AN EXAMINATION OF TECHNOLOGY TRANSFER: THE CHANNELS THROUGH WHICH TECHNOLOGY CAN BE TRANSFERRED TO AND ACQUIRED BY RECIPIENT ORGANISATIONS IN OMAN

A Thesis Submitted to the Faculty of Social Sciences,

University of Glasgow

For the Degree of

Doctor of Philosophy

By

HAMDAN HAMED AL-GHAFRI

B.Sc., University of Arizona

Department of Management Studies

July 1992

TO THE MEMORY OF MY FATHER

ABSTRACT

This research examines the transfer of technology to Oman and analyses the channels through which technology can be transferred to and acquired by recipient organisations in Oman.

The present empirical investigation is intended to contribute to the existing large volume of literature on technological transfer, and highlight the salient factors relating to this process and analyse their impact on Oman as a developing country. In addition, it examines the impact of these factors on the development of national capabilities such as natural resources, educational institutions, and manpower.

It was found from the literature review, the empirical findings and the questionnaire that Oman depends on foreign technology and foreign manpower, and lacks indigenous skilled manpower able to operate, monitor and adapt the imported technology.

This study concludes that Oman should develop a plan to create and develop local capabilities, to generate technological know-how, and to use indigenous manpower for the benefit of the country. Therefore, the import of technology from advanced countries and the development of indigenous technological infrastructure must be viewed by Omani decision-makers as complementary to one another.

ACKNOWLEDGEMENTS

The author wishes to express his gratitude to his supervisor, Professor R. von Zugbach de Sugg, for providing the opportunity for this research work and offering his help and guidance throughout the course of this study.

Thanks are due to the Government of the Sultanate of Oman for providing financial support during this research.

I would also like to take this opportunity to thank all my friends and colleagues, and my parents, my wife and my three children for their companionship, patience and continuous encouragement throughout the preparation of this study.

Finally, I would like to thank those who provided the assistance to facilitate the process of gathering the relevant information and who took part in the questionnaire.

CONTENTS

LIST OF TABLES AND FIGURES

TABLES

FIGURES

CHAPTER 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

1.1 THE OBJECTIVES OF THE STUDY

The transfer of technology to Oman has brought with it enormous changes in terms of industrial development and raised standard of living. This study is aimed at examining and analysing the channels through which technology can be transferred to and acquired by recipient organisations in Oman. In addition, it investigates the impact of these channels on the development of national capabilities such as natural resources, educational institutions, and manpower development. The objectives of this study are:

1 - To examine the issue of technology transfer and highlight the salient factors in this process analysing their impact on Oman as a developing country.

2 - To identify the obstacles facing the firms which include shortage of manpower and management capabilities that influence technology transfer, as well as the social,

cultural, and environmental differences.

3 - To examine the contribution of the institutions of higher education and the government in the transfer of technology to Oman.

4 - To examine the transfer of technology to some selected developing countries and to make relevant comparisons with that of Oman.

5 - To examine the extent to which the adaptation of technology by Oman requires the consideration of some fundamental aspects, such as developing local skills and making the appropriate choice of technology.

6 - To assess how far Omani technological independence is a function of the development of local capabilities.

1.2 AN INTRODUCTION TO OMAN

Geographical Features

Oman is situated at the extreme south-east of the Arabian Peninsula between latitudes 16° 40' N and 26° 20'

N and longitudes 51° 50' E and 59° 40' E. It is the second largest country in the Arabian Peninsula and covers a vast area of some 312,000 square kilometres. It also has a number of islands scattered around its shores. The most important of these are Masirah in the Arabian Sea, off Bar al-Hakman, near Jaalan, and the island of Al-Hallanyat, off the southern coast of Oman.

Oman boarders on Saudi Arabia and the United Arab Emirates to the west and on the Yemeni Republic to the South. It is bounded by the Strait of Hormuz to the north and the Arabian Sea to the east (see Fig. 1.1).

Oman falls between two saturated wind masses: the first blows from the Mediterranean Sea, the second from the Indian Ocean. However, the country's rainfall is relatively low and irregular. By the time the Mediterranean winds reach Oman, they have dispersed and shed their moisture, and in most years the winds from the Indian ocean fail to reach the Omani peninsula. Oman's climate varies from region to region. In the coastal areas it is hot and humid in summer. In the Interior it is hot and dry, except in the hills where the climate is moderate all year round, especially in the Southern Region. (Ministry of Information, 1990, pp. 19-22).

