is ready for Mexican conditions.
- *Commercialization* is the next phase in case of final product and implementation of the end product starts. When the technology employed is used only to fabricate sub system and it is ready for its subsequent integration into main system, then it is said to be implementation stage of such technology.
- It is very important to evaluate the technology at every stage so that customer needs can be addressed and any modification can be made through customer feedback. Technology is either a final product or a subsystem to a main system. So when needs are not being fulfilled, naturalization loop should be considered again.
- *Life cycle management* is the final step here. It is concluded here that product, process and needs must be estimated all the time. When needs change dramatically or any new opportunity arises, loop back to start the cycle is

considered. Application of existing technologies to its alternate use is a good opportunity.

2.5.2 **Prashant Salwan (2005)** [23]

Prashant Salwan addressed the issues regarding technology transfer and its management in strategic organizations. TT is a complex process from overseas countries and also with in the country from one organization to the other. Technology comprises of four main essentials: facilities, abilities, facts, and frameworks. Specifically in case of strategic systems, even developed countries would prefer to be self sufficient in order to handle intricate technologies with financial prudence. Still foreign policy of developed countries use technology transfer as greatest weapon to maintain their hegemony over the less technologically developed nations. At this point of time, developing countries must pay attention towards indigenous development in the field of science and technology. Effective teamwork is required to bridge the visible gap in research and development to achieve the maximum outcome. Prashant provided a generic plan of technology transfer development for large production setup. The plan is shown in the figure 2.3. [23]

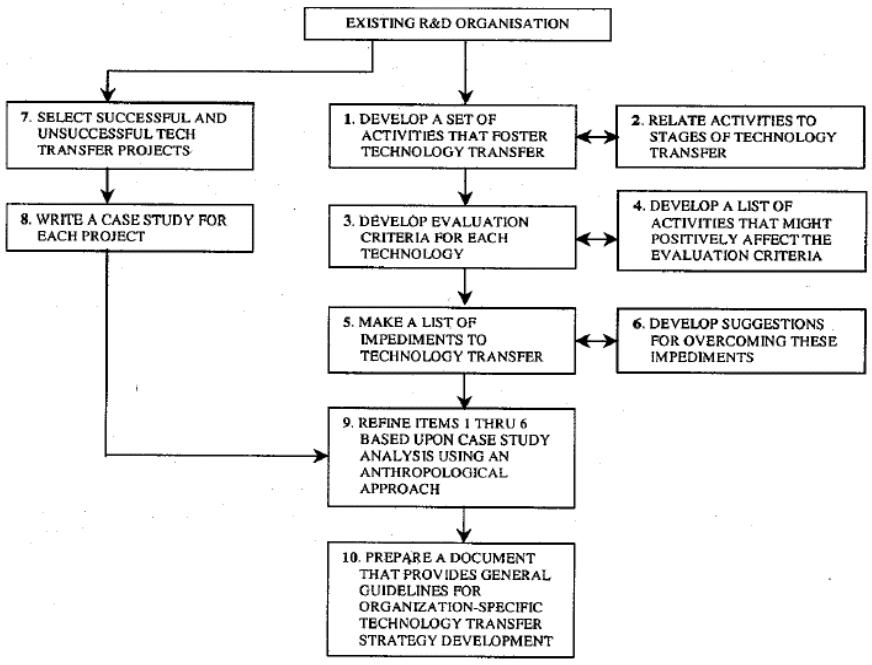

Figure 2.3: Technology Transfer Development Plan [23]

In order to apply the above approach, seasoned professional are required with practical knowledge of project management. Integrated guided missile system development program (IGMDP) is one of the most successful technology transfer programs in India.
The objective of the program was to develop the most modern missile system with respect to performance at the time of operation. This program followed the most up to date development process in order to remain competitive in the said technology. The whole team worked with complete devotion and dexterity to achieve the first milestone in the form of first indigenous missile after successful test and trials. Particularly, developing countries have been subjected to security challenges due to hegemonic attitude of western world. Therefore, all policies have been directed to safeguard territorial integrity and sovereignty as a vital interest. In a technological environment, all the stakeholders: R&D organization, industry, and user must be involved throughout the entire process. The major test of competent professionals is to find the optimum solution for the incomplete system and suggest further modifications and recommendations to mass production. Effective management system can lead to successful development. A program manager should recognize the fundamental principle that systems acquisition is an industrial process which demands both, an understanding of that process and the implementation of basic engineering disciplines and their control mechanism. [25]

The authoritative behavior of the US can be well understood by considering the case of UAE, for which access to source codes of the advanced capability F-16 D Block 60 fighter aircraft’s advanced avionics systems made restricted. The development of 80 fighter aircrafts was being funded by UAE worth of $ 7 billion plus. This is the clear example of dominant attitude of US towards developing countries. Political cum technological exploitation has always been involved in technology transfer in strategic systems.

Still, most developing countries have been unable to develop those intricate technologies which were given to them through proper license for subsequent mass production. Financial constraints, geopolitical compulsions and technical difficulties render the concept of self reliance. A delicate balance is to be struck between technology, actual

requirement and resource constraints. Maximum benefits can be obtained by collaborative efforts of seasoned professionals of strategic concerns.

2.5.3 **Philip L. Gardner** [26]

The research of Gardner followed from extensive previous research in the field of international technology transfer and provided a framework for technology commercialization. The current century is driven by technology and it has been globalized. Contemporary knowledge was not easy to acquire in past as it required huge investment. Globalization has removed these fences and made its access possible to all in the globe. This has provided a fair chance for everyone to play around.

The major natural resource that will drive economic development in the next century has been widely identified as technical knowledge (OECD, 1996; World Bank, 1997). It means that future economic achievement can be made through global technical knowledge. Through globalization, equal standards of living can be enjoyed throughout the world.

The proposed approach require a paradigm shift, away from commercial and economic models of technology transfer, to models that centre around technology stock and a global knowledge network, (Gardner and Douglass, 1998), illustrated in figure 2.4. [26]

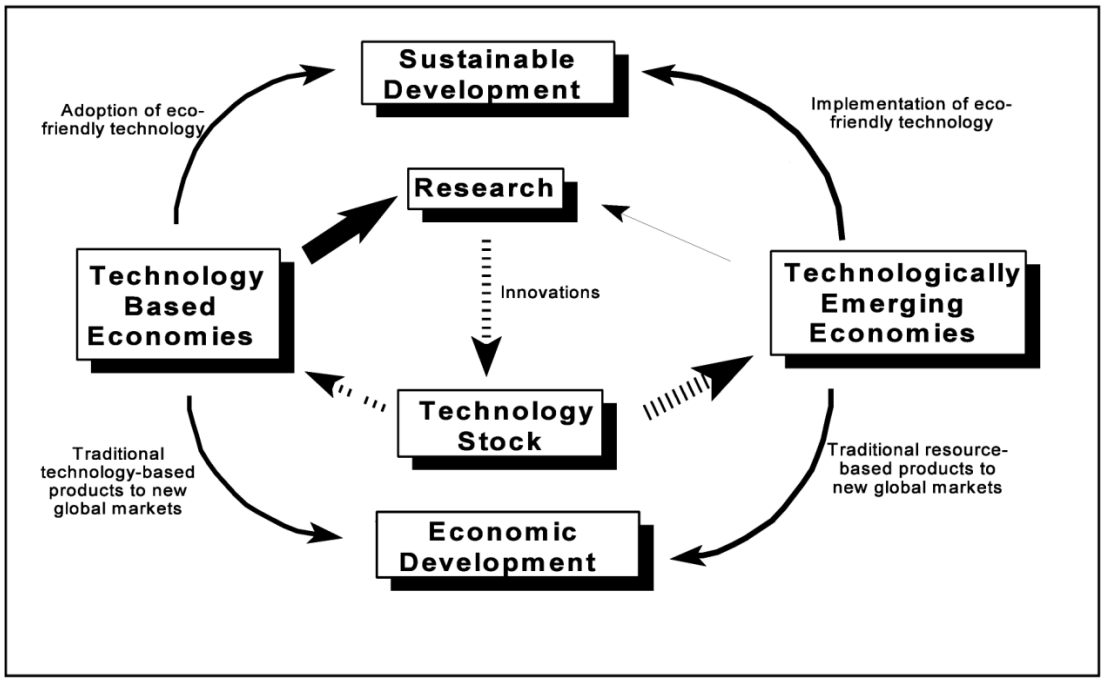

Figure 2.4: Model for global economic and sustainable development [26]

In previous models, stress was made on knowledge transfer from source to receiver. Gardner's research undertook TRIUMF, a National research laboratory for sub-atomic physics research, as a case study. The main focus of the TRIUMF was to commercialize technologies throughout the globe. It provides services to different companies and research laboratories almost every corner of the world. It has developed numerous links with research institutes around the world.

International technology transfer has become imperative to sustainable development in current scenario. Gardener stressed to go away from domestic economy to global marketplace. Emerging economies can get benefit from technology commercialization and efficient technologies will help the global market to attain economic growth and better life style. Economic and sustainable development can be achieved by introducing established technology based products into new global market and put the most modern technology into practice.

2.6 International Technology Transfer to India

Internationalization of technologies and production is becoming a common phenomenon for attaining and retaining the global competitiveness. Technology is an important ingredient of the development mix and an important aspect of the international economic gap is the technological gap. On the other side the technological backwardness and a slow pace of technological progress generally characterize the developing countries, the advanced countries possess a huge stock of technology and fast technological progress. Technology transfer is the term used to describe the processes by which technological knowledge moves within or between organizations. International technology transfer refers to the way in which this occurs between countries. Transfer of technology from the developed to the developing countries, there, is a necessary measure to speed up the pace of the economic development and modernization process in the low developing countries. [12]

The transfer of technology to developing countries is a major area of concern in the discussions on the establishment of a New International Economic Order (NIEO). It is given so much importance that it is considered that a New International Technological Order should be incorporated as an integral part of the NIEO. [27]

The transferred technological knowledge was in various forms. It can be embodied in goods including physical goods, plant and animal organisms, services and people, and organizational arrangements or codified in blueprints, designs, technical documents, and the content of innumerable types of training.

All these forms of knowledge may vary in a further important way. At one end of the spectrum, the transfer involved can be concerned with the knowledge for using and operating technology. At the other end, it can be concerned with the knowledge necessary for changing technology and innovating. Transferred knowledge may involve the many different kinds of design and engineering knowledge required to replicate and modify technologies. [28]

Technology transfer is an important means by which developing countries gain access to technologies that are new to them. For example, the acquisition of foreign technologies by East Asian newly industrialized countries associated with domestic technological learning and efforts have been made to accumulate the capability to change technologies are the key factors in their rapid technological and economic development. Most countries are important to transfer their technology due to its inherent strengths of huge market, high middle-income group people and easily adoptable nature of the consumer instead of cheap labor and availability of technically qualified human capital.

2.6.1 Indian Government Policy

For developing technological capability and competitiveness of the Indian industry the acquisition of foreign technology is encouraged through foreign technology collaboration agreements. Induction of knowledge through such collaborations has allowed either through automatic route or with prior Government approval. [12]

2.6.2 Technology Treaty

The terms of payment under foreign technology alliance which are eligible for approval through the automatic route and by the Government approval route includes technical knowhow fees, payment for design and drawing, payment for engineering service, support and royalty. [30]

Payments for hiring of foreign technicians, deputation of Indian technical manpower aboard, testing of indigenous raw material, products, and indigenously developed technology in foreign countries has governed by separate procedures and rules pertaining to current account transactions and are not covered by the foreign technology collaboration approval.

2.6.2.1 Conventional Method

Payment for foreign technology by Indian companies is allowed only under the conventional method subject to the following limits:

1. The lump sum payments not exceeding US$2 million
2. Royalty payable is being limited to 5 per cent for domestic sales and 8 per cent for exports without any restriction on the duration of the royalty payments.

Authorized dealers appointed by the Reserve bank of India (RBI) allow remittances for royalty payment of lump-sum fee and remittance for use of Trademark/Franchise in India within the limits prescribed under the conventional method. RBI's prior approval is required for remittance towards purchase of trademark/franchise. [30]

2.6.2.2 Approval Procedure

Royalty payment in the following cases requires prior Government approval through the board when only technical cooperation is proposed and another body where both financial & technical collaboration are proposed: [29]

a) Sectors/activities which are not on the automatic route for FDI, or
b) Proposals not meeting any of the parameters for automatic approval

Proposals for foreign technology transfer/collaboration not covered under the conventional method shall considered by the board in the department of Industrial Policy and Promotion. Application in such cases has submitted on a specific Form to the secretary for industrial assistance.

Based on the liberalized policies started in the year 1991 the growth in technology transfers are increasing year after year. The government of India has simplified the rules and allowed the foreign technology basing on the need and its effect on the society and environment at large. However, there is some delay in approvals but the Govt. of India has given permission to 7,886 approvals since the last 16 years. Table 2.1 gives the

details of these technology transfers since 1991 to August 2007. Table 2.2 elaborates the details of No. of technical collaborations approved from different countries and its percentages in the Total technical approvals.

USA stands first position in providing technology to India with 1750 approvals since 1991. Table 2.3 explains the sector wise technology transfers out of the Total technology transfer approvals. Electrical equipment including computer hardware and software sector made highest technology transfers i.e. 1253 technology transfer agreements concluded from the rest of the world over a period of 16 years (1991 August –August 2007).

Table –2.1

Growth in Foreign Technology Transfers in India:

Details of No. of Cumulative Foreign Technology transfer Approvals from 1991 -2007

Period	**No. of Approvals**
No. of Cumulative Foreign Technical collaborations (FTC) approvals (from August 1991 to August 2007)	7,886
No. of FTC approvals during 2006-07 (from April 2006 to March 2007)	81
No. of FTC approvals during 2007-08 (from April to August 2007)	40

Source: Department of Industrial Policy & Promotion, Ministry of Commerce & industry, Government of India.

Table 2.2

Details of Country-Wise Technology Transfer Approvals from 1991 to 2007 Aug)

Ranks	Name of the country	No. of Technical Collaborations approved	Percentage with Total Technical approvals
1	U.S.A	1,750	22.19
2	Germany	1,103	13.99
3	Japan	861	10.92
4	U.K	856	10.85
5	Italy	484	6.14
6	Other Countries	2,832	35.91
Total of all Countries		7,886	100.00

Source: Department of Industrial Policy & Promotion, Ministry of Commerce & industry, Government of India.

Table 2.3

Details of Sector-Wise Technology Transfer Approvals from 1991-2007(Aug)

Ranks	Sector	No. of Technical Collaborations	Percentage with Total technical approvals
1.	Electrical Equipments (including computer software & electronics)	1,253	15.89
2	Chemicals (other than fertilizers)	883	11.20
3	Industrial Machinery	869	11.02
4	Transportation Industry	730	9.26
5	Misc. Mechanical Engineering Industry	441	5.59
6	Other sectors	3,710	47.04
Total of all Sectors		7,886	100.00

Source: Department of Industrial Policy & Promotion, Ministry of Commerce & Industry, Government of India

2.6.3 Transfer of Technology Issues in India

The availability of a pool of scientific and technical know-how, tested, tried in the advanced countries has been considered as a boon to less developed countries and are taking considerable benefit for quite some time. However, there is now a growing view that the transfer of technology from the developed to the developing countries does not sufficiently conform to the real needs and interests of the latter. Cost, suitability, dependence and outdated technologies are the major and very important issues associated with the transfer of technology.

In many cases, the developing countries obtain foreign technology at unreasonably high prices as a result of exploitation. In a number of cases of foreign direct investment associated with technology transfer, the net outflow of capital by way of dividends, interest, royalties and technical fees are much higher than the corresponding inflow.
The appropriateness of the foreign technology to the physical, economic and social conditions of the developing countries is an important aspect considered in technology transfer. There is a large no. of cases where the foreign technology transferred has been irrelevant or inappropriate to the recipient country's social-economic priorities and conditions.

Additionally, significant dependence on foreign technology may lead to technologically captivated. The import of modern sophisticated technology has likely the tendency to displace the traditional indigenous technology that has improved under a different set of policies. The even flow of new products and processes introduced by multinationals into developing countries has been unfavorable to the promotion of domestic technological capacities and has discouraged local scientists and technicians from devoting themselves to practical development problems. It creates an attitude of submissive dependence which may reduce the capacity to do even relatively minor research or to adopt processes which can develop locally.

It has been seen that there is a trend to transfer outdated technology to the developing countries. Thus they would not enjoy the advantages of the latest technology and would still technologically way behind. It is unfortunate that the owners of modern technology view the developing countries as a means to salvage technology that has become obsolete in the advanced countries even when they possess technology that is more advanced.

2.6.4 Technology Transfer Disputes

There are various reasons for raising the disputes while implementing the collaboration agreements and great care has been taken in choosing the company as a partner. Ministry of Science and Industrial research India has conducted a study on Disputes in Technology Transfer Agreements case studies and provided suggestions to companies while entering technology transfer agreements.

Following are some of the areas where the general disputes will arise. [31]

- Disputes arise because of difference in understanding of different clauses of the agreement.
- At least one party must unable to operate the some part of the agreement due to any reason.
- Sometimes it happens that when the license company is taken over by another company and new management may not be interested or intentionally come out of the agreement.
- Disputes relating payment of royalty and fees
- Delay in meeting timelines of the projects
- Passing of unapproved technology
- Technology up gradation and incomplete data and drawings
- Licensor is competing with licensee with the latest models
- After sales service and support
- Intellectual Property Rights (IPR) issues like of trade mark
- Quality and cost of production
- Delay and supply of inferior raw materials and components

Various studies have made suggestions to take proper steps before entering into any technology transfer agreements. A case study developed by Vijaya kumar & Jyothi S Bhat on transfer of technology in SME sector, Baroni P Guida & G.Mussi on technology transfer in knowledge based systems besides Karel Dakin studies on single time technology transfer has given a great insights and new developments in technology transfer.

2.6.5 Promotional Aspects of Technology Transfer

Regardless of the problems of foreign technology it is widely known that properly regulated and promoted technology can play a positive role particularly in the technologically backward countries. The Government of India has taken a number of regulatory and promotional steps to take advantage of foreign technology without sacrificing national interests.

2.6.6 Bylaws

A number of regulatory measures have taken by different countries to ensure that the technology chosen is the best available and suitable to domestic conditions and that it is not randomly picked up and unnecessary import of foreign technology is not undertaken. The following are the aspects of technology commonly regulated.

2.6.6.1 Degree of Fairness

Generally it is determined by the priorities of the technology used by industry in the nation's economy, supply conditions of the technology and its type or nature. The Government policy towards foreign capital and technology broadly classified industries into three categories namely, industries where both foreign equity and technology has allowed, industries where only foreign technology has allowed and industries where neither foreign equity nor technology has allowed. Foreign equity has allowed only in high priority, high technology and export oriented industries. Foreign equity involvement

was normally limited to 40 percent though in certain cases like export oriented industries, a larger participation has permitted. There has been considerable liberalization in the 1990s.

2.6.6.2 Phasing of Domestic Manufacturing

The management insisted upon indigenization on a phased manner as and when the foreign technology has employed. The management in the past also insisted that suitable provisions made for training in the field of production and management. Further, there should be adequate arrangements for research and development, engineering design, training of technical personnel and other measures for the absorption, adaptation and development of the imported technology.

2.6.6.3 Technology Appropriateness

Particular technology import is generally based on considerations such as suitability of the technology to the socio economic and ecological conditions in the country and the priority of the technology using industry in the national economy. According to the guidelines issued by the Government of India, the entrepreneurs should explore alternative sources of technology to evaluate them for a techno economic point of view and furnish reasons for preferring the particular technology and source of import.

2.6.6.4 Payment Terms and Foreign Exchange Drop

Government takes measures to ensure that unreasonably high payments have not been made for any technology. Restrictions were imposed also on dividend payments and pricing. The Government of India's guidelines clearly laid down that there should be no requirement for the payment of minimum guaranteed royalty, regardless of the quantum and value of production. Royalty payments were subject to restrictions in terms of amount and period of payment besides being subject to Indian tax laws.

2.6.6.5 Promotional Measures

To take full benefit of the positive role of foreign technology, it is necessary to take certain promotional measures and these may include: [27]

a) Assessing technological requirements of various sectors and identifying areas where foreign technology is required.

b) Dissemination of information in foreign countries regarding foreign investment potentials and scope for technical collaboration in the domestic economy, government policy and regulation in respect of foreign capital and technology, institutional assistance and infrastructural and other facilities for industrial development. The Indian investment centre was established in 1961. Government has to provide advisory services to Indian entrepreneurs, in respect of foreign technology including the techniques and process of technology transfers.

Finally at the international level, technology transfer has becoming increasingly drawn into political negotiations between developed and developing countries particularly those involving international agreements on trade and environment related issues. Provisions on technology transfer form an important part in several multilateral agreements such as the Agreement on Trade Related Aspects of Intellectual Property Rights of the World Trade Organization and the United Nations Framework Convention on Climate Change as well as in regional and bilateral agreements. [31]

Technology transfer issues at this level are tend to be restricted to defining the rules under which transfers take place and establishing general agreement to support technology transfer to developing countries. Such agreements tend to be expressed in provisions in international agreements and have no deal either with implementation issues or with details about the transfer and mastery of technologies at the level of the company or other organization. Policies adopted by developed countries for stimulating the transfer of technologies to developing countries are also becoming increasingly relevant. This is because international policies on trade and environment issues often require such countries to create incentives for the transfer of technologies to developing

countries. In addition, technology transfer is a key objective of many official development assistance policies. [27]

Several developed countries provide incentives for their companies and organizations to transfer technologies to developing countries. Such incentives include financing and training as well as the support of partnerships between companies and organizations in developing countries and potential sources of technologies.[28] However, there is an ongoing discussion about the effectiveness of existing measures. Some analysts point out that existing incentives are selective and have limited coverage and that few such programs are centrally concerned with technology transfers.

With respect to the policies of developing countries themselves, it is accepted that their purpose should be to maximize the gains from technology transfer while limiting its shortcomings. However, the new international policies on trade such as those adopted by the WTO appear to be ambivalent in this respect.

Some aspects of the WTO regime, such as the Trade Related Investment Measures can limit the ability of acquiring the relevant country governments to act by excluding the use of certain interventions. However, the WTO regime does not rule out all types of interventions. In particular, measures to support training, human resources development and research & development have permitted. For developing countries, a key question is how to exploit the scope left for positive policies that can create the conditions under which technology transfer can be most helpful. This is particularly relevant in a context of global trade liberalization and of the new international rules that govern this process.

However the ability of developing countries to use technology transfers to develop their domestic capabilities allowing such countries to reap the social and economic benefits of existing technologies have been very mixed. There are also differences not only between countries but also between sectors within individual countries. [31]

There are various studies of technology transfer in manufacturing industry including case studies but very little study on the issues of technology transfers in service industry like software development, I.T areas.

2.7 Overview of Technology Trade of Japan

This part presents an overview of technology trade of Japan and discusses the tech transfer activities of UNIDO. Technology management efforts are critical to the industrialization of both developing countries and those with economies in transition. This is demonstrated by the recent experience of the East Asian countries including China where rapid rates of growth are closely associated with high rates of technology transfer, acquisition, adoption and management. [11]

International technology transfer is generally recognized as having played an important role in the industrial development of those countries that successfully achieved industrial development during the 20th century. An appropriate technology transfer policy assisted by a good political framework and business conditions, contributed to competitiveness in domestic and international markets worldwide while also contributing to the attainment of a global sustainable industrial development. [32]

2.7.1 Implications for Developing Countries [33]

For developing countries, economic development means the growth of per capita national income, coupled with fundamental changes in the structure of their economies and the important social and political transformation that attends these changes. The dynamics of economic development in any country depend directly on the amount of resources available, their quality and productivity, the extent to which they are used and their growth in both quantitative and qualitative terms.

All resources are man made. In other words, they are developed in a cumulative process that relies on the skills, commitment and ingenuity of people. Schumpeter portrayed as,

development lies primarily in employing existing human resources in a different way, in doing new things with them, irrespective of whether these resources increase or not.

Technology transfer is one of the means of pursuing technological innovation. Imported technology may directly affect the economic development of the recipient country in three partly interrelated ways.

a) Technology transfer may increase the physical stock of productive factors available. Such factors include emigrant personnel providing technology services or holding key managerial posts in local companies, imported machinery and equipment, foreign raw materials, components and parts not available in the host country and accompanying technology transfer contracts.

b) Foreign technology may contribute to this increase by exploiting existing resources. As an example, it may generate new job opportunities for previously unemployed labor, decrease immobile capacity in some sectors for the economy. Cases may also be included in this category where the technology transfer is able to exploit local resources that had been idle due to the weakness of indigenous entrepreneurship or its limited technical skill level.

c) Transfer of foreign technology may result in significant growth in the productivity of existing factors like labor, capital and natural resources either by increasing the volume of outputs while the volume of inputs remains unchanged or by decreasing the volume of input with the same volume of output.

The challenge is not only to increase productivity or make the most of technology in the short run. The real challenge is to bring about technological change and to formulate a strategy to overcome the disadvantages. If this is not achieved, the gap between the technology importer and the world technology frontier will remain the same and keep on increasing.

Foreign technology has, indeed been a major contributor to the industrial capabilities of most, if not all, of the newly industrializing economies (NIEs). Evidence shows that NIE firms have exploited foreign investments, technology and marketing channels to their advantage, gradually assimilating and adapting imported know-how and developing the skills needed to compete internationally. Foreign direct investments (FDI), joint ventures, licensing agreements, OEM and similar arrangements were instrumental to the industrial successes of NIEs. Technology imports were to a large extent used by NIEs as a learning device and as leverage for further innovation.

Technology transfer may play a similar role in enhancing the economic development of developing countries and in improving the competitiveness of their firms in international markets, if it is used as a learning device and if it interacts effectively with domestic technology efforts. Technology transfer may also have a wide-ranging impact on the countries that receive the technology. Generally speaking, technology imports increase the available stock of technological and managerial knowledge, and may help to increase people's living standards and the country's competitiveness. The expected outcome of technology transfer may not materialize, however.

2.7.2 Japanese Technology Trade in Asia [34]

Patents protection and technical know-how are the results of R&D activities utilized domestically by companies and also internationally traded in the form of transfer of right and grant of working licenses. This is known as technology trade. International trade and foreign direct investment are the major channels for technology diffusion. Technology trade of major industrialized countries in recent years has been increasing. In particular the USA has the largest share in the year 2000, , both in export and import of technology trade, the value of technology export of the USA was 380.3 (100 million US$) and that of Japan was 102.3 (100million US$). It can be seen in Figure 2.5, Japanese technology export value extensively exceeds import value from Europe, Asia and North America. In 2000, Japan's trade with the USA occupies about 44 per cent of

Total exports and about 74 per cent of Total imports. About 28 per cent of exports of Japanese trade go to the Asian region, however virtually no technologies were traded to Japan from Asian countries. The main products exported from Japan to North America in 1998 were motor vehicles, drugs and medicines, and the main products imported were communication and electronics equipment.

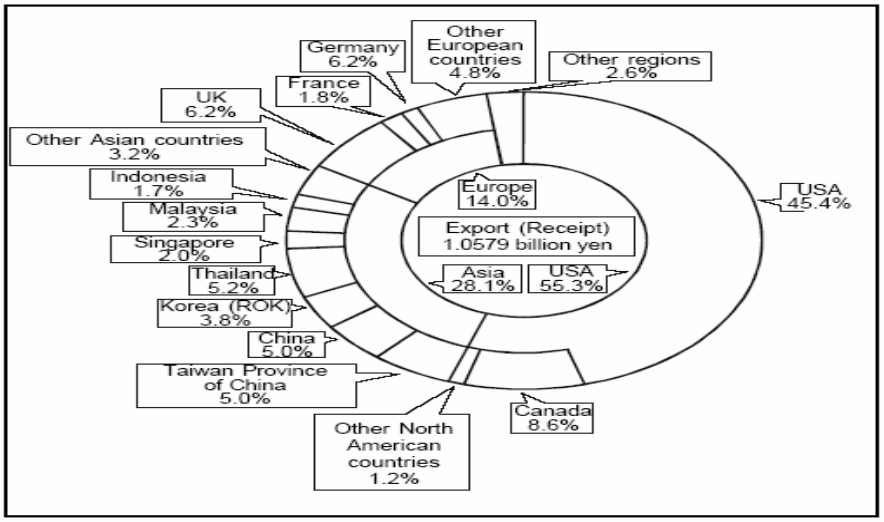

Fig 2.5: Technology Exports of Japan [34]

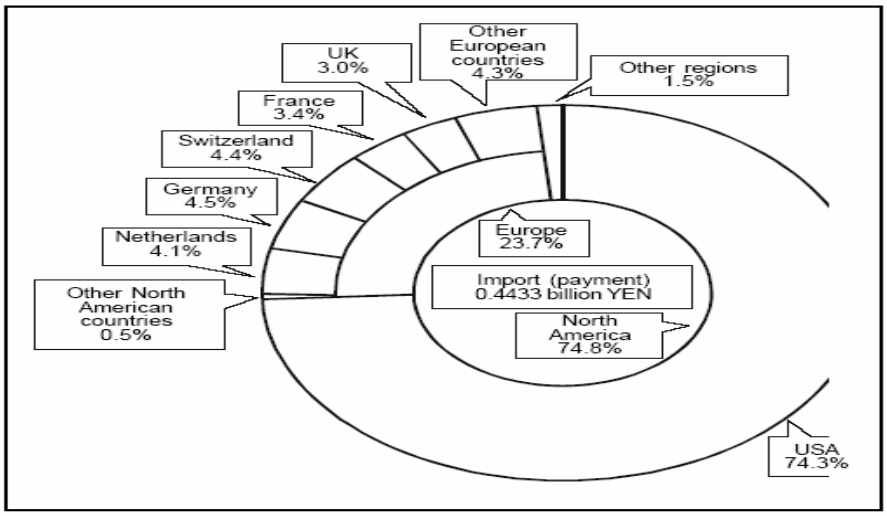

Fig 2.6: Technology Imports of Japan [34]

2.8 Technology Transfer and Intellectual Property [35]

Underdeveloped countries are far behind in technological chase in the global economy today. They have vastly fallen behind developed countries in both acquired technology and domestically developed technology. Furthermore, the lack of protection of intellectual property which governments of developing countries view as necessary to bring their economy and social welfare at par with the industrialized world. Developing countries share a belief that industrialized countries wish to maintain their control over advanced technology by demanding that developing countries implement strong intellectual property rights.

Developed countries believe that an inventor deserves exclusive rights to their innovation. Developed countries believe it is in their interest to protect the valuable technologies and intellectual property of their transnational companies (TNC) from being used, copied, without any reward. In their view, underdeveloped and developing countries engage in exactly those practices. Thus, developed countries continue to push for a commitment from developing countries towards stronger protection of intellectual property.

2.8.1 International Protection of IP

Intellectual property rights are defined as governmental protection of private innovations and creativity. [36] The Paris Convention of 1883 and the Berne Convention of 1886 were the first international treaties on IPR. The Paris Convention was created to ensure protection of industrial property.

This included patents, utility models, trademarks, and industrial designs. It required member nations to treat both domestic and foreign patent holders and applicants equally. It has an ambiguity that it did not specify a minimum standard for such treatment. The Berne Convention is an international copyright treaty for the protection of literary, scientific, and artistic works. It also required equal protection for domestic and foreign copyright holders but went further by describing minimum standards for such protection.

In 1967, the World Intellectual Property Organization was created as a division of the United Nations. It is responsible for protecting and promoting intellectual property through the Paris and Berne Conventions as well as resolving international disputes over the Intellectual Property Rights issues. However, the dispute resolution mechanism and enforcement capabilities are considered as weak points of the WIPO. The language of the provision which provide remedies to disputes is not clear and the verdicts rely on the good faith of the losing party to enforce the judgment against it. Overall, the WIPO has been largely ineffective at protecting IPR because the Paris and Berne conventions are incomplete and attempts to change the Conventions have failed due to deadlock in the voting among members. On the other hand, the WIPO consists of 170 nations as members including the United States. [36]

The Trade-Related Aspects of Intellectual Property Rights (TRIPs) Agreement was adopted at the Uruguay Round of the General Agreement on Tariffs and Trade due to the pressure exerted from the United States, Japan, and Europe in 1994. TRIPs was established as an agreement under the newly formed World Trade Organization and any nation wishing to join the WTO must comply with the standards laid down in TRIPs. TRIPs define minimum standards of protection for copyright, trademarks, patents, trade secrets, and contracts. Furthermore, it requires a twenty year protection period for all inventions, products, and processes in every area of technology. Each member nation is required to comply with TRIPs by enacting national legislation. January 1, 2006 was the deadline for all developing nations to comply with TRIPs but many developing nations are not on track to meet this deadline. [37]

To resolve disputes under TRIPs, countries are encouraged to engage in counseling and mediation meetings at the WTO. If that fails, then the WTO will appoint an independent council of experts to review each country’s policy and make a recommendation. Additionally, TRIPs allows members to impose trade sanctions on any member country which is against the Agreement clauses. Therefore, the dispute resolution mechanism is much stronger than that of the WIPO.

Despite the political influence of the developed countries, less developed countries make up over 75% of the nearly 150 member body of the WTO and see membership as desirable because the benefits include preferred status as a trading partner with all of the other members. In theory, all members are exactly equal in that each may cast one vote. Any legislation adopted by the Organization is the result of a consensus vote of the members. In reality, the United States, Japan, and the European community seem to have the most influence in the WTO because they have power over underdeveloped countries in ways which are outside of the domain of the WTO such as international loan guarantees. While developed and undeveloped nations alike may be grouped together under the umbrella of WTO membership, their needs and views of intellectual property differ widely.

2.8.2 Developing Countries

Technology transfer is essential to all developing countries. Developing countries do not possess a large amount of protected technology upon which they can build new technology and research. Also, they lack a sufficient pool of trained personnel to perform research and development in new technologies. Consequently, they need technology from developed nations to assist their growth. [38]

The “Two Gap” Theory describes constraints limiting a developing country’s ability to gain technology. First, developing countries are unable to save enough capital to create and maintain their own technological base to promote growth. Second, the cost of importing technology far exceeds export revenues usually in agriculture.

If technology from developed countries is imported and protected too strongly, the developing country will not be able to lay its own technological groundwork. LDC view patents as inhibitors to technology transfer. They bring about high fees for the use of beneficial technology and hinder attempts to foster the development of high technology industries domestically. Additionally, because most patents are owned by corporations in

the industrialized world, patents are regarded as instruments used by industrialized countries to exert control over the economic growth of developing countries.[39]

Aside from its effect on economic growth, LDC also argue that stronger patent protection will result in difficulty in providing access to drugs and other health items due to higher prices to most people. This concern reflects the fact that LDC policies towards IP are guided by the idea of insuring access to technology directed to the basic welfare of its people. The dire economic and social situations in many developing countries naturally gives rise to views that nobody should own knowledge, and that beneficial technologies should be easily spread amongst all people.

Finally, there is the consideration of expense in creating a strong IP system in a developing country. This expense is two-fold. First, there is the expense of overhauling the legal system to support enforcement of patents, copyrights, etc. This expense is joined with new training, which all judges and other legal personnel must receive to understand the new rights. Second, pirating operations actually provide jobs and profits to a significant number of people and companies in developing countries. [38] The local government is often unwilling to put so many people in the community out of work.

By far, the most common way for developing countries to receive technologies from developed nations is via foreign direct investment (FDI) from transnational corporations. In principle, TNC will engage in such investing when it will provide an advantage not found in the home market of the TNC. However, as TNC move more production to developing nations where labor and infrastructure are cheap, they need stronger patent rights to ensure that their technology and knowledge do not leak into other companies in those countries.

High tech industries, like computer software and pharmaceuticals, have high development costs and low imitation costs. TNC fear piracy and this fear may cause a company to limit who it licenses its technology to in the developing country. The end

result is that the TNC will not bring advanced technology to the LDC because of their weak patent and copyright protection.

Consequently, many believe that if the LDCs strengthen their protection of IP, they will see an increase in FDI. If this is true, it still does not serve the long-term interests of the less developed countries. Less developed countries need to absorb technologies and develop them in ways which exactly suit the problems they are trying to solve. In this view, sometimes called indirect technology transfer, imported technology and domestic R&D are complementary. [41] Currently, the developing countries believe that the dominant international treaties are not geared to suit their long term interests such as TRIPs. It is essentially a form of open innovation. [40]

Namely, the current policies will not help the developing countries grow out of complete dependence upon the technology of developed countries, in the long term. Changes can be made but only when the developed nations see the long term success of the developing nations as something which is in the best interest of all nations.

2.8.3 Developed Countries

Developed countries have a fundamentally different view of the role of intellectual property rights. They view IPR as a way of incentivizing innovation. [38] TRIPs reflects all of these concepts. Developed countries argue that patents are essential to international economic development because they provide a means to guarantee a return on invested time and capital in R&D. Thus, it is argued that TNC will be more likely to perform costly research, because a profit incentive will exist.

Additionally, developed countries feel that stronger IPR encourages R&D within the developing countries. The developed countries argue that with- out strong protection of patent rights, scientists will leave the developing countries because their work will not be protected.[36]

From the viewpoint of the TNC, stronger intellectual property rights are a requirement for FDI. The TNC are very scared of the extensive piracy occurring in developing nations today. At the same time, TNC know that they possess a lot of power because the developing countries desperately need modern technology. Therefore, both the TNC and the developed nations in which they are located argue that stronger IPR in developing nations will attract more FDI.

Edwin Mansfield conducted a survey of developing countries to discover whether a correlation exists between the strength of IPR and the level of FDI.[30] He found that stronger protection of IP will attract more foreign direct investment. However, the increase in FDI was observed to be largely limited to the areas of industrial chemicals, pharmaceuticals, and electrical equipment including computers. These industries use and produce a great number of patents. Additionally, the survey found that the increase in FDI occurred in R&D rather than services sector.

Another survey which attempted to find the relationship between stronger intellectual property rights and the level of foreign direct investment was conducted by Robert Sherwood. His study found a positive correlation between stronger IP rights and FDI in the form of R&D. But his most important finding was that no such relationship was found between stronger IPR and the level of domestic R&D. This indicates that attracting FDI only by means of strengthened IPR is not a good long term economic strategy for a developing country because it will do nothing to build a domestic industry of high-tech R&D.

These surveys provide interesting insight into the heart of the long term problem faced by developing countries and the TNC have not showed any interest in helping those countries achieve long term success in developing their own technologies. Rather, the TNC like better to be the lion of the jungle and safeguard their interest through current international policy such as TRIPs. [35]

2.8.5 Observations

The long term benefits provided by technology transfer under modern international policy on intellectual property are one sided. Transfer of technology through FDI certainly benefits the transnational corporations due to availability of cheap labor and the establishment of a particular image and reputation as an employer in a new labor market. And it is true that FDI creates jobs in developing countries and it has done very little to plant seeds for long term prosperity. In fact, 80-85% of patents held in developing countries are held by persons foreign to that country. Since developing countries are so dependent upon what little technology is brought over to them so it becomes difficult to negotiate effectively for their needs in the existing forums (WTO, WIPO).

Currently, developed countries express great concerns over the explosive growth of piracy in developing countries. They frequently point to this problem when arguing for the need for stronger IPR. Ironically, when the United States was a developing country, there was widespread pirating of European literature in the 1700s and the government took little interest in controlling it. Today, the United States exerts its economic and political power as a trade partner to pressurize developing nations to adopt stronger intellectual property rights.

Recently, a proposal known as the Charter of Economic Rights and Duties of States has been circulated among various international policy organizations. [36] The ideas of the Charter are summarized in two rules. The first rule was that every State has the right to benefit from the developments in science and technology for the acceleration of its economic and social development and Secondly that all States should promote international scientific and technological cooperation and technology transfer. While widely supported by developing nations, the Charter has not received support from developed nations. The spirit of the Charter is that of dissemination of knowledge and technology for the benefit of society at large.

The emphasis is on maximizing benefits to society. This was in disagreement with western ideas of property ownership which seeks to maximize benefits to the individual owner. An additional point of contention exists over the recent proposals by some developed countries that databases will be protected by copyrights. Underdeveloped countries oppose this idea because developed nations already control most of the world's important databases. Developing countries would face an even greater shortage of information which they so desperately need to build their own research community and education system. This proposal has major implications for the cost of using virtually any collection of information ever assembled. Since developing countries have not enough funds so this measure would effectively allow developed nations to control information flow to developing nations by adjusting access costs accordingly.

We are witnessing a trend towards the adoption of stronger IPR around the world. The long term prosperity of developing countries is clearly at risk as they are being used as a source of cheap labor. Developed countries must realize that policies for technology transfer which do not help developing countries become self sufficient will only yield a long term financial burden for developed countries. The developed countries should address this danger immediately but it seems that their representatives cannot see beyond their own profit margins. Indeed, the prospects for developing countries to free themselves from dependencies on western technology and to export domestically developed technologies is gloomy for the projected future. [35]

2.8.6 Recommendations

There are many ways in which the current policies affecting technology transfer can be reformed for the benefit of developing countries. Most of the reforms draw on the same principle like restrictions to knowledge exchange must be removed. The most frequent idea is that of mandatory licensing of technology to developing countries. The licensing should be accompanied by royalty fees which have been specially reduced for developing countries. This would go a long way towards helping those countries build a base of technology from which to begin to research and produce their own high-tech goods.

Additionally, this would provide much needed technology to university education systems. Obviously, many TNC oppose this idea as they are afraid to expose their technologies to companies in nations with weak IP protection.

Another recommendation is that developing countries should only invest funds in R&D to solve problems specific to their own needs. In other words, they should master the field which is relevant and unavoidable to their country. One example is tropical diseases, such as Malaria. Many developing nations, such as Brazil, exist in tropical areas and are affected by such diseases. The recommendation is that they should focus on solving such problems because they are probably in a better position to do so than to perform research in areas of technology in which they have no experience. We should also make recommendations for the companies within the developing countries. Applying the principle of Open Innovation, we conclude that companies in developing countries should seek to license technology from both companies within their country and companies external to their country. Licensing from other companies within the country may be quite ignored as only western technology is currently required. [40]

Companies within developing countries should also make an effort to establish a relationship with academia in their industry both within their own country and in the developed countries. Strong connections with academia are invaluable as both formal and informal knowledge exchange will benefit the companies of the developing nations infinitely.

Finally, the companies in developing countries have to learn from other successful companies in the same industry. Simply observing their structure and strategies may help one to avoid repeating the mistakes of others. Another way to learn is through partnering. Companies in developing countries should seek business partners in newly industrialized countries. The companies in newly industrialized countries may be more sympathetic to the difficulty of the companies of developing countries because newly industrialized countries were themselves developing countries before.