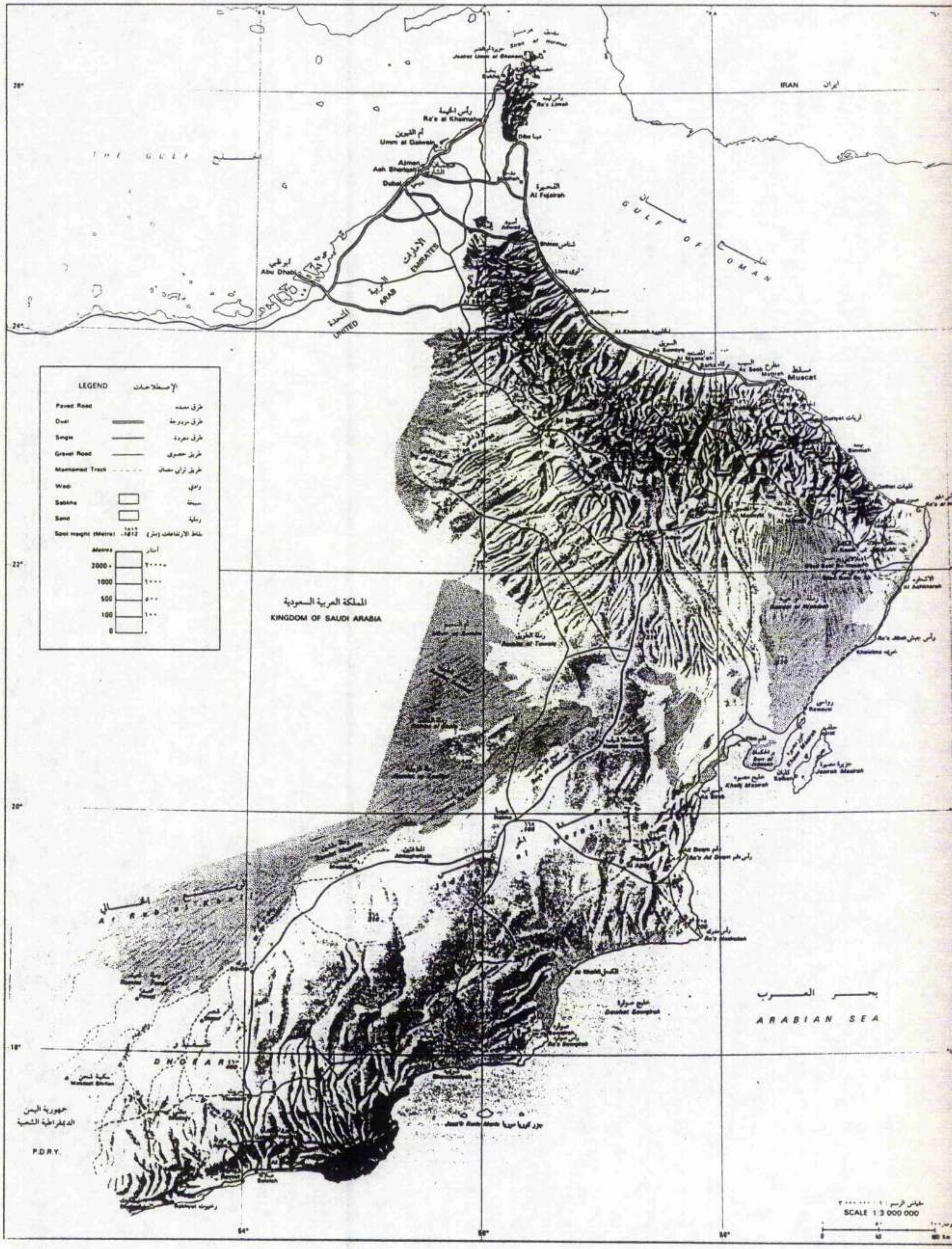

Fig. 1.1

Map of the Sultanate of Oman

The population of Oman is estimated at 2 million. Despite the tides of migrations and invasions which have swept through Oman since the dawn of history, its people have retained a firm hold on their Arab origins. The population of Oman can be classified on the basis of their source of income and the region where they live. Farmers and land labourers are found in all regions. Fishermen sail and trade along the coastal areas, where merchants sail in ships that have travelled throughout history to different parts of the world. Settled people live in the mountain villages and towns, while the once nomadic Bedouin people of the desert areas today increasingly enjoy the fruits of modern settled civilisation. (Oman, 1989, pp. 26-28).

Historical Background

With the revival of the spirit and life of the Sultanate of Oman came a great interest in the country's origins. Encouraged by His Majesty Sultan Qaboos, in 1970, Scholars started to investigate the remote past of this historic land where man first appeared after the Last Ice Age, about 12,000 BC. Though very little is known about the pre-Islamic past, many fascinating discoveries have been made. Archaeological sites dating back to the third millennium BC. are believed to be contemporary with the region's Berber culture and the great river cultures of Mesopotamia and Mohenjodaro.