A very important question in the context of international policy must be answered. A patent system which granted identical rights to inventions from all industries worked fine in an era when almost all inventions were mechanical. However, the industries of today differ so greatly in their product shelf life and development cycle times that the patent system must be changed. Already, a de facto change has taken place in some aspects of the patent system. For example, the required detail in patent applications in biotechnology and computer software differs greatly. [38]

Computer software and various types of hardware should have their patent duration shortened. For software, some proposals suggest duration as short as 5 years, with the source code sub- mitted as the deposit, or reference implementation. The visibility of the code would have huge benefits for developing countries as they could use it to help educate their work force in programming techniques while companies could use the code to get a new perspective on solving a particular problem. The shorter duration itself would also help technology transfer to developing countries. Developing countries would be more likely to strengthen patent rights if they could expect the patent to expire in a relatively short time. After the patent expired, they would be free to extend the technology throughout society. At the same time, the stronger IPR would attract more FDI. With stronger IPR and shorter patent duration, transnational corporations would still have incentive to bring technology to the developing countries. The incentive of cheap labor would still exist. Additionally, the profitability of licensing a technology would change very little when com- pared with the traditional patent duration because within the industries in which patent duration would be reduced, technology is overshadowed by something better within a few years and hence the profitability of the old technology declines irrespective of the patent duration.

It is concluded that TRIPs should be replaced with a new policy. The new policy must facilitate equitable technology transfer and should balance property rights with the needs of developing countries so that they may rise to a technological development level where they will not be dependent upon imported western technology. This policy shift can only occur until the developed countries understand why it is important.

Certainly, it will be a slow process for the developed countries to continue to fight hard to remain the sole distributors of high technology. However, the western ideas of property ownership need not change in order for international policies to change. Both sides can benefit without completely compromising their ideals. If pressure for a reformed patent system continues to mount perhaps changes in that domain will dissolve some of the tensions between developed and developing countries. No single change will solve the problems faced by either side. However, the first step towards progress must be an understanding by both sides regarding the role of international technology transfer in helping all countries achieves long term economic success. It must be understood that the role of technology transfer should shape the international policy; the policy should not shape the role of technology transfer.

2.9 Problems and Prospects of ITT in Developing Economies [47]

M. Tesfayohannes and Z. T. Temtime proposed and formulated technology transfer schemes and action programs for the government of Botswana. The study is based on theoretical analysis of technology transfer for SMIs in Botswana. It is a middle income developing country in Africa and looking to achieve sustainable economic growth through developing competitive and dynamic industrial capacity. These SMIs in Botswana do not provide the desired base to absorb the acquired appropriate technology required for sustained growth. Local firms are still operating with out-dated technology. The author discussed obstacles to technology transfer and its subsequent cost effective adoption. It will be helpful for building indigenous technological base. ITT is mostly concerned with the replication of technological ideas, skills in terms of their, hardware, orgaware, humanware, and infoware elements (Huria 2000).

Fig. 2.7 shows transferable elements of technology adapted from Huria, V.K (2000) and these are reformulated by Tesfayohannes, M. Fig. 2.8 proposed a Government sponsored technology transfer schemes and action programs respectively. [47]

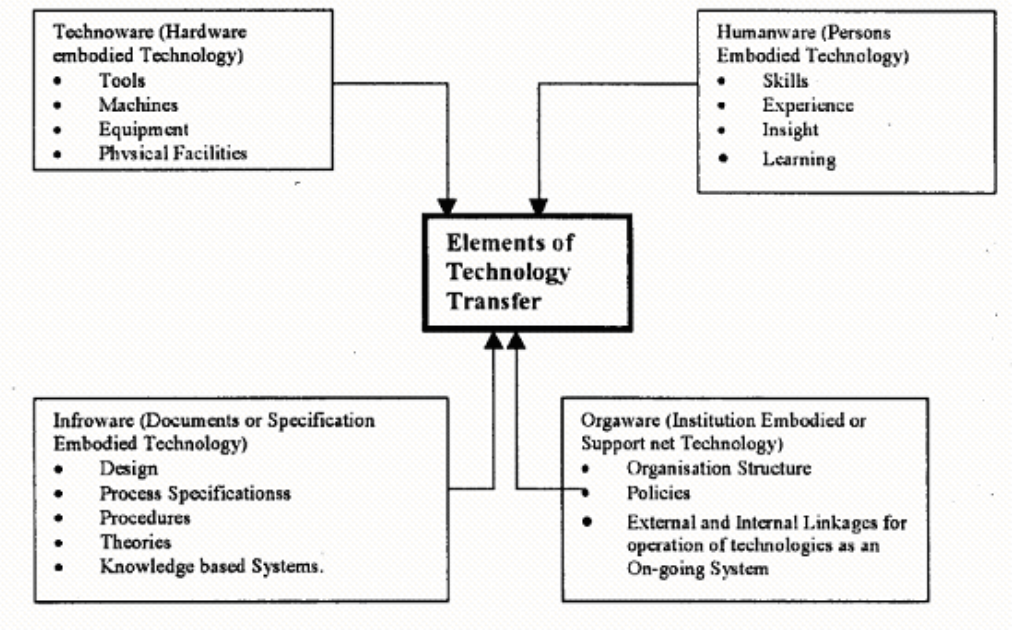

Figure 2.7: Transferrable Elements of Technology [47]

Scheme or Action Programmes	Objective
Plant and Machinery Procurement Assistance Scheme	To assist SMIs to modernize their operational activities by equipping themselves with modern and efficient operational facilities.
Technological Standards and Improvements Scheme	To help SMIs to enhance their overall technological standard or position
Technical Training and Advisory Services Scheme	To support SMIs to produce quality products at affordable cost by providing training and technical advisory services in the areas of: Industrial promotion and technical competence, Product and process design and control, quality control and production planning systems Technological innovations and R&D promotion
Rural SMIs Promotional Scheme	To enhance, strengthen and expand the operational activities of rural industries by upgrading their technological capacity.
Managerial and Entrepreneurial Development Scheme	To help SMIs by providing professional and technical services which include: Marketing and product Promotion Human resources and organizational set-up Business expansion policies and strategies Entrepreneurial skill and small business management
Joint Venture and Business Linkages Promotional Services Scheme	To support SMIs to establish alliance and linkages with suitable local and foreign business establishments

Figure 2.8: Proposed Sponsored Technology Transfer Schemes and Action Programs [47]

Botswana's economy is largely dependent upon mining sector particularly Diamond. To diversify the economy, Government of Botswana has been promoting the development of

small and medium industries (SMIs). The declining job opportunities in mining sector forced the government to provide employment for low skilled labor in SMIs as these have potential to accommodate and create more jobs.

Most of the SMIs are producing second rate products and are equipped with outdated technology. The transferred technology must meet the special condition for intended place to which it is being transferred. The week capacity of SMIs to absorb the advanced technologies has become major impediment to successful ToT in Botswana. The study identified seven important factors in SMIs which are discussed below.

i. SMIs are interested in importing very advanced technology which is beyond their scope in terms of utilization and performance improvement.
ii. Lack of infrastructure to absorb the desired technology.
iii. Both the host and receiver may be interested in transfer that gives financial gain. The recipient firms wish to receive technology which will enhance their industrial experience.
iv. Inappropriateness of technology; technology that can not be understood and implemented.
v. Technology transplantation in which host country directly transfer the whole technology operations.
vi. Poor organizational setup, lack of strategic orientation and proper vision are some of the main causes of poor technology absorption.
vii. Many potential partners have a fear to form alliance in terms of joint venture due to fragile socio economic structure and stagnant government regulations in the developing countries.

2.9.1 Recommendations by the Researchers

Recommendations presented by author are given as follows: [47]

- SMIs and supporting institutes should their attitude and develop concepts for appropriate technology. Its not mere a physical transfer of equipment managerial and organizational skills are part of it.
- Knowledge and training is mandatory before acquiring up to date technology as many of SMIs lack necessary skills and readiness. Organizational capacity to absorb and utilize technology is very important.
- Institutional framework must be setup to support the process of transfer. It includes identification, acquiring, testing, evaluation, absorption, assessment, promotion and forecasting of technology.
- Government can play vital role in implementing technology transfer to SMIs through its agencies.

Investment in technology is becoming an important weapon not only to achieve competitive advantage but also to survive in this turbulent global market. Developing countries lack the necessary skills, resources, infrastructure and expertise. It is thus advisable to adopt appropriate technology from developed world which is already tested.

2.10 Summary

The purpose of this chapter is to explore the past research in the field of transfer of technology processes and to develop the concept for international technology transfer in its totality. In addition to the review presented, numerous other studies have been observed in order to identify the factors affecting on the technology transfer process. Technology transfer is a planned process that has to be managed effectively in order to ensure maximum transfer benefit.

Transfer of technology serves as an engine for economic growth. Every country has its own choice to adopt technology transfer channel in one form or the other. Especially in the initial stages, the country must go for the best suited technology and select most appropriate and needful technology to its national interest by keeping indigenous strengths, weaknesses, compulsions and constraints in view. It has been used as a catalyst

to achieve ultimate success for respective industrial growth. It can be accomplished through selective acquisition of available developed technologies.

China has shown progressive acquisitions and proved to be the most successful by following various technology transfer modes at appropriate stages from equipment import to reverse engineering. It pursued import of selective modern technology and applied it to give a jump start. Later, china has developed its own R&D base for commercial and defense purposes through suitable organizations and structural reforms. Finally, joining together R&D with academia and industry to attain final product ready to export made them sustainable and profitable. After establishing its hegemony on manufacturing sector, china has now been looking to overcome its underperformance in high technology and become at par with global counterparts. Therefore it serves an important lesson that it is necessary to phase out ToT with realistic and progressive planning.

Successful ToT needs strategic vision, focused objectives and graduated progression to ensure proper diffusion covering various facets of independent actions, policies and strategies. It essentially consists of skilled human resource, institutional infrastructure including R&D facilities and technical advice through experts.

Some of the international trends existing in the this particular field are discussed below;

i. Joint venture is preferred mode of ToT as no single industry can be self sufficient.
ii. Export oriented strategy must be adopted to mitigate resource constraints.
iii. Collaboration of academia and industrial units can help fill the human resource gap. It can be prevented by developing and enhancing the role of incubation centers and industrial parks.
iv. Emphasis on R&D is playing an important role.
v. Defense related ToT should be based on military cum commercial mix to benefit both ends.
vi. Latest trends in defense technologies including information systems, laser systems and aeronautics are also mentioned.

Restrictions to imported technologies provoked less developed countries to develop the base for specific industries under compulsion. Self reliance can be achieved through indigenization using ToT as an effective tool. The practices, related to technology transfer, in developed countries can be appropriately applied as a guideline to local environment in order to achieve success.

Chapter 3

RESEARCH METHODOLGY

3.1 Introduction

This chapter describes the research methodology adopted, the problems encountered and limitations felt in the data collection. It may be appropriate to note here, that this study is almost exclusively based on data collected from official sources in the selected defense R&D organization.

3.2 Research Objectives

The objective of this study is to focus the international technology transfer practices in a defense R&D organization in Pakistan. There has been no work done in this particular field in Pakistan till now. Various government offices namely Ministry of Science and Technology (MoST) Pakistan Council for Science and technology (PCST), Pakistan Science Foundation (PSF), Pakistan Technology Board (PTB), PCSIR are visited for the purpose to gather actual data on transfer of technology subject but no considerable material or any consolidated framework is present with the government. National Centre for Technology Transfer was established in 1980's and dissolved in 1993 for unknown reasons. Moreover, transfer of technology is discussed in its broader context in the development of science and technology in Pakistan. A few working papers were written merely reflecting the thinking of authors and covered the broader aspects of technology transfer as a subject.

The study is comprised of two portions. The first portion serves to analyze the technology transfer practices in a defense R&D facility in Pakistan. An appraisal of existing transfer of technology practices were analyzed by reviewing the technology transfer agreements. Second portion proposes a theoretical generic model of processes for ToT to be followed in a defense R&D organization in Pakistan.

Many problems arise in technology transfer due to large number of indirect mechanism involving liaison companies. The importance of joint venture agreements and significance and implications of clauses in joint venture agreements for acquisition and development was inadequately treated. While going through the agreement clauses, it is revealed that not much attention was given to theses contract clauses as it should be or according to international patterns. The agreement clauses are taken care of with the passage of time and experience gained thereon. The joint venture agreements have been refined with respect to its clauses with respect to time. Certain restrictive clauses like profit sharing, royalties, company management, training of personnel, obsolescent technology, raw material supplies and even penalty for late delivery of product.

As there is no regulatory body and even policy exists in Pakistan for the acquisition and subsequent development of technology, a theoretical model of processes is proposed to be followed for the smooth transmission of technology to defense R&D organization in Pakistan. The model is incorporated with success measurement stage to ascertain the degree of performance. Due to absence of such a body, every organization autonomously goes into technology transfer agreements with foreign clients and there is no check and even any sort of accountability at a national level. In short, it is suggested that technology agreements clauses must be read with open eyes before its execution taking internal patterns into consideration. The other purpose of the study is to suggest a model for technology transfer and make the higher echelon feel to do some tangible efforts in this field. An effort is made in general to the subject of international technology transfer processes and to promote a trend for the future research in this particular field. There will be information network available for private and public sectors to share technological capabilities by taking technology policy into view to identify industrial needs. The network can serve as a hub to provide necessary information like current technologies, prospective programs, supplier database of major technologies, and accessibility of technical journals to all interested. Furthermore, the author faced acute problem of non-cooperation from the official sources. The persons were reluctant to disclose any specific information due to secrecy of the content material. The author only used the data for the

sole purpose of appreciation of the system without divulging any information regarding the organization. The access to the original documents was next to impossible. Only copies of twenty contracts out of many have been obtained after relentless persuasion and promises of secrecy. This general unwillingness to share information for research purpose is not peculiar to the firms in countries like Pakistan but this is practiced worldwide. The company provided a broad picture of the operations and completely reluctant to discuss the factors like pricing policy, financial aspects and marketing techniques.

3.3 Introduction of LTE [49]

The roots of the LTE extend to 1992. The energy and dynamism of this company has allowed it to establish itself in precision manufacturing and communications technology. In charting its course it has carefully avoided duplication of efforts, explored new avenues in the manufacturing industry, and sought collaboration with leading international companies interested in joint ventures. The pioneering spirit has poised Pakistan for a quantum leap in the field of fiber optics and optical fiber technology. This is a quality conscious company, whose quality assurance system encompasses development, production, finance, sales and marketing. International standards such as IEC-794-1 and ITU recommendations G. 650 are strictly adhered to during optical cable and fiber testing.

The company is playing a vital role in Information Technology and telecom sector of Pakistan. Its local presence is a great boost to public and private sector. High tech industries like these not only bring strength to country's technical knowhow but also give strength to country economies by supporting its product in the international market and earn valuable foreign exchange.

3.3.1 Mission Statement

The focus is to address pressing needs of Pakistan and other developing countries by market-driven telecom product development, strengthening of Pakistani optical fiber based telecom / networking industry, technical training and services, and driving telecom / IT policy.

Mission is to provide exemplary innovative business-to-business telecom products and services. The company strives to do this by providing competitively priced high-quality products and services with personal and professional customer service

Currently, it works in diverse areas including Fiber Optics Communications, Computer Networking, Systems Architecture, Integrated Voice / Video / Data Communications, telecom hardware installation, testing and maintenance services.

Key objectives are:

- To engage, in accordance with development policies and priorities of the government, in the infrastructure building, Operation, maintenance and expansion of local telecommunication
- To provide domestic and international telecommunication vendor services
- To manufacture and maintain telecommunications equipment and ancillaries;
- To render training services to telecommunication industry;
- Cost effective support for multiple telecom service providers

In the communication world, to talk state–of-the-art is to talk of fiber optics. Today the planet earth finds itself wrapped with fiber optics and these are the pioneers of this technology in Pakistan. Optical Fiber & Cable Division has over seven years experience in manufacturing of high quality Fiber Optic Cables, Optical Fiber, Passive Devices and Interconnect Products for Original Equipment Manufacturers and telecommunication networks on a worldwide basis.

Why customer attribute their project success to us:

Craftsmanship is crucial to the manufacture of Optical Fibers, Cables and conventional interconnect products. The trained technicians are the first line in a production process that is focused on Quality and Consistency every step of the way.

State-of-the-art automated manufacturing equipment is employed throughout the manufacturing process to ensure that every product meets your design and performance specifications and quality standards.

Zero-Defect Quality Control Philosophy is in practice in the company. The quality of all products we manufacture is assured through constant evaluation of every facet of the manufacturing process that all products meet or exceed your specifications and performance data.

The ultimate success of any company lies in customer satisfaction. it not only possess the basic ingredients of customer satisfaction in the form of competitive prices, superior design, precision in manufacturing, stringent quality control, sound financial management, and prompt services; but also the all-important team spirit, which is essential for the proper synthesis of the above ingredients. The company is ISO 9001:2000 certified and its quality management system caters all aspects stated above.

3.3.2 Production Capabilities & Services

Optical Fiber

- No dispersion-Shifted Fiber (ITU-T G.652) Versions A, B, C & D
- Multimode Fiber with a 50-Micron Core (ITU-T G. 651) & 62.5-Micron Core
- Nonzero Dispersion Shifted Fiber (ITU-T G. 655) Versions A, B & C

Optical Fiber Cables

- Duct
- Direct Buried
- Aerial
- Central Loose Tube
- Tactical
- Premise
- Patch cord / Zip cord / Simplex / Duplex

Services

- Total Turnkey Optical Fiber based solution provider
- 24/7 Outside Plant (OSP) fault tracing and rectification services
- The only high end OSP Optical Fiber Characterization service provider

Solutions

- Fiber To The Home (FTTH) Solutions
- Video surveillance system
- Security Access system

Passive Fiber Optic Devices

Couplers

- Single & Multimode Dual-window 3-dB couplers
- Tap Couplers (1% to 50% Tap ratio)
- 1310 / 1550 WDM Couplers
- In-line fixed Attenuator (1.0 dB to 20 dB Attenuation)
- In-line all Fiber Polarizers (E.R > 35dB)

3.3.3 Strategic Management Processes

Strategic management is defined as art or science of formulating, implementing and evaluating cross-functional decisions that enable an organization to achieve its objectives.

Strategic management consists of three stages:

i. Strategy formulation (Vision + Mission)
ii. Strategy implementation (Achieve goals)
iii. Strategy evaluation (Feedback, Statistical analysis)

Strategic management processes can be elaborated as:

- Historical context, examination of previous trends and the emergence of a future vision for the way forward

- Situational Assessment, SWOT Analysis of the present situation
- Strategic Issue Agenda, identify issues from points 1 and 2.
- Strategic Options, define as many positive solutions to meet the SWOT analysis and future vision. Define strategies, and outline costs, feasibility, acceptability and effectiveness.
- Feasibility Assessment, a selection of strategies is examined through Stakeholder Analysis and Resource Analysis.

- Series of evaluation programs are devised for the implementation to evaluate the stakeholder's predictions.

Some reasons for choosing strategic management processes are;

- To formulate effective strategies consistent with the business and competitive strategy in the local and global economy.
- Examine policy issues and strategic planning with a long term perspective. Determine objectives and set priorities right.
- Anticipate potential threats / weaknesses or strengths / opportunities.

Some other common reasons for implementation of strategic Management process are:

- Transform vision into reality
- Reduce the number of customer complaints
- Eliminate the high cost of factory chaos
- Reach company full growth and earnings potential
- Exceed bottom line expectations
- A better way to run business

Primary mission was the indigenous manufacturing of optical fiber in Pakistan. As a spin offs, the facility will create awareness in the local telecom market. Current mission is *to manufacturer state of the art, competitive optical fiber products.*

Pakistan local market is a price driven market. Most of the buyers are looking for better price and they are willing to compromise on the quality. Keeping this in mind, current objectives are modified as follows:

- Produce low cost but above average quality product to cater local demand
- Production quantities should satisfy majority of local business to business optical fiber cable demand

3.3.4 Assessment of External Environment

- For the past one decade the organization has been able to sustain and grow against multinational giants operating in Pakistan. Government has been supporting indigenous production units. Special import / export waivers / rebates have been offered by government.
- Historically, the global telecommunications marketplace has enjoyed tremendous growth in terms of network size, number of subscribers, number of operators, and overall revenues. While this growth has been impressive, of real importance is what is going to happen to the telecommunications market in the near future, say the next ten years. The next ten years will be a pivotal time for the telecommunications industry as the effects of global deregulation, the continued expansion of services, and the further build out of developing and underdeveloped countries combine to reshape the global marketplace.
- Another fundamental influence that will drive the growth of telecommunications is the continued growth in the world's population. Obviously, as the population expands so does the need for telecommunication services.
- The number of main telephone lines worldwide has grown from 850 billion to 1.25 billion in 2006.
- Worldwide tele-density has increased from 14 lines per 100 people in 2000 to approximately 20 in 2006. The bulk of this growth is expected in the Asia / Pacific region.
- A number of competing technologies exist in the global wireless market: analog, CDMA, TDMA, GSM, and PDC. Most carriers today are in the process of

upgrading or have upgraded their current systems from analog to digital technologies and new carriers are starting with digital technology. As a result, the technology mix has change significantly.

- Optical Fiber is rapidly becoming the standard communication technology worldwide.
- What all of this growth in telephony drives is revenue. Worldwide telecom service revenue has grown grow from $840 billion in 1998 to $1.8 trillion in 2006. This growth represents a compound annual rate of approx 9%.
- It is evident that the global telecommunications market is expanding and will continue to expand in the foreseeable future. This expansion has created tremendous opportunities for current operators and emerging operators, who are, in turn, creating opportunities for companies that support them. Infrastructure vendors, consultants, software vendors, and many other types of suppliers are enjoying the expanded opportunities the telecom market is offering.
- Annual optical fiber demand worldwide is projected as per following figure 3.1:

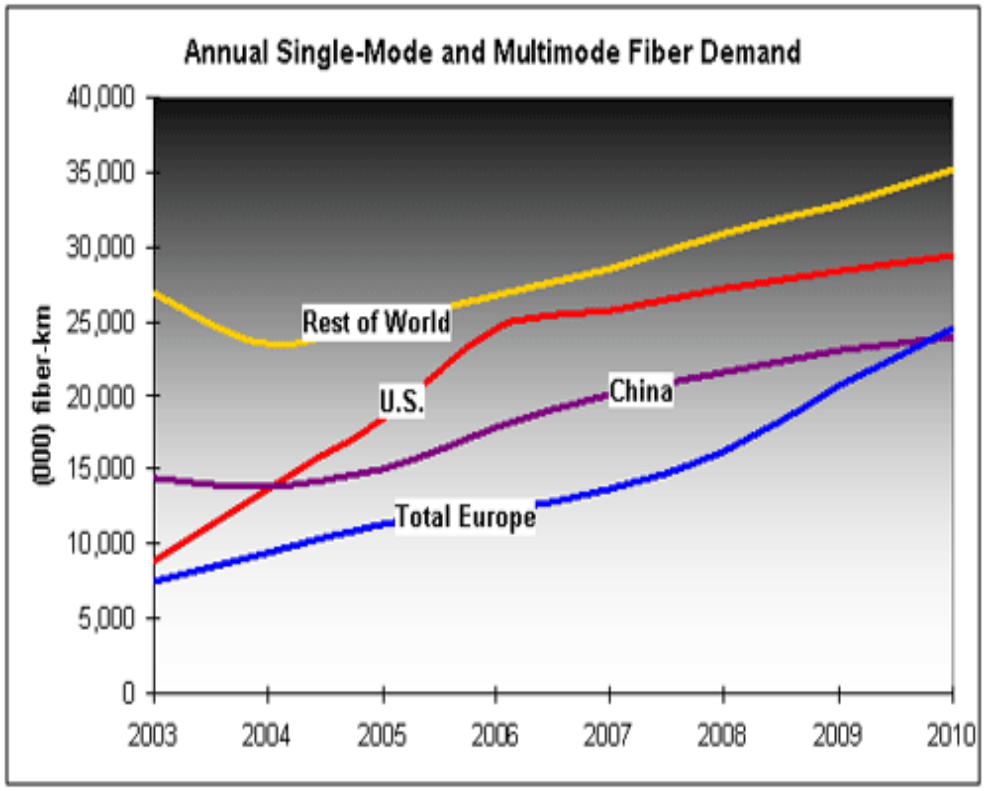

Fig 3.1: Projected Global Annual demand of Optical Fiber [49]

3.3.4.1 Opportunities Identification

Opportunities are in the following areas:

- The only optical fiber manufacturing company in Pakistan
- it is equipped with human resource and high end manufacturing / test equipment to cater any customized demand of customer
- Maintenance teams placed across Pakistan to provide 24/7 optical fiber link rectification
- Increase the optical fiber based applications awareness in public and private sector of Pakistan
- Engagement with multinationals operating in Pakistan for local and international projects
- Fiber to the Curb applications
- Fiber to the Building applications

- Fiber to the home applications
- Premise applications
- Newly developed products:

  i. Center Loose tube cable for cable TV and Security surveillance applications
  ii. Connector accessories manufacturing to capture local market
  iii. Optical Ground Wire OPGW to cater upcoming mega events in Pakistan energy sector
  iv. Specialty Fibers for diverse applications in defense and commercial communication sector

- High quality product being supplied in the market. Differentiating to from its average quality product being imported from China
- It has state of the art laboratories and testing facilities which can provide facilities to universities, research centers in mutually beneficial manner
- Appropriate export orientation can exploit tremendous potential in this particular area especially to Muslim world at affordable prices.

3.3.4.2 Threats

Potential threats are in the following areas:

- Retention of human resource in public sector with higher qualifications like MS/PhD in the relevant field is a difficult proposition due to better financial packages in the private enterprises. It has resulted brain drain and poses a serious impediment to human resource development and needs to be rationalized
- Professional progression is hampered by the unsteady rules imposed by the government. Some of the employees have obtained exclusive trainings from abroad while others remain unable due to nepotism or some other reasons leading to demoralizing effect
- Competition in the market for telecommunications / CCTV industry is highly competitive and the company expects this competition to increase. There is a fierce competition in the domestic as well as with the international Manufacturers

who are supplying the cable to this market. Not only does the company compete with other manufacturer / service providers.

- It is expected that continued growth and competition in the telecommunications / CCTV industry and the entrance of new competitors into the market will continue.
- International factors may cause significant risks to the company. The company's business may be subject to unexpected changes in: regulatory requirements, tariffs and other trade barriers, costs of localizing products for foreign countries, lack of acceptance of localized products in foreign countries, difficulties in managing international operations, political instability, potentially adverse tax obligations, restrictions on the repatriation of earnings and the burdens of complying with a wide variety of foreign laws and regulations.
- Alternative pricing arrangements may be required initially to cultivate relationships with new market entrants and to a lesser degree with established companies. These arrangements may call for deferred payments. However, if the company permits customers to pay for its products and services on a deferral or revenue sharing basis, the company may ultimately be unable to collect payments for such products and services.
- Stocking of Cable with the distributors all over the country should be kept; this can only be possible if we offer some attractive opportunity to distributors than our competitors.
- Fluctuations in exchange rates between the United States dollar and foreign currencies may have a material adverse effect on the company's business, results of operations, and financial condition.
- An integral factor in the company's growth strategy is the development of third party relationships with a number of consulting and systems integrator firms / Distributors to enhance its marketing, sales, and customer support efforts.
- Failure to generate these relationships will have a negative impact on the company's ability to meet its targeted growth in sales.
- A price comparison between the domestic & international telecom cable manufacturers for Central Loose Tube Design.

- Fluctuations in exchange rates between the United States dollar and foreign currencies may have a material adverse effect on the company's business, results of operations, and financial condition.
- The laws of certain countries in which the company may sell its products and services do not protect the company's intellectual property rights. As a result, it may be possible for a third party to copy or otherwise obtain and use the company's technology without authorization, or to develop similar technology independently. If this occurs to any substantial degree to the company's business, results of operations and financial condition could be affected.
- Declining markets – due to abrupt change with market vital statistics
- Trade barriers – constraint levied against Pakistan for all our imports
- Technology shifts – forces our customers to shift their buying specifications or criteria
- User requirements change with the advent of new technology and Geo-political conditions of the region
- A price competition from within the telecom cable manufacturers and importers

3.3.5 Assessment of Internal Environment Factors

- The biggest strength of any company is its human resource. Its key strengths are its human resource along with one of its kind technology. It enjoys monopolistic situation in Pakistan due to initiative taken by its pioneers back in 1992.
- Over the period, the human resource has been professionally groomed and gained experience, which is not available in the local market.
- In house ability to produce products, design systems, implementation and maintenance gives it an edge over any of its competitors.
- Current management has been hired from the international telecom market to run it in corporate environment. This addition to the management team has made positive impact on identifying its weaknesses and exploiting strong points.
- The manufacturing facility is approx. a decade old. The plant technology has been upgraded from time to time. With recent technology upgrade available in

the market calls for a revamping of the plant machinery e.g. new cable printer marketing by HP can print as small as 4 pts font on cable production operating on 200-rpm with respect to current printer, which can print only 10 pts font on cable production rpm of 100. Replacing the printer can increase the production rate.

- Company value chain is shown in the following figure 3.2.

Fig 3.2: Value Chain of the LTE [49]

3.3.5.1 Strengths

The company has developed technical strengths in the following areas:

- Comprehensive infrastructure availability developed over a period of time has a capacity to be enhanced with further investment in specific areas
- Successful logistic support has made scope possible to cover entire spectrum with further selective ToT
- Being a Government owned organization; it has build trust in the Market.
- Majority of manpower at individual level is well exposed with state of the art technology
- It has potential market for its products and services in terms of equipment and trained human resource
- Ability to draw optical fibers
- Strong relations with the raw material suppliers
- Quality product
- Pioneer / Sole manufacturer of optical fiber producer in Pakistan

- Highly skilled human resource
- Enough production capacity to cater local business to business market demand
- In-house product customization capability
- Capability to develop new products
- Big names of Telecom operators are its customers
- Positive contribution to economy through savings and exports

3.3.5.2 Weaknesses

Currently, there are some weaknesses identified in the following areas:

- Documented marketing plan not present
- Product packaging needs attention
- Innovations missing
- Market survey procedure and any prior conducted survey not available
- Market segmentation not done
- Promotional / advertisement plan not available
- Technology demonstration seminars not planned
- Internal communication weak
- Support group for after sales activities not clearly defined and effective
- Corporate vision and mission not properly communicated to human resource
- HR not fully geared up with requisite gadgetry to tackle customers requirements
- Employee morale issues
- SOP for financial recovery not properly implemented
- Lack of incentives and therefore initiative in public industry specially the dichotomy in pay and privileges of individual organizations
- Bureaucratic bottlenecks and absence of corporate culture
- Non existent industry-academia, collaboration despite the fact that there is a huge window of opportunity of cooperation and mutual benefits
- Obsession with modern technology standards without taking into account local conditions and resource considerations

3.3.6 Core Competency

Premier product was the development of optical fiber preform. The process to manufacturer preform is called multiple combustion vapor deposition (MCVD). In this process gasses are injected in a silica hollow glass rod and heated up to 2000 ^{0}C. Gasses are solidified inside the hollow silica glass rod. This preform is again treated at 2200 ^{0}C in optical fiber 14 meter drawing tower to draw optical fiber.

The core human resource has indigenously developed the preform. It is the only preform and optical fiber manufacturing facility in Pakistan. It can perform all kind of optical fiber Lab and Out-side plant (OSP) test. It has complete hegemony in the field of optical fiber technology in the local market.

Its competitors are basically traders or optical fiber cable manufactures. They do not have in-depth knowledge and paraphernalia necessary for the optical fiber technology.

3.3.7 Competitive Advantage

It has emerged as a 'Total Turnkey Solution Provider'. It offers complete solution from designing a network solution, hardware supplies, civil works, network implementation / connectivity, linking the complete system to maintenance after commissioning as per international standards under one roof.

Its competitors do not have this edge. They can only offer hardware and its installation. No other organization has all these capabilities under one umbrella. Companies like Nortel, Alcatel, Huawei, ZTE, etc. offers hardware and its installation only. Rest of the solution implementation elements are given to other vendors.

It operates in accordance with the highest standards in all relationships with customers, suppliers, environment and the community.

The vision is to provide the World-class high Tech, cost-effective telecommunications products and services by consistently satisfying the realistic expectations at an affordable price to our customers and stakeholders.

3.3.8 Strategy Formulation

The prime strategic options include:

- Grow in line with industry
- Defend existing status
- Incremental learning / progress
- Strategic flexibility
- Increase skills or productivity
- Innovate and create new offerings
- Stabilize / strengthen financial position
- Improve market share, enhance brand, extend distribution
- Increase capacity or efficiency or reduce costs
- Extend product ranges and /or served markets

Product and market mix matrix:

	Existing Products	**New Products**
Existing Markets	Lowest risk	Moderate risk
New Markets	Moderate risk	Highest risk

Strategic statements are defined as broad indicators of the direction(s) in which the company should be driven in order to fulfill its vision / mission while taking realistic account of its resources, constraints and opportunities. These statements also serve as the link between the company objectives and action plans and should result in a series of integrated sub-strategies and action programs with goals, budgets, and timetables. These can be most effective when linked to specific functional areas, such as:

Industry	Operations
Marketplace	Finance/funding
Technology	Sales
Offerings	Management
Marketing	Organization

The key strategic statements, which need to be implemented, are as follows:

- Services to be offered in business to business environment
  - Being the only total turnkey solution provider in Pakistan has the edge over its multinational competitors.
  - It is the only high-end characterization testing service provider in Pakistan. This characteristic gives it an authoritative edge over any other service provider.
- Manufacturing plant upgrade & periodic evaluation
  - It is known for its quality product. To keep this distinct quality, plant technology needs to be upgraded and periodic market intelligence should be put in place for any future upgrade requirement.
- Technology awareness program
  - Its role includes publicizing Optical Fiber Technology in Pakistan. Human resources in the concerned quarters need to be educated.

3.3.9 Strategy Implementation

Strategy implementation action agenda items can be summarized as presented in the figure 3.3.

To successfully implement the strategies, seriousness and professionalism of management plays an important role. Allocation of resources along with stringent planning is prerequisite.

- Services to be offered in business-to-business environment

The technical department responsible for executing of the testing and maintenance services is TCS department. Current human resource strength of 25 is not sufficient to cater the market demand. The strength should be added up to 50 employees to cater next two year demand. These employees need to be trained.

- Manufacturing plant upgrade & periodic evaluation

Alternate plant machinery source should be exercised to get a comparative proposal from equipment suppliers. The maximum plant upgrade time should not exceed 6 months. The lead-time required for any new entrant in Pakistan market is approximately 10 ~ 12 months. Marketing & sales department has been tasked to give sales budget forecast for current and newly developed products for the next two years.

- Technology awareness program

Main function includes publicizing Optical Fiber Technology in Pakistan. As long as more people in the telecom industry will become aware about optical fiber technology, the desire and need for this technology will be understood. The program shall be launched on professional forums as well as in the education institutes.

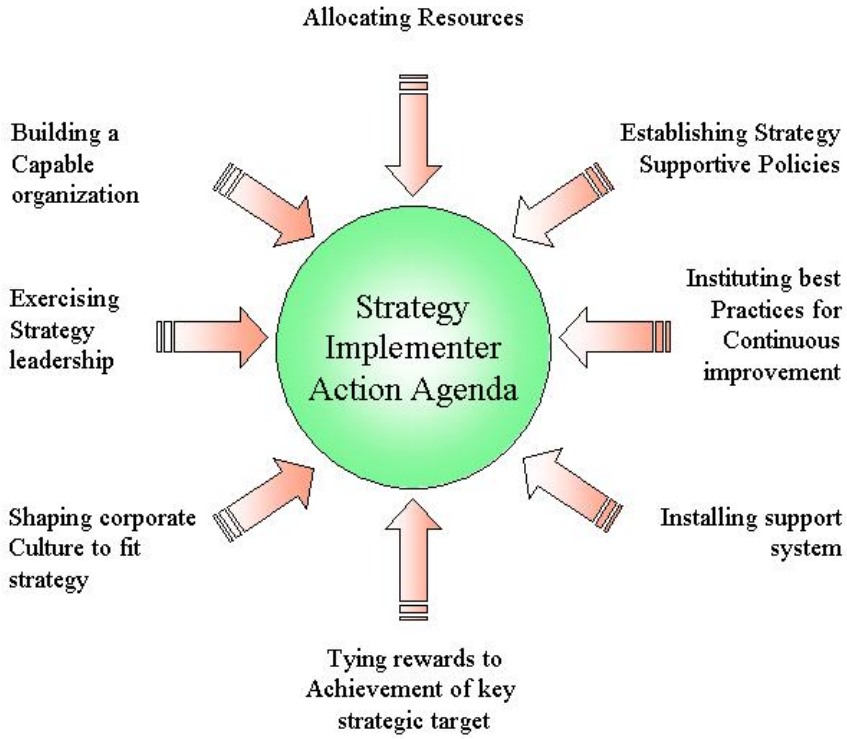

Figure 3.3: Strategy Implementation Action Agenda of LTE [49]

3.3.10 Strategy Evaluation (Expected Results and Findings)

Optical fiber links being laid all across Pakistan shall require maintenance and testing 24/7 period. Having its highly skilled workforce available all over Pakistan will surely provide superior service. The pilot project has been launched and the maintenance team has been working efficiently with one of the service provider in Punjab covering approx. 500 Kms area of laid cable. In the past one quarter the company has been able to generate revenue of Rs. 25 million for providing maintenance services.

For one of the cable product named CLT cable, the demand has risen from 200 Kms per month to 300 Kms per month. This is almost 150% revenue increase over a period of six months.

Once the technology awareness program is conducted, the tangible results can be seen in near future. This will also help skilled human resource to further enhance their skill set and contribute in nation infrastructure building.

Optical fiber will be a critical technology in many aspects of future. The need of communications bandwidth up to the point where copper is no longer a suitable communication medium. Optical fiber already offers a step change in bandwidth capacity for the communications backbone. As the continuing boom in the telecommunications industry demonstrates, the present and future is optical fiber.

3.4 Conclusion

This study is based on the analysis of the technology contracts executed especially the contents that the contracts actually done the in same fashion within the scope of its documents. The management process of the company and SWOT analysis is also carried out to present the broader picture of the company and also serves as an eye opener for the company itself.

During the study, it is seen that the international pattern is being followed for the purpose of transfer of technology and know-how through joint venture and some technical assistance. For this purpose international guidelines and available contracts were also consulted for the reference. Contract draft is an art in itself and it must be written with complete consciousness. Few issues have been encountered during or after the execution of agreements including remittance delays and timely delivery of quantity to be developed.

A joint venture agreement involving technical collaboration and marketing between M/S LTE and M/S Fiberlogix UK is a sample contract attached as annexure “A” and a standardized draft for Joint venture agreements is also attached for ready reference as annexure “B”.

Chapter 4

TECHNOLOGY TRANSFER PRACTICES IN PAKISTAN

4.1 Introduction

Many developing countries realized that economic prosperity and social development can only be achieved by incorporating modern technology in key sectors in order to bring about an autonomous technological development process during the last decade of the previous century. For this purpose, technological objectives must be aligned with the national development policy to ensure the effects of new technology on national economy.

At first, many countries developed science and technology councils and some kind of institutional mechanism to cater the issues at highest decision making level. Secondly, establishing indigenous capabilities were long run objectives by the acquisition of foreign technology.

Identification of technological needs vary from country to country and from time to time depending upon relative resource, market size and overall level of technological development of country. It is important that technological requirements for the fulfillment of national development objectives are identified as much as possible in the light of current needs and circumstances of the country. It includes the technology already available in the country or can be developed indigenously and focuses to fill the gaps by induction of foreign technology where required.

4.2 Types of Technology Transfer Agreements

Technology transfer agreements include broadly the technical assistance agreements and licensing agreements. The major difference between these two are that the technical assistance agreements is more of a purchase contract while licensing agreements involve the grant of a right owned by the licensor. [50]

Technical assistance agreements are more like agreements for purchase of machinery, technical know how, trainings and services. These services are not secretive in nature and are easily available. Terms and condition are also drafted in a manner as in case of purchase agreements. The most common forms of such agreements are technical assistance agreements, business cooperation agreements, design ad engineering services agreements, consultancy services agreements.

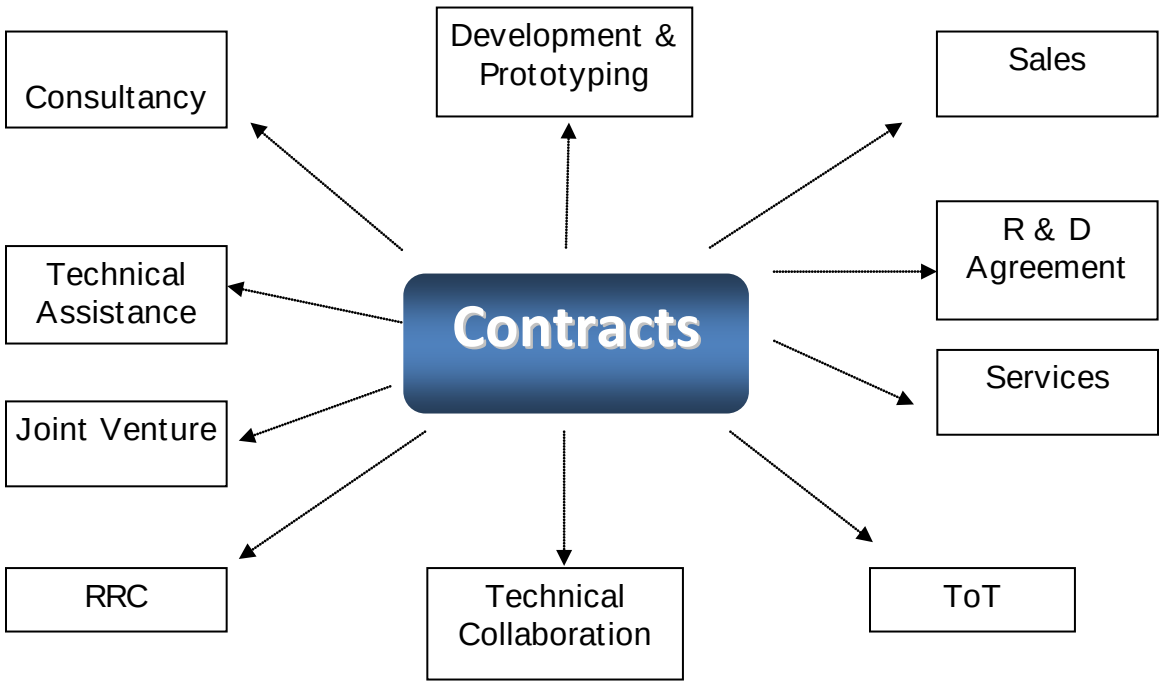

Figure 4.1: Types of Technology Contracts [69]

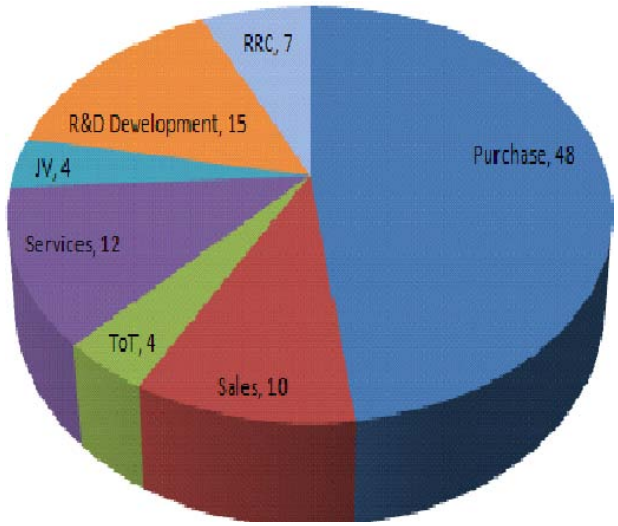

Figure 4.2: %age of Technology Contracts [69]

4.3 Existing ToT Practices of a Defence R&D Organization

The current sequence of practices in the field of international technology transfer in a defence R&D organization is as follows;

1. Analysis and Planning

Technology transfer involves three parts i.e. Receiver, Supplier, technology itself. Availability analysis is the first step in which international market survey is done regarding the intended technology. Once quotations are collected through different vendors technical analysis is performed keeping cost and specifications into view. The conformity to specifications is validated by comparing the quotes.

2. Finding Sources of Technology

Various channels have been used to obtain the desired technology. These are as follows;

- Informal sources
- Trade Fairs
- Through consultants
- International agencies

- By competitive Tendering
- Through government sources

3. Evaluating a Technology

Each source explains its technology and short listing of potential suppliers is done keeping the terms and conditions into view. Source track record and history is evaluated in this phase.

4. Negotiating Contract

Legal status, Intellectual Property Rights, Documentation, Marketing, Training, Technical Assistance, Finances, Machinery, Infrastructure, Physical quantity and other important matters are discussed here. Some transfers encompass partial and some complete transfer depending upon the agreement between the donor and receiver.

5. Finally writing a formal contract

4.3.1 Restrictive Clauses of Technology Contract

Following are the clauses that posed a kind of restrictions

Restrictions on technology improvements in processes during agreement period

- To purchase raw material, components and equipment from designated supplier with Conditional use.
- Export of products manufactured under agreement
- Quality of Product (prototype) a batch will be sent to company before complete delivery.
- Payments of industrial rights after agreement termination

4.3.2 Technology Transfer Contract Criteria

During the technology transfer process following three areas has been given stress in the order given below;

i. “Documentation” means drawing data packs, instruction manuals, Software and any other relevant data necessary for transfer.
ii. The goal of “Training” is to make people as competent as the technology owner.
iii. “Technical assistance” required during planning, start-up and support for some prescribed time afterwards.

i. Documentation

It is ensured that the documentation is ready to use in terms of completeness and correctness. The language used is standard and measurements are provided in generic international formats. Changes and improvements in documentation may take place due to the nature of the product, skill, capability. Documentation ownership is made mandatory in order to identify and traceability purpose. Defects in Documentation and/or software are also catered here.

ii. Training

Training is the most important part of the transfer. Skilled personnel are trained to manufacture the product as per specifications. The people are trained to repair, maintain, overhaul, and modify the complete system to be transferred. Training is also mandatory for up-gradation of work force. Place of training and duration, cost of training & schedule appropriate testing procedures are in place for the said purpose.

iii. Technical Assistance

Technical assistance is required from very beginning to the end of project. It takes place in three different phases i.e. before commissioning/prototyping, Start-up phase, Period of serial production. Requirements are different in three phases.

4.3.3 Generic Contents of Technology Agreements

i. Preamble
ii. Definition of know-how
iii. Formation of Joint Venture company
iv. Share Capital of company
v. Management of the company
vi. Distribution of Dividend of company
vii. Maintenance of Books and Records by the company
viii. Marketing
ix. Right to use Trade Marks
x. Supply of Technical Data
xi. Payment of Royalty
xii. Design Plans, Layout, Specifications for the Site
xiii. Training of Personnel and assistance
xiv. Deputation of Production Supervisor
xv. Project Engineer Selection
xvi. Terms of Payments
xvii. Settlement of Disputes
xviii. Force Majeaure
xix. Secrecy
xx. Laws of Jurisdiction
xxi. Execution of Agreement

4.4 Science and Technology Policy in Pakistan

In Pakistan, a comprehensive science and technology policy was adopted in 1984 and reviewed extensively thereafter to achieve self-sufficiency in food and energy, and for providing optimal healthcare, increasing literacy, improving national growth, and establishing high-tech institutes to support the industrial sector. A significant progress has been made in Pakistan in Science and Technology and the Pakistan Academy of Sciences

has been involved all along in this endeavor. [51] However, the challenges of the new millennium are extraordinary and require greater dedication than has been the case so far.

At the time of independence in 1947, Pakistan inherited very few institutions capable of scientific development and technological research. In the past five decades, Pakistan has made noticeable progress. The current institutional structure for Science and Technology in Pakistan comprises governmental and non-governmental institutions. The private sector is gearing up to use the available technological know-how to gain competitive edge internationally. Venture capital companies and autonomous institutions are engaged in accelerating technology-based growth.

The gap in Science and Technology between the East and the West is of recent origin. Contributions of the East in discoveries of science can't be rebuffed as it was the East that led the way in science for 500 years. Despite a nonpareil heritage, the East is lagging behind in Science and Technology, and the West has achieved technological superiority and is now setting the pace for technological advancement. [52] In the present millennium, joint ventures and collaborations in Science and Technology between the East and the West are emerging as a unifying force.

The currently widening gap in Science and Technology in Less Developed Asian Countries stems from multiple causes. Some of the common factors that have led these countries in a trailing position are lack of political stability, population pressure, harsh climate, import of finished products and huge national debts. These factors have not only widened the gap but have also disturbed the equity of science and technology between the East and the West.

Science and Technology development gains momentum when a suitable environment for its popularization is created. The creation and promotion of such an environment is a prerequisite for development of Science and Technology particularly in a country where social and economic patterns and customs are bound by tradition and religion. Pakistan has launched a movement for the popularization of Science and Technology as an

integral part of its long-range development plan. It is in this context, particularly, that the Pakistan Academy of Sciences has been most active. It has a continuing commitment towards inculcating a rational and scientific way of thinking among the Pakistanis.

At present, there are 85 major S&T organizations with over 224 laboratories and research stations in Pakistan working in different areas of science and technology. In addition, there are 109 universities in the country, about half of which are in private sector. National commission for science and technology (NCST) is the most important institution created in 1984. It has cross cutting function of determining policy across many government agencies and it does not have any administrative function. [52]

The commission is headed by the Prime Minister of Pakistan and includes ministers of S&T, Education, Agriculture, Industries, and Finance along with provincial support. The commission has an executive committee that is responsible to coordinate, oversee, and review the S&T policies, R&D program and implementation of the policy decisions taken by the commission. Pakistan council for science and technology is the designated secretariat of NCST and in this capacity it plays an important role in the science and technology policy formulation and decision making process.

Ministry of science and technology, created in 1972, is the focal point on all important matters regarding science and technology including developing science and technology at government level. Keeping in view the importance of information technology and its central role in future economic progress, recently a separate ministry was created for Information Technology and Telecommunications. [51]

Higher Education Commission (HEC), Pakistan Atomic Energy Commission (PAEC), National Engineering and Scientific Commission (NESCOM), Space and upper Atmospheric Commission (SUPARCO) are the other important bodies where S&T decisions pertaining to their sphere of work are made. HEC is responsible for the higher education including education and R&D in basic and applied sciences and engineering & technology. Current S&T statistics of Pakistan are shown in the following figures.

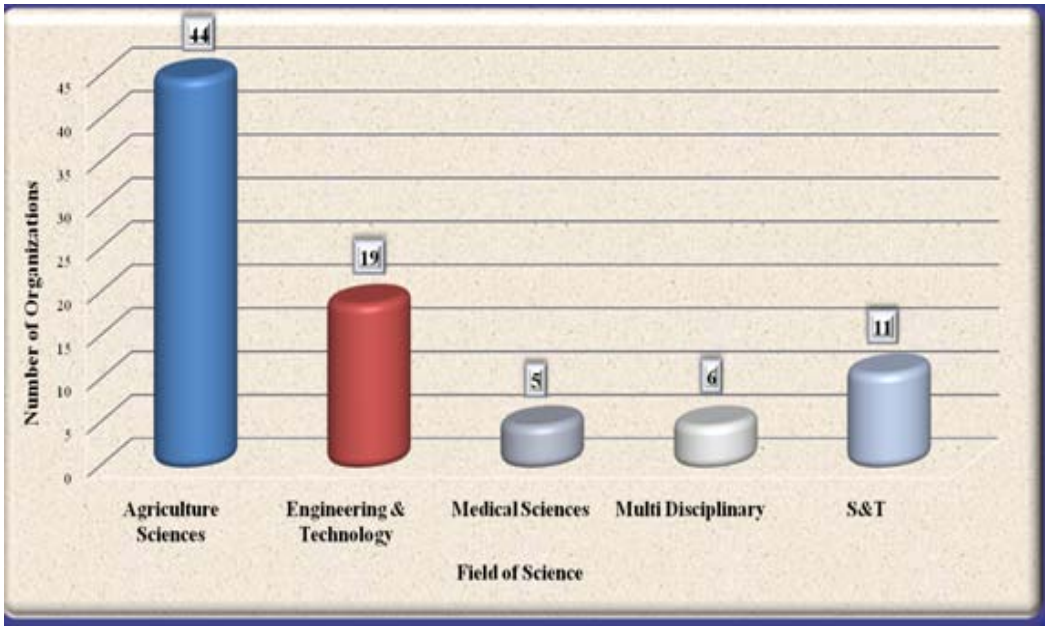

Figure 4.3: Number of Research Organizations by Field [70]

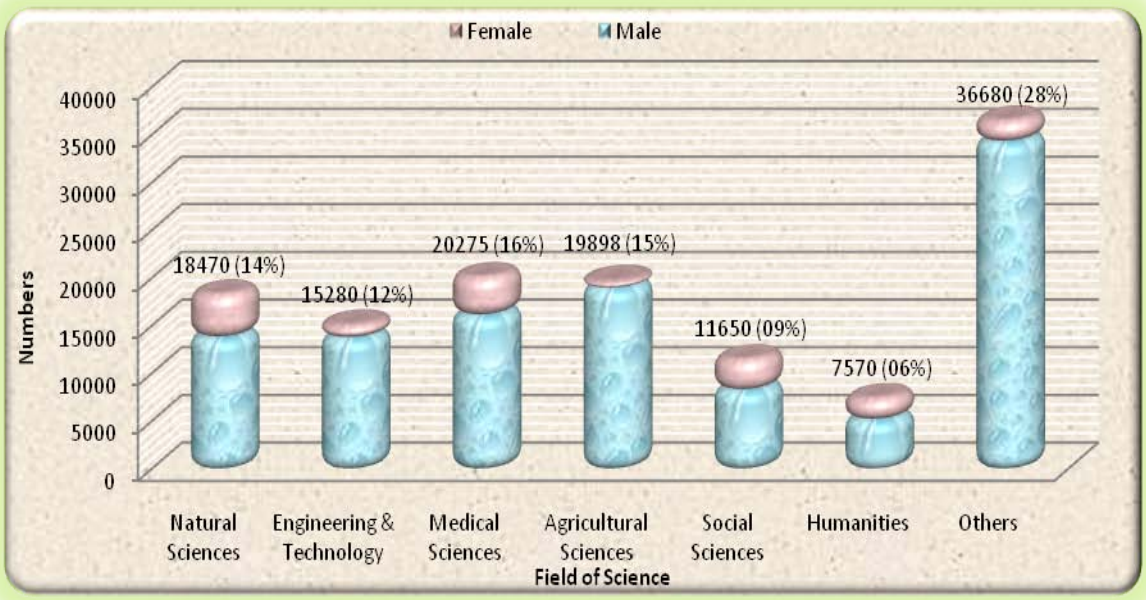

Figure 4.4: S&T Manpower by Field [70]

Country	Year	R&D Expenditure (% of GDP)	Researchers/Million
USA	2007	2.80	4651
Japan	2007	3.50	5646
Germany	2007	2.60	3390
China	2007	1.42	950
India	2007	0.90	145
UK	2007	1.85	3340
Sweden	2007	3.90	6250
Finland	2007	3.45	7690
Pakistan	2008	0.59	162

Table 4.1: S&T Indicators of Pakistan in Comparison with selected Countries [71]

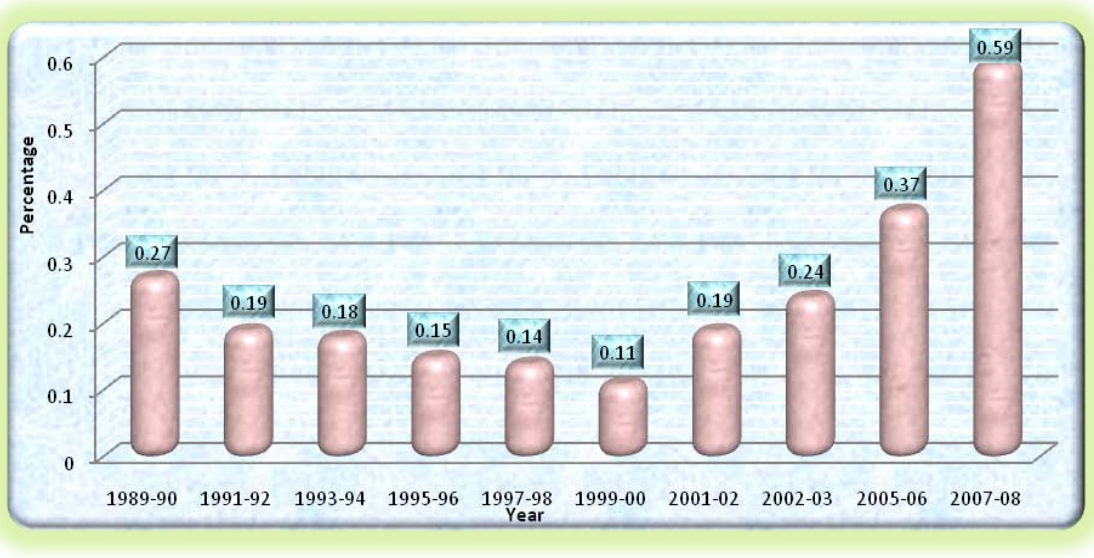

Figure 4.5: R&D Expenditure as Percentage of GDP [70]

Pakistan has recently promulgated a new Science and Technology Policy, which fosters a passion for scientific progress. This policy aims at optimizing technology-based development by investing in the latest technologies in order to gain an edge in indigenous industrial growth. Keeping this in view, the endeavor of the Academy is to focus on

national scientific priorities by coordinating international collaboration on its platform in the fields of:

(1)Agriculture (including Livestock, Fisheries and Forests)
(2)Medicine and Health
(3) Energy
(4) Environment
(5) Earth Sciences (including Irrigation and Soils, Meteorology and Oceanography, Minerals, Seismology)
(6) Information Technology and
(7) Biotechnology
(8) Bioinformatics
(9) Medicinal Plants
(10) Nanotechnology
(11) Climate change and water shortage

4.5 Role of Public Sector

The role of public sector organization has been always remarkable through its strategic vision. Overall, the achievements of public sector in using transfer of technology have been quite encouraging especially in the field of technology acquisition in selected areas. Collaboration with private organizations has met with varying degree of success. However, there is a dire need to consolidate their gains and overcome the shortfalls so as to turn them into a profitable industry. [51]

The success of Pakistan Nuclear Program initiated through strategic vision in the 70's is another example of dividends of technology transfer based on human resource and imported technology. This was sufficiently supported by Pakistan Atomic Energy Commission (PAEC) academia and research laboratories which provided the basic support. [52] To achieve self reliance in other technologies like night vision devices, laser range finder, image processing, sensors, signature control system, Navigation, Satellite

communication and many others, establishment of various organizations was accomplished and justified. These facilities are, now, available to endeavor in any related up-gradation and redesign of the system thus achieving self reliance in these sophisticated and essential technological fields. To augment the defense capabilities, National Engineering and Scientific Commission with its subsidiary establishments made numerous ToT contracts with friendly countries thus attaining self reliance through indigenization and professionalism of its own engineers. The organization has established state of the art R&D facilities to support the defense industry and undertake joint projects with varying degree of success. Heavy Industries Taxila (HIT), Pakistan Aeronautical Complex (PAC) Kamra are some other renowned organizations working on the modern technology programs.

Defense industry has always been an engine of growth for other industries. During the establishment of Heavy Industry Taxila it resulted in mushrooming of private support industry all over Pakistan which has now become the backbone of auto mobile industry. Despite the limitations of Chinese technology, projects based on Chinese collaboration have been highly successful as compared to western technologies which impose restrictions in certain selected areas, due to reliability and uninterrupted support. Reverse engineering being time taking and skill intensive mode of ToT has been successfully pursued by our industry.

4.6 Findings Related to Pakistan

Technology transfer is very important factor in the future economic growth of Pakistan. In this respect several steps has been taken both on the government level and also at the private level. The Daily Nation had news about Government of Pakistan's initiative: [53]

“The government has identified four major drivers of economic growth including agriculture, small and medium enterprises (SMEs) oil and gas sector and information technology (IT) to further enhance the pace of economic development”.

According to Official sources Public sector Development Program has been designed to support these drivers of growth, while meeting human development and poverty reduction targets.

Keeping in view the significance of the modem day technology in today's world of energy thrusting world, Government of Pakistan held exhibition related to oil, gas, and energy exhibition. This kind of activities helps attract foreign investments in the country. The news item was: [54]

KARACHI (February 24 2003): The four-day exhibition is scheduled from March, 2003 and is expected to draw attention of the key decision-makers from the region's energy sector. Despite the rapidly changing geopolitical environment in the region, a number of major local and international energy sector companies have shown keen interest in participating in the exhibition and more than 40 companies have reserved their stalls at the exhibition.

To compete in the local and foreign markets, the best option is to develop our own technology. The local technology has several advantages. Mostly it requires local raw materials, scientists and technicians are locally available, and there is little or no problem regarding the assimilation of that technology to the local culture. In this respect PCSIR is ready to help SME's to produce and compete in the market. The Director General PCSIR Mr. Syed Naeem Mahmood said: [55]

The Pakistan Council of Scientific Industrial Research (PCSIR) is ready to help local Small and Medium Enterprises (SMEs) in industrial research to produce their products. The institution may also transfer all the technology of products or formulae to businesses, if they have the money to establish their industry anywhere in the country. We have formally invited the Union of Small and Medium Enterprises (UNISAME) and Zulfikar Thaver, chairman, UNISAME, to discuss the problems SMEs face. PCSIR has almost 175 qualified scientists in Karachi alone and is already providing industrial support to many large industries. He asked SMEs to launch their own products in the country

instead of importing foreign brand items. PCSIR can help SMEs with the production of. textiles, leather products, pharmaceuticals, cosmetics, household chemicals, food additives and consumers products in the form of emulsions, surfactants resins, adhesives, plastic parts, perfumes, flavors and other chemicals and nonchemical products. The expertise and technical manpower with the PCSIR have been able to decode and analyzed over 2,000 of imported products and have helped local SMEs in the development of import-substituted materials. He said PCSIR scientists and technologists have developed 684 industrial processes and products and 350 patents, mostly based on locally available raw materials. Out of these, nearly 400 processes have been commercially exploited on an industrial scale.

Latest technology is always been an issue in the military history. Even today, technology is the main component in analyzing the strength of any force. Pakistan Navy is no longer behind in this regard. To remain an active navy in this region, a strategic plan was built and several decisions were made. The acquisition of Agosta Class submarines along with its technology is one of the components of the strategy. In 1994 a contract was made with DCN France for three Agosta class submarines.

The first submarine was to be completely built in France. Pakistan Navy engineers and workmen were to be trained and qualified in the construction processes. DCN was to assist PN Dockyard to upgrade the infrastructure for construction of submarine. The first submarine joined PN Fleet in December 1999 as PNS/M KHALID.

The transfer of technology level for next two submarines was to be raised gradually in second and third submarine. This was also necessary to immediately put to use the new acquired construction skills. Based on this principle, three pressure hull sections of submarine NO.2 (PNS/M SAAD) were built in France and delivered in 1998. This enabled the engineers and workmen trained in France to quickly organize and put to use their skills. Even before the delivery of sections of submarine No. 2 the work on major structures was started in December 1997. The three sections were transferred to Section Building Hall using Dual Walking Beams and were pre-outfitted for one year. These

sections were lowered in Graving Dock in December 1999 and linked together. The outfitting phase in Graving Dock included 14000 equipment and foundations, 6000 pipes, .40 kilo meter of cables and 38000 connections. Approximately 30000 quality checks were performed during the construction of submarine No.2. The second submarine was launched on 24 August 2002 and started its harbor and sea trials. This submarine has completed over 1200 harbor and sea trials and on successful completion this has been commissioned as PNS/M SAAD on 12 December 2003.

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The maximum transfer of Technology was envisaged in submarine NO.3. The cylindrical part of the pressure hull was to be built from raw plates. All major structures and appendages were to be built in Pakistan. The work of pressure hull construction also started in 1997 was shared between PN Dockyard and KS&EW. PN Dockyard provided the material after cutting to size and shape on NC cutting machine to KS&EW. This kit of material was rolled formed and welded to make 12 subsections. Based on similar construction methodology these sections along with Air Independent Propulsion (AlP) system MESMA, have been lowered into Graving dock on 19 August 2003 and outfitting has started. [56]

Technology and international trade, both requires standardization. It is now a reality that without standardization, it would be impossible to grow and compete in the international market. In this respect GOP has taken some "bold steps and also it is facilitating local industry to acquire technology and processes which meet the international standards. In this respect, assistance has been asked from US and European agencies. There was a report on UNIDO publication [57] regarding GOP efforts:

Following a European Commission identification mission that visited Pakistan in February 2003, the Commission's EuropeAid Cooperation Office in Pakistan decided to proceed with a joint appraisal mission by the International Trade Centre (ITC - UNCTADIWTO), UNIDO and the World Intellectual Property Organization (WI PO). The mission (9 - 17 June, 2003) covered Islamabad, Lahore and Karachi and comprised Mireille Perrin Decorzent of the EuropeAid Delegation in Islamabad, George

Papazafiropoulos of lTC, Mansur Raza of WI PO, and Lalith Goonatilake and Carlos Chanduvi (UNIDO Representative in Pakistan).

The five million Euro *Trade- Related Capacity Building Program,* which is expected to start in early 2004, will provide support in two main areas: trade and capacity building on WTO issues (both in the private and in the public sector); and standards, quality and SPS (Sanitary and Phytosanitary) requirements. The UNIDO Standards Metrology Quality / SPS component of the program, which has a budget of 2.2 Million Euros, reflects the Toolbox of Instruments framework for the facilitation of trade in the fields of standardization and conformity as laid out in the EC communiqué, to the WTO Committee on Technical Barriers to Trade, 19 April, 2002 (Ref:GITBTJW/173/Add.1)

In addition to specifying the sectors to be covered by the program, i.e. agriculture, fisheries, leather and textiles, the mission identified the nature of the capacity-building activities and the number of persons to be trained.
The Trade and capacity building on WTO issues component comprises three areas: Technical assistance in implementation of WTO obligations, such as TRIPS (Trade-Related Intellectual Property Rights, and safeguards; Awareness and capacity building on current trade negotiations (notably WTO Doha Development Agreement) of particular relevance to EU-Pakistan trade relations. The main target audiences are government officials, the private sector and civil society organizations. The third area is a dedicated training and research center on WTO and international trade.

The Standards, Metrology, Quality / SPS component covers four main areas. The first area is accreditation rules *I* regulations: to harmonize international and Pakistani standards, including technical assistance to upgrade product quality and further develop the national accreditation system, ensuring compliance with international regulations *I* standards, cooperation in the field of adaptation of procedures and dissemination of new standards. The second area is laboratories: to provide technical assistance and support for Pakistani testing facilities (to have internationally recognized accredited laboratories). The third area, the industry component, will build capacities and provide assistance to

industry to deal with certification requirements, such as SA 8000, ISO 9000, ISO 14000 and HACCP. The fourth and final area of the *Standards, Metrology, Quality / SPS* component is training and capacity building on WTO and EU SPS requirements for officials and the private sector. .

COMSAT held a meeting on "Science and Technology for Sustainable Development" in October 2001. Eminent scientists and researchers participated the meeting. In his inaugural speech, Dr. Atta-ur-Rahman pointed out that the 21st century is going to be a knowledge driven century. He mentioned that the excellence in basic scientific areas and-their application in tandem with technology is the only way we can do away with scourge of poverty in the developing world. In this time of knowledge-based economy, Pakistan stands at 92nd position in the field of scientific research and development. It is placed at 8th position amongst top ten scientifically productive Muslim countries.

The government has increased research and development expenditures as percentage of Gross Domestic Product (GDP) from 0.2 per cent in 2001-02 to about 0.6 per cent in 2007-08.

Resultantly, research and development manpower per million population increased from 96 in 1995 to 162 in 2007. Number of research publications has also increased from 641 in 2000 to 2,494 in 2007.

Prof. Dr. Riazuddin talked about some emerging technologies likely to dominate the 21st century, like Nanotechnology, Nanomedicine, space technology, biotechnology, and genetic engineering.

Mr. Pervaiz Ahmad Butt discussed the critical area of restructuring R & D in Pakistan. He pointed out that the success can only be achieved if drastic reforms are carried out withing the R & D sector and also if R & D organization follow a "Demand Pull" rather than "Supply Push" strategy.

Asian Technology Information Program (ATIP) [58] has prepared a Research Overview report mentioning the efforts made by the GOP in the field of science and technology.

Scientific and technological effort in Pakistan is presently organized at two levels, in the following manner:

Level 1: Decision Making. Planning and Coordination

The principal body concerned with the formulation of national policies in the S&T sector as well as with the overall promotion and co-ordination of scientific research and development activities in the country is the Ministry of Science and Technology which has two important autonomous organizations - the Pakistan Council of Science and Technology (PCST) and the Pakistan Science Foundation (PSF).

The major functions of PCST are:

1) To advice the Government on science policy and matters relating to the promotion of national scientific effort,
2) To review the work of Research Councils, and
3) To ensure linkage of science with national development plans.

The PSF is primarily a financing agency whose main function is to promote basic and fundamental research, having a bearing on the socioeconomic needs of the country.

Level II: Performance of Research

S&T research work is largely carried out in autonomous or semiautonomous organizations administratively linked with various federal ministries.

4.7 Summary of Findings

In the process of finding information regarding the topic, lot of data came across was studied. Although selective portion is mentioned here, most of it is not even referred.

Nevertheless, it does not mean that all of these were irrelevant. Rather few were very much focused on the topic but are not referred due to its length.

To summarize, it is found that the Government of Pakistan even from its initial days was concerned about the technology and its effective use in the country both in the area of business and military.

For this purpose, acquisition of technology was planned. The reason of not starting with the local available technology is that at the time of creation, 1947, the country was not in the condition to exploit its own resources. There was not furniture available for the offices to run.

Later, when government established Planning Commission, with the charter from the assembly and constitution, the country formally was able to get proper guidance and direction in this area.

Planning Commission has done some remarkable work. Although at several times, the ruling government surpassed the suggestions made by the commission but largely the country gained momentum and growth due to the effective policy making, planning, and monitoring functions of the commission. In the development of industry especially in the field of technology acquisition, the role of Planning Commission cannot be overlooked. It was found during the interview sessions with the officers from the Planning Commission that in most of the cases wherever government overruled the policies and suggestions of planning commission, the result gained was found not favorable.

Education plays very important role in every country's economic development. The case of Philippines is already mentioned earlier, another example from this region is Sri Lanka. The literacy rate is above 95%. It is expected that as soon as the resources are properly diverted towards the economic development, the country will become economically sound. It already has most of the prerequisites.

In the case of Pakistan where literacy rate is shamefully low, it will be very difficult to grow and become economically sound even within next ten years. The data from

education sector shows that if today GOP doubles its education budget for the next ten years, the literacy rate still cannot be doubled after ten years. Pakistan needs to focus in this sector seriously. The low literacy rate is a serious hurdle in the technology transfer.

Another factor is the quality of education. Baring few institutions and universities, many are providing below standard education. As a result, a graduate having the piece of paper as degree is not mentally and intellectually capable to perform effective role and become catalyst in the transfer of technology.

It was found during different interviews and discussion from the people having background of human resource development, that majority of our industry players still does not believe in training and development of its employees. Only in major cities like Karachi and Lahore where the organizations are little aware and sends their employees for training and development. The reason could be that most of the firms are owned and run by individual entrepreneur, who is more concerned for short-term returns. This is another reason where the owner and the employees are not even aware of new technologies available in their respective operations. Therefore, they are not interested in getting new technology.

Language plays very important role in the transfer of technology. Pakistan where Urdu is the national language, spoken and understood across the country, English is the second language, which is understood not even by 20% of the population. Most of the scientific and technological knowledge is available in English, French, German, Japanese, and Chinese. People ignorant from these languages have problems in assimilating new ideas, concepts and knowledge from these countries.

The GOP has taken some steps by arranging scholarships leading to graduate and post graduate studies in these countries. The scholarship program includes some initial period in which the student is required to learn the local language. This helps in getting the technology from that country.

The example of Pakistan Navy mentioned earlier regarding the purchase of Agosta class submarine, the engineers and technicians sent France were first required to learn French language before they started learning the new technology.

Existing employees of a running enterprise sometimes feel threatened on the introduction of new technology. They are susceptible because they think new technology will result in the layoff in the organization and they may loose their jobs. One of the telephone companies was unable to install fiber optic cables at the customer ends because the linemen were confident this would reduce their importance in the company. Therefore, they managed to the failure of the whole project.

Another angle in this issue is legal contract. At times, donor country impose legal requirement that the products specifications should not be changed or improved. All kinds of changes will only be made according to the parent company's instructions. This discourages in the research and development activities, as the local entrepreneur never tries to upgrade or assimilate the technology no matter how unfavorable the product or technology has become over the passage of years.

At times, the donor country also imposes the restriction of buying the raw material from them. This enables the parent company to earn two fold, through the license, as well as, through the export of raw materials. Substituting with local raw materials in most of the cases is not allowed. This situation discourages the development of need to research on the area of local raw material usage.

Law and order situation is another aspect of discouraging investments especially from the international businesspersons and industrialists. News regarding hostility towards foreigners arouses other governments to issue travel warnings to Pakistan. As a result, they look towards other countries for investment opportunities.

Political situations on the international and regional fronts are off great importance. A probable war between Pakistan and India is always a matter of concern for the international investor, which brings ideas and technologies.

Local political situations like ethnic violence, strikes, and terrorist activities create feelings of uncertainty even to the locals as well as foreigners. Moreover, lack of job opportunities and low level of quality of life discourages the Pakistani expatriates to return and invest in Pakistan.

4.8 Conclusion

To conclude, I would like to highlight the role of Planning Commission in the economic development of Pakistan. Planning Commission is a premier institution having the capability to perform and deliver. It needs improvement and requires to be strengthened in terms of its role and operations. There are other public sector institutions which has delivered in the past and still has the capability to play important role, may also be given due consideration with respect to their operations and systems.

Another area, that requires immediate attention on a continuous basis, is education. Without proper and quality education, as a nation we cannot prosper. Government as well as all private and public institutions along with different business and non-business organization must commit and contribute to increase the literacy level in the country.

Baring few institutions, most of them provide below acceptable quality education. Government may introduce some kind of central certifying examination, which has to be passed in order to gain license to practice. A good example is the examination held for Charter Accountants in Pakistan. Unless one qualifies in the CA exam, the graduate cannot practice as a chartered Accountant.

Recently, different kinds of exhibitions and seminars are being held by different companies. It is good sign, as this will help entrepreneurs, and managers to gain knowledge about the internationally available technologies and emerging trends in the competitive market. .

One of the emerging problems is the influences from the local powerful leaders. Government need to pay immediate notice and circumvent their illegal and irrational influences.

Proper infrastructure is the pre-requisite for the industrial growth. In the past, several areas were developed for this purpose like SITE in Karachi and Noriabad at the outskirt of Karachi. All these areas need to be maintained and there facilities required immediate up gradation. In addition to these, new technological parks should be developed in order to attract investment in the industrial sector.

In Pakistan, research and development activities are very low in volume and quality. This needs to be increased and focused according to the industrial and business requirements. There are examples where, the scientists spend lot of valuable time and other resources to achieve a solution for which there exists no problem.

In negotiating with donor countries, we need to formularize policies in order to get best deal and maximum benefits when transferring technology from other countries.

Change in international geo-political situation should also be monitored closely and relevant offices must plan and help business sector to take maximum advantage from the emerging circumstances.

Deteriorating law and order situation will hamper additional investments and technology transfer in the country. To control this, Government must formularize process to provide justice at all levels of society at minimum cost. This is a proven fact from the books of history that a nation cannot survive without the proper system of justice available to people belonging to all walks of life. Justice is the first step towards the development of all sectors in the country.

Chapter 5

GENERIC ToT MODEL FOR A DEFENSE R&D ORGANIZATION

5.1 Introduction

This chapter presents a conceptual model of processes as a framework of the technology transfer and development processes to a defense R&D organization in Pakistan with regard to international perspective. Technology transfer is not as simple as it seems to be in the context of less developed countries. Technology transfer has played valuable role in economic development and considered as an effective tool to gain technological sophistication in a very little time. On the other side, failures have been witnessed in case of transfers to less developed countries due to insufficient financial resources. Sometimes, failure occurs after the transfer process. Green Revolution is one of the examples, i.e. the transfer of western agriculture methods to various developing nations to increase the food production (Cf. Wright, 1992). The major reasons for technology transfer failure are due to lack of need assessment and lack of technology assessment. [59]

The proposed model consists of development stages as well as some propositions related to the stages of transferred technology, technology acquisition processes, and stakeholders of technology development involved in the entire process.

The model explains several process dynamics must be taken into account while transferring the desired technology to R&D setup in Pakistan keeping global perspectives focusing on the linkages between the donor and receiver. In addition to formal channels, this model can be applicable to non-formal channels like replication, equally important as methods of technology acquisition in terms of intra-firm transfer. Moreover, the proposed model analyzes the processes from several different viewpoints and can be applicable to country, industry, firm level.

5.2 Technology Transfer Dynamics

There is vast literature available on the subject of Technology transfer. It is a process through which some other individuals use specific technology for the prescribed purpose or for some novel application. [60] Technology transfer involves stages like discovering, evaluating, adoption and development of the technology. [61] An appropriate method of technology transfer should be adopted keeping national policies in view having complete insight regarding the technology. [62]

Technology can be classified as vital, strategic, and conventional according to national needs. Technology has a multidimensional nature and not only limited to manufacturing of goods or techniques. A new innovation can be easily absorbed in an atmosphere of already technologically aware society and can result into elevation of technology at a national level. This can be achieved through the information exchange process and better communication between the experts in the specific fields. When market competition increases the manufacturing cost or the services cost automatically decreases. The result would directly or indirectly benefit the society at large. Therefore, it is said that time in which appropriate technologies are produced and introduced into the industry serve as the most important factor for measuring the technology life. The direct linkage between the university and industry can not lead to a constant source of cooperation due to different nature of these two. There must be another sector in between them. This sector can do a lot by innovating, testing and the outcomes can be absorbed through industry. [63]

5.3 Towards Structured Approach

Technologies can be acquired by companies through number of ways including;

- By directly doing Internal R&D activities
- Contracting External R&D
- Licensing from another company
- Through Joint Ventures for product or production process as well as for R&D for entering new product area

- Direct purchase of Equipment
- Investment in Manpower
- Acquiring companies

Scores of technology transfer theoretical models have been constructed till now. The fundamental problem and obstacle is the actual definition and measurement of the stocks and flow of knowledge. From earlier writers, Arrow developed the concept of “Learning by Doing” in the structure of an economic model in which learning is limited to the capital goods industry. [64] Findlay constructed a dynamic model of technology transfer to less developed countries and highlights that the progression of technology gap depends upon its original size and control of foreign over domestic capital stock. [65]

Transfer of technology is accomplished through commercial contracts involving the provision of goods and services. There are many types of contracts covering from equipment delivery, acquisition of production rights to the training of people and temporary provision of experts. Transfer of technology is a package deal involving variety of goods and services. Licensing, Turnkey contracts, and Joint ventures are usually referred to as technology transfer contracts. It is evident that complete technology transfer processes take considerable time and number of years are required depending upon the complexity of the transfer project and recipient capabilities. The model of consultant engineers presented as industry by Eckhard Siggel proposed that by introducing consulting engineers in the transfer deal shifts the risk of project failure to technology supplier thus making it popular from the LDCs’ viewpoint. [66]

Before technology acquisition, a company must have to analyze the intended technology and its location on the technology S-curve. Arthur D. Little, a consulting firm, presented an approach that proposes the acquisition of technology according to technology life cycle and investment decision depends upon the competitive impact of technology. This impact depends upon the technology location at S-curve shown in the figure 5.1. Different stages have been shown on the S-curve with respect to time. Technology stages are classified as emerging, pacing, key and base technologies. For any company, the

technology acquisition decision depends upon the performance and technology stage of the intended technology. [67]

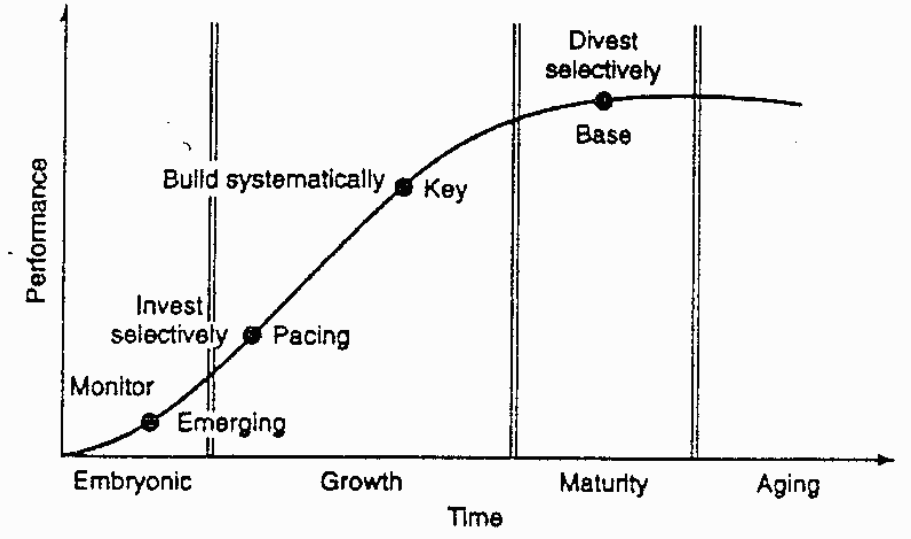

Fig 5.1: Technological Investment Mode [9]

Transfer of technology is not as simple as it seems to be. The social and economic forces could be influenced in order to steer technology to contribute to sustainable development (Weaver et al., 2000, Mulder, 2006). Several factors must be kept into consideration like local culture, conditions, economic and geographic circumstances. There is a need to study the cultural roots of a technology before implementing the western technology into eastern culture (Awny, 2005). International Technology Transfer has become common and played significant role in the wealth creation. ITT includes transfer of systematic knowledge for the manufacture of product, for the application of a process or for the rendering of a service (Zhang, 2003). Most of the transfer is carried out for the reasons like;

- Securing imported material for local consumption (Vertical Integration)
- Serving host market, if import become expensive (Horizontal Integration)
- Operating in world market in a foreign country (Globalization) [59]

The ToT is a process by which customer successfully gets hardware and proficiency in software, technical skill and knowledge regarding the technology at the same time from

the seller. The generic set of processes must include the following components as shown below in Fig 5.2.

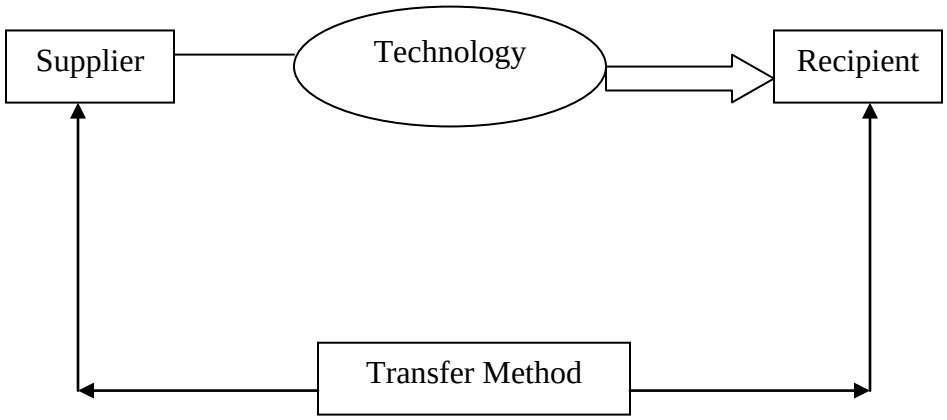

Fig 5.2: Basic Components of Technology Transfer [63]

1. Technology Supplier
2. Technology Recipient
3. Technology Transferred
4. Technology Transfer Method

Developing countries have realized that social compatibility can only be achieved through industrialization process and imported technologies can provide the required base for industrial development through international technology transfer initiatives. ITT occurs through mutual cooperation agreements or by direct purchase of equipment from western world. It also occurs through multinational corporations (MNCs) which invest production facilities in LDCs due to cheap labor rates available. There have been significant evidences in huge success gained by Korea, Taiwan, Hong Kong, Malaysia, Indonesia, and Singapore. Various theoretical models have been tested to achieve transfer process with varying degree of success.

A ToT model has already presented different approaches for technology assessment and selection process for less developed countries. Technology transfer involves a series of

stages for any developed or developing nation. This particular paper focuses to develop an approach to technology assessment and selection. Transfer of technology can be affected by internal and external forces or factors. The ToT model proposes two approaches for development; quantitative approach and qualitative approach. Any less developed country can assess the need and stage of technology required with respect to its own capabilities through this “ToT Model” on quantitative and qualitative basis.

In quantitative approach, technology breakdown structure is made and the structure is categorized in different factors and sub-factors. Weight has been assigned to every factor and sub-factor according to its respective level. Factor analysis is performed using ToT curve method thus giving the appropriate level of technology to be imported for developing country. Three horizontal dimensions were assumed for the purpose of identification of suitable technology including receiver level, donor level and receiver technology level with respect to intended technology. The vertical dimension focuses on the factors and sub-factors related to receiver, donor, and technology being transferred.

Qualitative approach suggests a ToT matrix in which all the goods and bads of internal and external factors to developing country are enumerated. The matrix contains feasible strategies to best select the suitable technology by taking internal and external forces into view. Quantitative approach was also applied to validate an actual ToT project to measure the suitability level of the project. [68]

A generic model of ToT processes has been developed for the less developed countries keeping its very importance in view. The “ToT Model” described above presented approaches for selection and assessment of technology for developing countries while the under-mentioned model is devised to cater the whole process of technology transfer from developed nations. A framework is proposed for the complete activities of technology transfer process considering the all possible levels.

5.4 Generic ToT Model for A Defence R&D Organization

The main objective of less developed countries to pursue ToT is to gain maximum development in much shorter time than that originally taken by the industrialized countries to reach the present level. Less developed countries are mainly technology borrowers. Keeping this scenario into view, a theoretical model has been developed for the transfer of technology projects to a defense R&D organization is presented in the figure 5.3.

This generic model provides criteria for the successful transfer of candidate technology. The model has been developed on the basis of preliminary literature available on several theoretical models presented on transfer of technology processes. The successful transfer process must be systematic and deliberate in manner. ToT projects involve several coordinated activities through which buyer receives technology from the technology supplier. This model proposes a set of activities and processes that must be followed before acquiring technology from any foreign source.

ToT is a complex process that involves engineering, management, economic, social, political and environmental factors. Multinational corporations have been the main source of ToT through Foreign Direct Investment and Joint Ventures. It is seen that technology capability enhancement has been carried out widely through local R&D in the developing countries. There is no integration of business and technology strategy in defense R&D setup.

The first step is to identify the target market need. Whether the technology to be transferred is need of the society or just a wishful thinking? The management decision is required in transferring the technology. It is very important that decision making group is equipped with pool of experts in related fields. Knowledge can be transferred through formal means such as conferences, seminars, training programs as well as informal means like on job training, telephone communications. This expert group work through the system to develop specific criteria relevant to country, sector or firm.

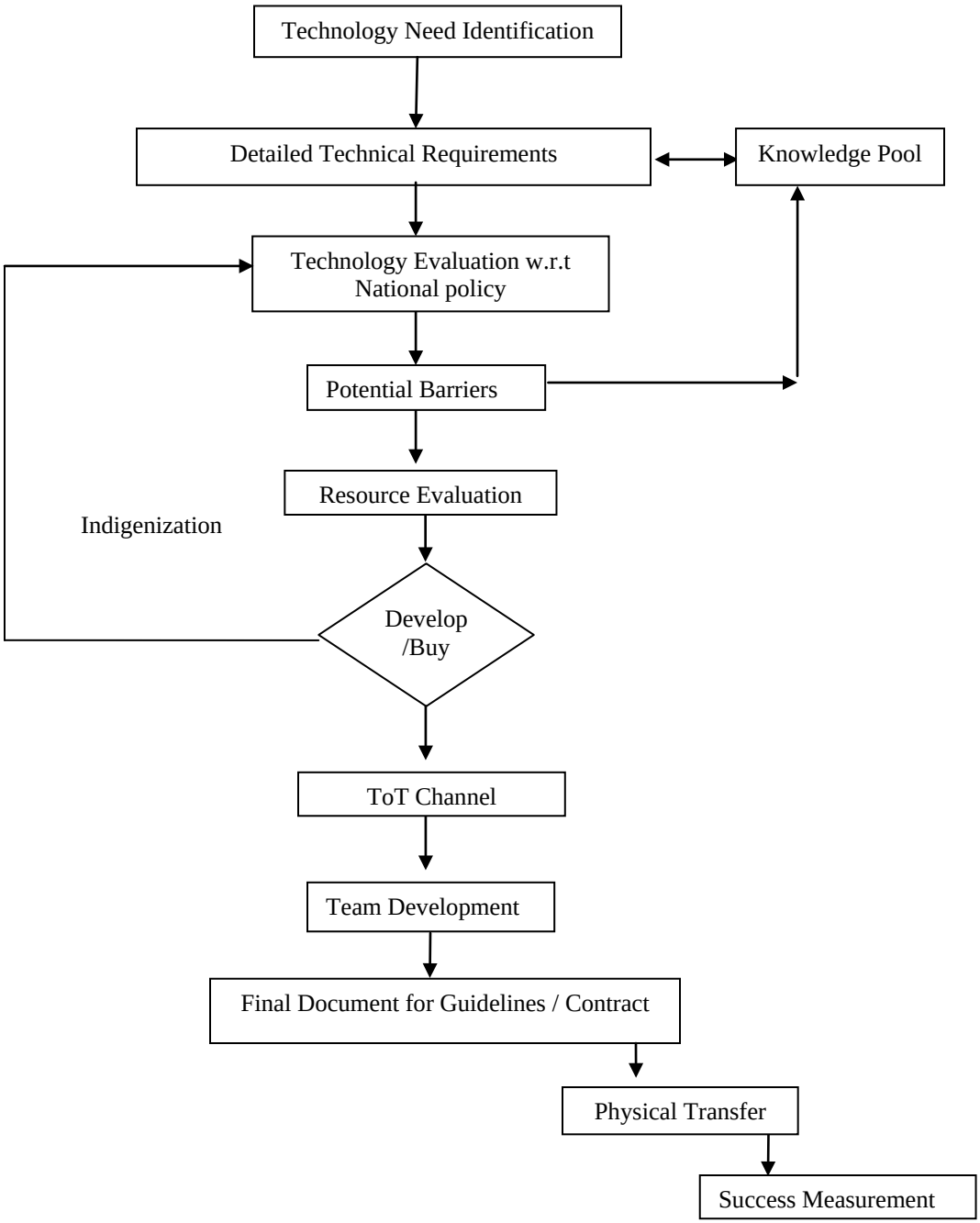

Figure 5.3 Generic ToT Model of Processes for a Defense R&D Organization

Technology evaluation is done in the next step. It is the most crucial step as to whether buy or transfer the technology keeping national policies in view. Every country has its own development plans and a structured decision making process. At this stage, objectives, preliminary feasibility study, country priorities, technology options available, cost analysis and their implementation is carried out. Technology choice depends upon national goals as well as on other factors like financial ability of company and profit margins. Technology analysis and evaluation ensure both quantitative and qualitative criteria.

Potential barrier are vital and must be taken into account. These barriers may include cultural differences, language, social values, foreign policies, political factors and technology change. Physical infrastructure including resource allocation, equipment, budget, raw material availability and also market opportunities are examined before transferring the technology in order to ensure the absorption of the technology project.
The legal system of the country plays crucial role in technology flow process. It may impose heavy sanctions on supplier.

Most of the technologies are transferred from overseas through multinational corporations. There are technologies that can be developed locally and at make or buy stage it is evaluated whether it is feasible to make locally if the skills and resources needed are appropriate. Technology decision is made after reviewing the possible alternatives otherwise plans are reconsidered or re-evaluated.

Conventional transfer modes as well as unconventional modes are of common interest as these are cost effective and beneficial. The unconventional channels include reverse engineering, brain drain and Foreign Direct Investment in industrialized countries. Commercial ToT can be achieved through Joint Ventures, FDI, Licensing, Franchising, Marketing Contracts, Turnkey Contracts and international subcontracting.
An exclusive team of individuals is composed for each transfer project. Success largely depends upon the quality of the people selected for the project. This team is responsible for the physical transfer of the project. It involves complete procurement and

transportation processes of the technology. Effective teamwork is required to bridge the visible gap in transfer projects to achieve the maximum outcome.

Finally, Success measurement and evaluation process is mandatory in order to gauge the whole transfer process. It helps in learning from the mistakes and improvement processes. It should be evaluated both at macro as well as micro levels.

Technology transmission should be smooth between the seller and buyer. The decision making body consists of government authorities along with pool of knowledgeable experts. This model provides a thorough systematic process for decision making. It prescribes the theoretical basis for decision making framework for strategic choice of technology for a defense R&D organization. Government policies, investment climate, entry to local market, regulations, industrial policy and conducive environment for technological growth are very vital factors to magnetize the modern technology holders.

5.4.1 Merits of Proposed ToT Model For R&D Organizations

Following are the merits of the ToT model,

- This theoretical framework is useful for the development of appropriate decision making approach towards effective technology transfer process.
- The model provides structured approach from need identification to success measurement.
- This procedure can overcome any possible biases in judgment of decision making.
- Useful for optimum allocation of resources to avoid project duplication so that capital can be committed to feasible ventures only.

5.5 Conclusion

Transfer of technology has been considered as a very simple process. Sometimes, it has been executed without much consideration due to urgent need of the developing country. There are many factors that are not recognized in the process of transfer of technology

and results in failure. A generic model of processes has been developed that gives guideline for consideration in technology transfer process to a defense R&D organization.

This theoretical model is suggested for the smooth transmission of technology projects from an overseas company to a defense R&D organization in Pakistan. This is mainly based on the commercial channels being used for ToT. The outcome of the study presents an insight to ToT projects development and provides valuable guidelines, especially to defense sector in Pakistan with regard to international technology transfer.

Technology evaluation procedure is also proposed in order to focus the purchase activities of technology in the future and to learn lessons from the past. This procedure can overcome any possible favoritism in judgment of decision makers. This theoretical framework is useful for development of an appropriate decision making approach towards effective process of ToT.

Finally, it can also provide an approach for optimum resource allocation and defines a systematic manner for choosing between technology proposals so that only feasible ventures can be carried out. Certain basic processes are identified keeping developing country’s environment in consideration.

Chapter 6

RECOMMENDATIONS

6.1 Introduction

This study was aimed to study and analyze the existing transfer of technology practices in a defense R&D organization in Pakistan. The comprehensive analysis of technology transfer agreements was of premier concern. Moreover, transfer of technology is discussed in its broader context in the development of science and technology in Pakistan. The technology agreements were seen in the scope of its documents and it is found that international guidelines are followed during drafting the contract. Strategic management processes and SWOT analysis was also carried out.

The focus on technology agreements was chosen because the idea was conceived through the comprehensive study undertaken by Dr. Syed Qadir Ahmed, Assistant Professor in the department of Commerce at the University of Karachi, Pakistan. He carried out very detailed and methodical analysis of the Licensing agreements for transfer of technology in Pakistan. Another reason for pursuing this study was that my professional background made it possible to carry out such a study as there are many examples of technology agreements, technical assistance agreements and technical cooperation and Marketing agreements present in the organization.

The importance of technology agreements with foreign clients and implications for acquisition, development and diffusion was not handled as it should be. Furthermore, the author faced acute problem of non-cooperation from the official sources. The persons were reluctant to disclose any specific information due to secrecy of the content material. The author only used the data for the sole purpose of appreciation of the system without divulging any information regarding the organization. Initially, some technology contracts were not executed as it was presumed due to lack of knowledge while at the stage of draft level.

Having developed in depth concept and application of transfer of technology and seen the dividends in terms of economic growth and self reliance achieved by various countries and success stories of even our own experiences, it has been observed that transfer of technology is the right way forward provided it is appropriately diffused and pursued as a well devised futuristic plan.

Furthermore, ToT requirements should be derived from the national objectives as a mean to achieve the end and not the other way around. It should be dictated by peculiar domestic environment and ground realities and should be achieved progressively in well planned stages to ensure that each stage is complementary to each other. It is also based on the fact that ToT remains an important means for achieving economic development for Pakistan. We should consolidate our gains by overcoming the weaknesses based on the lessons learnt from our own experiences. Its success lies in the development of human resource and their subsequent training and infrastructure improvement.

Overall, the industry has performed well, however, there are certain deficiencies, shortfalls and voids which need to be overcome to enable them meet the challenges of today and future. Since it is one of the components of strategic establishments in Pakistan, it would be prudent to select it as a case study.

6.2 Strategy Identification

All such establishments should identify the shortfalls in their production facilities including new projects likely to be undertaken and specify the technologies aimed to be acquired. The following objectives for making strategy are identified in the analysis and are described below;

I. Detailed pre-qualification of recipient industry infrastructure for absorption of intended technology
II. Pursue transfer of technology with futuristic innovative outlook to remain competitive
III. Logistic support and sustenance to anticipate restrictions

IV. Absorption of core and emerging technologies by developing skills and human resource
V. Self sufficiency through indigenization by reducing dependence on foreign sources
VI. Encourage export orientation for financial benefits

6.3 Suggestions

Transfer of technology is a complex task that involves technical, legal, administrative and economic aspects. A group of experts in the relevant field must be composed for making policy decisions and guidelines for the drafting technology transfer agreements at national level. These are few suggestions in this regard;

- A clear transfer of technology policy must be formulated encompassing comprehensive guidelines for ToT agreements at national level and its subsequent monitoring.
- The agreements must include technical specifications of the product in terms of technical data pack, material specifications, and age of technology.
- There must be information network available for the public and private sectors firms and institutions to share technological capabilities taking technological policy into view to identify the industrial & technological needs. The network can serve as a hub to provide necessary information like current technologies, prospective programs, supplier database of major technologies, and accessibility of technical journals to all interested.

In evaluating agreements, the expert group shall be guided by policy guidelines which shall include:

(1) Appropriateness and need for the technology/industrial property right;

(2) Fairness of the technology payment in relation to the value of the technology to the technology recipient and the national economy as well.

(3) Restrictive agreement clauses shall not be allowed in any agreement; specifically, the following clauses shall be prohibited:

a. Those which restrict the use of technology supplied after the expiry of the agreement.

b. Those which require payments for patents and other industrial property rights after their expiration, termination.

c. Those which restrict the technology recipient from access to continued improvements in techniques and processes related to the technology involved during the period of the agreement even if the technology recipient is willing to make additional payments thereon.

d. Those which provide patentable improvements made by the technology recipient shall be patented in the name of the technology supplier and required to be exclusively assigned to the technology supplier; or required to be communicated to the technology supplier for its use, free of charge.

e. Those which require the technology recipient not to contest the validity of any of the patents of the technology supplier.

f. Those which restrict a non-exclusive technology recipient from obtaining patented or unpatented technology from other technology suppliers with regard to the sale or manufacture of competing products.

g. Those which require the technology recipient to purchase its raw materials, components and equipment from the technology supplier or a person designated by him (except where it could be proven that the selling price is based on international market prices or the same price that the supplier charges third parties and there are no cheaper sources of supply).

h. Those which restrict directly or indirectly the export of the products manufactured by the technology recipient under the agreement.

i. Those which limit the scope, volume of production or the sale or resale prices of the products manufactured by the technology recipient.

j. Those which limit the research activities of the technology recipient to improve the technology.

(4) The agreement shall provide that the Pakistani law shall govern the interpretation of the contract.

6.4 Recommendations

6.4.1 At Government Level

- To gain synergy, an organization be setup at government level which should spell out the vision, objectives and strategy for guidance of all defense R&D establishments.
- There should be a law on technology transfer protecting national as well as international stakeholders.
- Political stability is needed for conducive investment climate. S&T policy should be revised keeping national needs into view.
- There must be an integration between industry, academia and research organizations.
- R&D facilities should be awarded official status to enjoy the provisions of governmental privileges and incentives permissible under rules and regulations to other organizations.

6.4.2 At Organization Level

- Proposed generic ToT model of processes should be applied at organization level and should be evaluated in other similar organizations.
- Target only those technologies which can be absorbed easily. There must be a base available for ToT before acquiring technology.
- Pay packages should be rationalized to prevent brain drain.

- ToT agreement clauses must be assessed carefully in the technology agreement.
- Organization should collaborate with chamber of commerce to explore mutual technology cooperation areas and expertise available to utilize their surplus capacity.
- A survey should be conducted to identify the duplication of projects at horizontal level.
- R&D should be pursued with futuristic innovative outlook in order to remain competitive.
- Interaction with private industry would result in cost mitigation by doing joint R&D activities.
- Incomplete projects should be brought back into loop to bridge technological gap and utilize the mutual resources at horizontal level.
- Higher education policy should be relaxed for researchers and engineers based on special skill and expertise.

6.5 Way Forward

Like other developing countries, Pakistan is a desperate importer of advanced technologies developed in the industrial countries. These technologies are crucial to generate and sustain the rapid economic growth required to raise the quality of life and standards of living of the people. In view of the economic importance function of imported technologies, it is important to identify the major sources and channels through which these technologies are transferred and to assess the extent to which the transfer has contributed to the development of local technological capabilities. At its present relatively low level of industrial and technological development, Pakistan must have to focus at its technology strategy on importing those technologies most relevant to its development needs, at the most favorable terms, and to absorb, adapt and improve these imported technologies, very much like Singapore and Thailand and Taiwan successfully did in earlier decades. Several studies on technology transfer have indicated that foreign direct investment; technical licensing agreements; joint venture agreements for technical cooperation and assistance; and participation in world trade through exports have been the major channels of international technology transfer to Pakistan.

In order to expand the technological base, it would be impractical and cost prohibitive to hire a large number of engineers and research fellows. Technology incubation centers (TIC) already established to bridge the gap between the academia and industry be affiliated with the industry to serve in a mutually beneficial arrangement. Government must have to take initiatives to formalize the interaction through some regulation.

It should collaborate with technology incubation centers and chambers of commerce of the country to explore areas of dual use of the technology and expertise available with these industries to utilize their surplus capacity.

Different technologies have different effects and potential for further technological advancement. Therefore, recipient technology must be inducted with the consideration of wider and dynamic applicability. To capitalize on the presently available technology, efforts must be made to find something out of the emerging technology for new applications. Emerging technologies include Nano technologies, Laser and optics, Sensor technology, Aeronautics, information systems, materials and processing, signature control systems etc.

Modern contract agreements are extremely professional documents. These documents need to be drafted very cautiously to ensure their effective implementation and guarding own interest to cater the international implications. It must be written in such a way that it can explain all technical, financial and administrative aspects with complete understanding and there should be no ambiguity at all. Timelines, objectives and mutually agreed conditions should be included to safeguard one’s own interests. Therefore, every industry must seek the legal guidance while drafting the agreements and a dedicated legal advisor is mandatory part of an establishment.

The analysis reveals that the technology agreements do not contain detailed description in terms of know-how, training and quality control. The quality control processes are not defined whether it will be performed for the complete process or be carried out at each process stage. It is also seen that delays have been met due to production of sample

inspection as these samples are inspected and deficiencies have been rectified through a cumbersome procedure.

Another very important factor is observed that developed countries are willing to transfer only those technologies to less developed countries which are redundant and obsolete in terms of their own use. Once an agreement is written it is not possible to make amendments. It is also seen that time and again embargos and restrictions have been imposed on Pakistan which resulted in continuous support in terms of supply of raw materials and other ancillary equipment needed for the completion of the project. This leads to untimely delivery of items.

The above mentioned findings lead one to believe that the agreements are not drafted with care. Technology transfer must not be taken for the acquisition of technology but to innovate something which is not seen in any of our establishments.

At national level, a model can be developed for the scope enhancement of transfer of technology that should be applicable to all private and commercial ventures also. Nevertheless, efforts have been put in by the author will help to lift the discussion to a higher level for those who come later.

Annexure "A"

Joint Technical Collaboration & Marketing Agreement

Joint Venture, Technical Collaboration & Marketing Agreement

Preamble:

Whereas M/s Fiberlogix U.K hereinafter called as Party "B" is interested in Contract Manufacturing of its patented products and joint development of Speciality Fibers and related products and getting them manufactured from M/s The LTE hereinafter called as Party "A" for its Research and Development activities and those of its clientele in the relevant field, customized passive devices, testing and qualification and vertical integration of this fiber and said devices.

And whereas Party "B" has offered to provide Party "A" necessary 'Know how' and related Technical Assistance and equipment for the said purpose

And whereas Party "B" also claims to possess patents and as such has also offered to enter into contract manufacturing with Party "A" of these patented items /products

And whereas Party "B" has sound market knowledge and active customer base, have offered to get the specialty fiber and all those related products, within the scope of capabilities of Party "A" manufactured from Party "A" for subsequent supply to its client in European and North American markets

And whereas Party "A" has agreed to accept the offer made by Party "B" for Joint Development and to manufacture and supply various types of items to Party "B" which are set out in schedule "A" hereto annexed (Hereinafter referred to as 'Product'(s) and their marketing by Party "B"

to European and North American markets on the terms and conditions herein contained.

Now, therefore, it is agreed between the parties that,

Article 1:

Effectiveness of this agreement

The agreement shall become effective after it has been signed by both the parties.

Article 2:

Definition of Know-How:

Know-How means and includes all inventions, processes, patents, engineering and manufacturing skills, and other Technical information whether patented or patentable or not, which are presently owned by Party "B" which may be so owned during the term of the agreement including without limitation:-

i. Specifications & Drawings of Products

ii. Specifications of Equipment, Test Jigs, Including Equipment

iii. Specifications Part, Lists, Bill of quantities of raw materials & consumables.

iv. Technical and Engineering Data, Calculation and information.

v. Design Data, Calculation and information.

vi. Sketches, Photographs all other forms of recorded information techniques and design for qualification, inspection and testing, equipment and procedures.

Party "B" shall fully and promptly furnish to Party "A" any other info with each Know How as Party "A" may require from time to time during term of this agreement in connection with Joint Development manufacturing of the Product(s)

Article 3:

Contract Manufacturing

Contract manufacturing means manufacturing by Party "A" at their premises those products whose patents are owned by Party "B", as and when required, by Party "A" on placement of orders by Party "B" on Party "A".

Article 4:

Joint Development of Prototype (s)

Means successful development of prototype(s) of a product by parties in accordance with mutually agreed design, specification, acceptance criteria and qualification standards by pooling and apportioning of relevant expertise, resources technical & managerial skills by parties as per mutually agreed work sharing plan with respective work share defined and expressed in Dollar denominated terms.

Article 5:

Scope of Work

The scope of work to be shared between the parties, detail of which is listed at Annexure "A", is stipulated as under:

i. Contract manufacturing by party "A" for party "B"

ii. Joint Development of:

- Specialty optical fiber
- IPR and technology for passive devices
- Vertical integration of fiber & Devices

iii. Joint Business Development

iv. Technical Assistance

Article 6:

Modalities of Technical Collaboration

Modalities of the Technical collaboration between the parties shall be as under:

Article 7:

Contract Manufacturing

Contract manufacturing shall be confined to the Product(s) whose patents are owned by party "B" and are listed as per Annex "A"

Since these are developed products and supposedly in regular demand. Party "B" shall sent proper Request for Quotation (RFQ) to party "A" on regular basis. Party "A" shall respond with a proper quotation to party "B". Party "B" shall then place a proper Purchase order /Contact on party "A". Party "A" shall then complete and deliver the order in a stipulated quantity, quality and time frame as stipulated in Purchase Order/Contract.

Article 8:

Terms of Payment

- The currency of payment shall be United States Dollars.
- Depending upon the value of the order, the mode of payment shall be either through bank transfer or irrevocable documentary letter of credit.
- The Letter of Credit shall be opened by party "A" in favor of party 'A''s designated bank.
- Patented Product(s), with demands of recurring nature, but not lending themselves to immediate sale may be supplied by party "A" to party "B" on deferred payment basis against purchase order/contract.
- Alternatively, they may be supplied by party "A" to be warehoused by party "B" at their premises against an Irrevocable Bank Guarantee to be furnished by party "B" to party "A". The said guarantee shall be en-cashable by party "A" after a certain mutually agreed period regardless of the product(s) having being sold /consumed or otherwise by party "B" at their respective end, within the period stipulated in the said Bank Guarantee.

Article 9:

Joint Development

The procedure for Joint development of all product(s) as defined in Article Scope of Work and stipulated as per Annex "A" shall be as under:

Party "B" shall send Request for proposal (RFP) for the said product(s) required to be developed by party "A" indicating its:

- Design Specifications
- Testing Procedures
- Qualification method(s)
- Acceptance Criteria
- Application
- Qty to be developed (Min)
- Info about prospective client (if necessary)
- Prospective /Projected requirement after successful development
- Any other related info

Party "A", on receipt of RFP, shall inform party "B" earliest possible on the development prospects of the products and submit a proper quotation to party "B"

Party "B" on acceptance of the quote shall then place a development order on party "A"

Party "B" shall assist party "A" during the course of development period to enable it to successfully develop the said product(s). On receipt of developed consignment, party "B" after subsequent evaluation shall confirm successful development of the product(s) to party "A".

Article 10:

Business Development

Both sides shall endeavor to maximize their joint efforts to create a wide ranging clientele in European & North American markets for their

patented as well as jointly developed products listed at annexure “A” to the contract by way of:

- Collective participation in relevant International Exhibitions, Seminars, Workshops etc to facilitate potential customer contracts, collect leads and to pursue them in order to translate them into orders.
- Conducting joint /individual marketing as a team to contact potential customer to solicit orders /business.
- Parties to arrange continuous feed back from market place, share information on regular basis about their respective efforts towards soliciting and securing business from defined targeted customers.

In pursuance of the business development activities defined above, each party shall bear their respective boarding lodging, traveling and related expenses.

Article 11:

Technical Assistance

Both parties shall assist each other during the course of Contract Manufacturing, development of specialty fibers for targeted clientele.

Party “A” shall extend cooperation for use of its facilities to party “B” in as appropriate manner as feasible, required for Contract Manufacturing and joint development of product orders which are placed or likely to be placed by party “B” on party “A”.

The modalities of Technical Assistance rendered by parties to each other, as and when required, shall be as under:

- Party “B” shall provide as much technical details /info as required by party “A” during manufacturing, development of establishment products and specialty fibers.
- Where required party “B” shall arrange provisioning of testing & qualification of developed / being developed products for party

"A" at their premises or at appropriate facilities outside Pakistan as and when requested.

- Party "B" to assist party "A" to lend appropriate equipment required on temporary basis and assist in sourcing and procurement of any other necessary equipment essentially required to develop a product from European / North American sources and to arrange requisite training of party "A" personnel for its effective utilization.

Article 12:

Progress Review Meeting

Both parties agree to review the progress of the agreement in a meeting to be held every six months on mutually agreed dates after the signing of the Agreement.

The agenda of the meeting shall be prepared by mutual consensus and will be held alternatively in Pakistan and U.K

Each party shall bear its own expenses for traveling, boarding and lodging, however the host party shall be responsible for other related expenses of the visiting party during its stay.

Article 13:

Right to enter into agreement

Party "A" and "B" warrant that they have the right to enter into this agreement and that their performance hereof will not violate any agreement made with any third party.

Article 14:

Term of agreement

The initial term of this agreement, will being and continue for a period of three (03) years from the date of being signed by both the parties.

Article 15:

Additional Term

At the end of initial term, the term of agreement will be extended automatically for an additional period of three (03) years period from the end of initial terms until either party "A" or party "B" gives notice of termination to the other at least ___ days prior to expiration of initial term or any other additional term.

The extension hereof for each additional term(s) shall be subject to approval in writing by both the parties.

Article 16:

Successors and assigns of Parties

The agreement shall be binding upon and ensure to the benefit of the respective parties hereto, and the obligations hereunder shall not be assignable by either party without written consent being first obtained from the other.

Article 17:

Amendment

This agreement embodies entire understanding of the parties as to its subject matter shall not be amended except in writing executed by both parties to this agreement.

Article 18:

Premature Termination of Agreement

Either party may give notice in writing to the other to terminate this agreement in the event of:

- Any default by such party in the performance or observation of any of its obligations under this agreement, which is not remedied to the satisfaction of the party giving such notice within ninety days following delivery of such notice. Such notice to contain

reasonable particulars of such default and to state the intention to terminate this agreement under this clause unless such default is made good or remedied.

- Judicial proceedings for Bankruptcy, composition with creditors, sequestration of assets for creditors, or receivership, instituted by or against such other party, insolvency of such other party or its failure to meets its obligations as they mature for any material period of time.
- Liquidation, compulsory or voluntary of such other party except in connection with an amalgamation, reconstruction, merger, consultation, reorganization, or disposition of assets as a gong concern voluntarily undertaking and with a view to the continuance of the business by the transferee thereof, provided, however, that upon such event the business entity continuing the business formerly carried on by other party shall, in appropriate instrument delivered to the other party to this agreement, undertake to perform all of the obligations of such other party hereunder.

Article 19:

Force Majeure

Neither party shall be liable for any delay in executing any undertaking under this agreement or for inaction or non performance thereof, if such delay or inaction is caused by reasons such as strike, lockout, accident by fire, cyclone, civil commotion, internal rebellion, war, acts of God, government laws and regulations of any other cause beyond its control and without its fault or negligence.

Article 20:

Settlement of Disputes

All disputes, questions or differences, etc, arising in connection with this agreement shall be referred to arbitration to the international chamber of commerce whose decision shall be binding and final.

Article 21:

Service of Notice

Notice and other communications under the agreement shall be in writing by telex, fax, airmail, speed post, or by any other mode mutually agreed upon from time to time addressed as indicated in description of parties above or as other party may request in writing, and the effective date will be the date, on which it is mailed in the post with prepaid postage with proper address of the party to whom it is to be served.

Article 22:

End User Certificate

Party "B" shall be responsible to furnish party "A" with end user certificate as per prescribed format attached as Annexure "B" to this agreement for all orders /contract completed by party "A".

Article 23:

Law Applicable

This agreement shall be governed and interpreted according to the laws of Islamic Republic of Pakistan.

Article 24:

Copy of agreement as counterpart

This agreement is being executed in English in duplicate and each party shall in retain one copy and both copies will be treated as counterpart of the agreement in witness whereof, the parties hereto have confirmed this agreement by signing the same on the day and year first above written.

Article 25:

Confidentiality

The parties shall maintain complete confidentiality of the Product(s) during and after completion of its development and in no case shall communicate any info about its either verbally or in writing to any third party.

Article 26:

Executed as an Agreement

Signed for and behalf of

_____	_____
Chief Executive /Chairmen	Managing Director
For and on behalf of	*For and on behalf of*
The LTE	FiberLogix Limited
Pakistan	United Kingdom
Tele: (92) 5770 520520	Tele: (44) 1923 82
Fax: (92) 5770 520133	Fax: (44) 1923 83
Witness No. 1	**Witness No. 2**
Name:	Name:
Address:	Address:
N.I.C:	N.I.C:
Date:	Date:

1. **Contract Manufacturing**

S #	Description /Nomenclature	Specification	Remarks

2. **Speciality Optical Fiber**

S #	Description /Nomenclature	Specification	Remarks

3. **IPR and Technology for passive devices**

S #	Description /Nomenclature	Specification	Remarks

4. **Vertical Integration of fiber and Devices**

S #	Description /Nomenclature	Specification	Remarks

"ANNEXURE B"

STANDARDIZED DRAFT FOR JOINT VENTURE AGREEMENT

PREAMBLE

This agreement is made at _____ of between LTE having its offices at _____ _____, hereinafter referred to as LTE on the one part and M/S _____, a company registered under _____ Companies Act, and having its registered office at _ _____, _____, hereinafter referred to as _____, _____, M/S _____ _____ of the other part. Whereas M/S _____ is company engaged in manufacture of _____ and is well experienced in technical know how for the manufacture of _____, whereas LTE has approached M/S _____ to supply know how to them for the manufacture of _____, which M/S _____ has agreed. And whereas both the parties have agreed to form a joint venture company in Pakistan for manufacture of _____, for which technical know how etc will be made available by M/S_____

NOW THIS AGREEMENT WITNESSETH

ARTICLE:-1FORMATION OF JOINT VENTURE COMPANY

1.1 M/S _____ and LTE will form a joint venture company, which will be incorporated under companies act _____ with its head office at _____ and LTE will take necessary steps for the incorporation of the said company.

1.2 LTE will cause the joint venture company to be organized in accordance with the terms of this agreement with memorandum and articles of association, which shall be in form of document and annexed at annexure attached. However, if the registrar of the companies located at _____, does not approve the memorandum

and articles of association in the form of enclosed document the parties agree that they will make such amendments as are acceptable to the registrar of companies, with out altering the purpose or intention.

1.3 Both the companies will share the cost of incorporation of the joint venture company equally.

ARTICLE:-2 SHARE CAPITAL OF THE COMPANY

2.1 The joint venture company shall have an authorized capital of Rs _____ (in words) consisting of Rs _____ equity shares of Rs _____ each.

ARTICLE:-3 ASSIGNMENT OF MACHINES AND EQUIPMENT TO THE COMPANY

3.1 In payment for the shares of the joint venture company at the time of incorporation, M/S shall assign and transfer to Joint Venture Company, all the machinery and equipments described in the schedule 1 annexed hereto and the said machinery and equipments will become the property of the joint venture company, and LTE shall assign and transfer to joint venture company the title free and clear of all line, charges and claims, the plot of land, buildings, and other structures thereon, including all fixtures, equipments and machinery situated at ___ _____, which plot of land, buildings, fixtures, equipment and machinery are described in schedule II annexed hereto.

ARTICLE:-4 MANAGEMENT OF THE COMPANY

4.1 The affairs of the company shall be managed by a board of _____ Directors, ___ _____ of whom shall be nominated by M/S _____ and _____ of whom shall be nominated by LTE. The Decisions of board of directors on the matters mentioned in schedule III will be taken by at least _____ Directors.

ARTICLE:-5 APPOINTMENT OF RESIDENT AND EXECUTIVE VICE PRESIDENT OF COMPANY

5.1 The president of the joint venture company shall be nominated by LTE who shall be responsible for all non Technical questions / matters in the day to day management. M/S_____ will nominate executive vice president, who shall be responsible for the technical matters.

ARTICLE:-6 DISTRIBUTION OF DIVIDENDS OF COMPANY

6.1 Before distributions of dividends on the shares of the joint venture company, the parties will decide how much profits of the joint venture company should be retained for the expansion of the joint venture company as rapidly as market conditions permit.

ARTICLE:-7 MAINTENANCE OF BOOKS OF ACCOUNTS AND RECORDS BY THE COMPANY

7.1 The joint venture company will maintain proper books of accounts and other records, in which all transactions relating to the company shall be entered. The books of accounts and other records will be available for inspection to the authorized representative of both the parties, who shall be entitled to take copies or extracts from such accounts books and records. The auditors of the joint venture company shall be _____ chartered accountants.

Article: 8 MARKETING & MARKETING ASSISTANCE

8.1 M/s _____ will supply to the joint venture company without any cost all information and assistance relating to advertising and marketing for the sale of products manufactured by joint venture company during the tenure of this agreement.

Article 9: RIGHT TO USE TRADE MARKS & TRADE NAMES

9.1 During the continuance and subject to the provisions of this agreement, M/s _____ will grant to Joint Venture Company the right to use the trade marks and trade names upon or in connection with the products manufactured or assembled by the joint venture company within the territory and which comply with relative standards.

9.2 The joint venture company will get the trade marks and trade names registered with appropriate authority, so that such trade marks and trade names may not be misused in the territory by any unauthorized persons or party. M/s _____ will execute all documents and do all such tings, which are necessary to register the said trade marks and trade names in the territory in accordance with the Pakistani Law.

9.3 The Joint Venture Company will also be authorized to assign its license, right and sub license for their use to other person or parties with the prior consent in writing of M/s _____.

Article 10: SUPPLY OF TECHNICAL DATA AND INFORMATION

10.1 M/s _____ will provide technical Data information to the Joint Venture Company without any charge as shall be necessary for it to manufacture, sell and service the licensed products and products related thereto.

Article 11: PAYMENT OF ROYALTY

11.1 The Joint Venture Company will pay to M/s _____ within _____ days following the end of calendar year royalty equal to _____% of the net sale price of all licensed products manufactured and sold by the Joint Venture Company during such year. The Joint Venture company shall make payment to M/s _____ in US$ at their office in _____ .

Article 12: PLANS, SPECIFICATION ETC FOR CONSTRUCTION OF FACTORY

12.1 M/s _____ shall furnish to Joint Venture Company the detailed plans, specification and other Data and information so that the Joint Venture Company can construct factory at a suitable place in Pakistan to manufacture _____ products annually, which said production facilities may be altered, added to or expanded economically to increase the production or the joint venture company will also be able to adopt the facilities to manufacture of other related or similar products the business exigencies of the Joint Venture Company required from time to time M/s _____ hereby guarantees that the information and specifications etc supplied by it will satisfy all the above requirements.

Article 13: ADVICE TO COMPANY ABOUT DESIGN, LAYOUT ETC

13.1 M/s _____ will advise the Joint Venture Company in connection with design, Layout and Construction of production facilities and the specifications of equipment, placement of orders and awarding the contracts and from time tot time review all plans, layouts, design and contracts for the supply of machinery & equipment.

Article 14: TECHNICAL DATA & TECHNICAL ASSISTANCE

14.1 M/s _____ will furnish to the Joint Venture Company all technical Data, information and assistance required for the efficient operation and maintenance of machinery and equipment and list of plant spares, lubrication and maintenance manuals, operating instruction manuals and other related manuals, and instruction books.

Article 15: TRAINING OF PERSONNEL

15.1 Prior to the commencement of production by Joint Venture Company, M/s ____ will provide training to the _____ engineering's of the Joint Venture Company at its plant at _____ for _____ days /months.

15.2 The Joint Venture Company will pay the cost of Stay, Traveling expenses and salaries of persons deputed for training.

15.3 M/s _____ will ensure that it imparts best training for the operation, maintenance of machinery and equipments and manufacture of the products.

Article 16: DEPUTATION OF PRODUCTION SUPERVISOR(S)

16.1 At the commencement of production by joint venture Company and during the initial period, M/s _____ will depute _____ qualified production supervisor(s) and _____ assistants(s) for a period of _____ months to make the factory ready for operation and starting productions.

16.2 The expenses for traveling stay and salaries of foreign technical personnel will be borne by Joint Venture Company.

16.3 In addition to deputation of foreign Technical Personnel, the Joint Venture Company may request M/s _____ to depute such personnel or individuals as it shall consider necessary to assist it in operation /maintenance of machineries and equipment and the manufacturing of products. In such cases, entire expenses including salaries of the personnel deputed to joint Venture Company will be borne by Joint Venture Company. The persons deputed shall be entitled to the class of travel, Hotel and other facilities and allowances in according with their entitlement in M/s _____.

Article 17: SELECTION OF PROJECT ENGINEER AND TECHNICAL PERSONNEL

17.1 Ms/ _____ will select or nominate the project engineers and other technical personnel to assist him at the works of the joint venture company, which M/s _____ considers necessary to control the works and exercise site supervision.

Article 18: PARTIES COVENANT NOT TO TRANSFER SHAREHOLDING WITHOUT CONSENT OF OTHER PARTY

18.1 No party will sell, transfer, assign mortgage, pledge or otherwise deal with any or all shares of the capital in the joint venture company, without prior consent of the other party in writing.

18.2 If any party comes to the conclusion that the joint venture should be broken then it shall by notice in writing to the other, may offer to sell to the other all its shareholding in the joint venture company at a price and terms & conditions specified in the notice. The other party to whom such offer has been made, shall within 90 days from the receipt of the notice, advice the offeror, in writing whether if accepts the offer of the offeror or elects to sell to the offeror all its shares in the joint venture company.

If the offeree does not advise the offeror within 90 days from the date of receipt of the notice, then the offeree will be deemed to have accepted the offer to sell the shares.

18.3 The sale of shares shall be completed not later than 90 days from the date after receipt by the offerer of the notice of election.

18.4 On sale of such shares, the members of the board of directors or other officers or employees nominated by the party selling the shares of the joint venture company selling the shares will resign and the purchasing party will pay to the vendor the price by banker's draft, however, the option to buy – sell arrangements cannot be exercised before---------- years from the date of commencement of production by the joint venture company.

Article 19: SETTLEMENT OF DISPUTES

19.1 All disputes or differences of any nature arising between the parties regarding their rights, obligations, interpretation of these presents, and all matters arising under this agreement will be resolved through cooperation and consultation. If the

said disputes etc are not settled through cooperation and consultation, the said matters will be referred to arbitration.

19.2 This submission to arbitration shall be deemed to be a submission to arbitration in Pakistan in accordance with rules of Arbitration Act, 1940 or any statutory modification thereof. The award of arbitrator or arbitrators, as the case may be shall be final and binding on the parties.

Article 20: LAW OF JURISDICTION.

20.1 All questions relating to the validity, interpretation or performance of the agreement will be governed by law of Islamic Republic of Pakistan.

Article 21: EXECUTION OF AGREEMENT.

21.1 This agreement shall be executed in duplicate. The original will be retained by M/S_____ and duplicate by LTE.

IN WITNESS WHEREOF, THE PARTIES HERETO HAVE SIGNED THESE PRESENTS ON THE DAYS, MONTH AND THE YEAR FIRST ABOVE WRITTEN:

Schedules: The schedule I above referred to

Schedules: The schedule II above referred to

Schedules: The schedule III above referred to

Name	Name
Rank	Rank
Designation	Designation

Witnesses

1.	Name	Name
2.	Name	Name

FORMAT OF:

i. Schedule “A”

ii. Annexure “A”

iii. Annexure “B”

iv. Annexure “C”

v. Completion Certificate shall be worked out by LTE in consultation with M/s _____ respectively attached as annexure and made as integral part of the contract.

Annexure – "C"

SCHEDULE – I

LIST OF PLANT & MACHINERY

S#	Nomenclature	Qty	Marked & Model No	Remarks

LIST OF EQUIPMENTS

S#	Nomenclature	Qty	Drg No. Specns	Remarks

Note:

The format as stipulated above is tentative, details of plant & machinery equipments and related equipment being acquired to be listed, depending upon the nature of product for which the Joint Venture has been negotiated and finalized.

Contract No.----------

Annexure – "D"

SCHEDULE – II

DETAIL OF LAND, BUILDINGS AND STRUCTURES

LAND

S#	Description of Plot	Size (Sq yds / Kanals etc)	Khasra No. etc	Description of location of plot	Remarks

BUILDING

S#	Description of Building	Size (covered area)	Location on Plot	Remarks about present condition etc.

STRUCTURES

S#	Description of structure	Size (covered area)	Location on Plot /building	Remarks etc.

Note:

Detail plan duly certified by relevant local authority(s) to be attached.

Annexure – "E"

SCHEDULE – III

IDENTIFICATION & LIST OF SUBJECTS /MATTERS FOR DECISIONS BY BOARD OF DIRECTORS

To be finalized by Board of Directors of Joint Venture Company

"ANNEXURE F"

PAKISTAN AND ARGENTINA COOPERATION

Pakistan and Argentina agreed to cooperate in different fields of Science and Technology. These areas are;

1-Agricultural Biotechnology.

a) Adaptation of crops to arid and saline with NIAB & NIBGE.

b) Utilization of plant biomass with PCSIR & NIBGE.

c) Biofuels from non-edible crops as Castor oil with PCSIR & NIBGE.

2-Ocean Research.

a) Geo and Bio-resource mapping with NIO.

b) Environment studies with NIO & GCISC.

c) Shrimp aquaculture with NIO.

d) Provision of research vessel with NIO.

3-Solar Energy

a) Solar Thermal Technology with PCRET & PCSIR.

b) Solar photovoltaic with PCRET.

c) Production of high purity silicon with PCSIR.

4-Electronics

a)Cooperation in setting up of semi industrial scale production facilities in various Domains of electronics i.e., microelectronics, automotive electronics, communication Systems, large scale display boards,etc with NIE.

b) Production of electro medical equipment with PCSIR.

5-Natural Products

a) Chemistry with HEJRIC.

b) Production of organic pesticides with HEJRIC and PCSIR.

c) Production of herbal medicine with PCSIR.

d) Extraction of essential oils such as Eucalyptus oil with PCSIR and NIAB.

6-Clean Technologies

a) In production of Leather,food industry,pharmaceuticals,dyes,etc with PCSIR.

b) For Biodegradation of pollutants with NIBGE.

7-Material Science

a) Development of different alloys with PCSIR.

b) Nano-structured material & nano coating with PCSIR.

8-S&T Infrastructure

a) Production of Laboratory equipment with PCSIR.

9-S&T Human Resources

a) Training of technology managers with MoST.

b) Exchange of scientist / experts under Post-MS fellowship programs with MoST.

c) Establishment of website for exchange of information between different scientists and institutions by MoST.

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