Evidence has been found of the trade between Sumer, a land which existed before Babylon, and Oman. (Ministry of Information, 1988, p. 17).

Copper mining and smelting by the year 2,000 BC. had become a sizeable industry, as revealed by excavations at locations in the Sohar area. It seems certain that the legendary country of 'Magan', referred to in Sumerian tablets as a source of copper, was Oman. Frankincense, the aromatic gum used in ancient Egyptian and European rites, and traditionally offered by the Queen of Sheba to Solomon, was produced in Dhofar, in southern Oman. One of the most precious of the ancient world's commodities, it is another Omani product that is now being exploited as an essential base ingredient in a highly fashionable scent. (Ministry of Information, 1988, pp. 18-21).

Still in pre-Islamic times, tribes from Yemen - legend has it that they came from the region of the famous Marib dam - trickled into Oman. Later, the Azd tribal group, from which the present ruling family is descended, entered Oman. Then Oman was under the rule of the Persians, but the Azd were able to regain Oman from the Persian rule and they spread Arab influence to all parts of the country. Islam came to Oman, and Abd and Jaifar, the sons of Julandi bin Al-Mustakbar, embraced Islam. (Oman, 1987, p. 15).

From the seventh to the fifteen centuries Oman's maritime trade flourished. Omani ships regularly called at ports in Persia, India, and South-east Asia. As early as the eighth century, the fame of the great Omani seaman Abu Ubaida bin al Qassim, who laid the foundations for scientific maritime navigation and made a 7,000-kilometer voyage from Oman to Canton (Guangzhou) in China, was widely known. As they travelled and traded, the Omanis spread the message of Islam as well as the Arabic language and culture. (Ministry of information, 1990, p. 49).

In 1507, nine years after Vasco da Gama rounded the Cape of Good Hope, finding a sea route to India - ironically being guided by the famous Omani navigator Ahmed bin Majid - a Portuguese fleet brutally ransacked Muscat, capital of Oman, and within a year the Portuguese flag flew all at several places along the coast. Nearly a century and a half later, in 1650, Sultan bin Saif Al-Yarubi reconquered Muscat. Then, having built up a powerful fleet for the war of liberation, he carried the war into the indian ocean, establishing a wealthy state with colonial possessions in East Africa. (Oman, in Arabic, 1987, 18).

Sayyid Said bin Sultan is an historically prominent Omani ruler who exercised power during the period 1807-

1856. During this time Oman's influence reached Zanzibar and other parts of East Africa in addition to provinces in Persia and Baluchistan. Muscat became an important commercial centre and meeting point for the entire Gulf area. Sayyid Said concentrated his efforts on developing and improving his country's commerce and economy. It was sayyid Said, incidentally, who introduced the clove to Zanzibar which he brought originally from Indonesia. These plantations provided a third of the Sultanate's budget. During his reign, Oman developed her relations with many parts of the world; a special envoy was sent to the United States in 1840 - the first Arab emissary to that country. Oman was thus the first Arab country to establish diplomatic relations with the United States. It had already concluded agreements and conventions with Great Britain, France, Holland and other countries. (Oman, in Arabic, 1989, pp. 20-22).

Thereafter, however, there followed a period of decline and, at the time of the First World war, Oman's share of international commercial activities was very limited. Indeed, Oman remained largely isolated from the rest of the world until, in 1970, His Majesty Sultan Qaboos came to power. His Majesty's reign was the beginning of a bright new era that renewed Oman's historic glories and opened a new chapter of development, prosperity, and social and economic progress, as well as technological advances including technology transfer from developed countries.

1.3 MODERN OMAN

When the Sultanate of Oman embarked on its massive development programme, it has little experience of construction and virtually no civil administration. Oman, however, is the genuine heir of a great civilisation which extended southward to the shores of Africa and northward to Persia. Supported by the confidence that such a history imbues, within a few years His Majesty Sultan Qaboos was able to lead Oman out of her isolation and stagnation to become an affluent modern state, ready to step into the twenty first century.

Oil revenues are the main source of finance for the economic development projects in Oman. Omani oil exploration operations started as far back as 1924. However, it is was not until 1964 that oil was discovered in commercial quantities. Oil exports began in 1967, and since then have been growing rapidly. At the start, production capacities were in the region of 20 million barrels a year, but reached about 121 million barrels in 1970 and jumped to 133 million barrels in 1976, the equivalent of 366,000 barrels a day (Ministry of Commerce and Industry, 1980, pp. 92-98).

In the beginning the production and marketing of oil was in the hands of foreign companies. In 1974 the Omani Government concluded an agreement with the company then holding all the shares of Oman Oil Development Company whereby one quarter of the shares would be handed over to the Omani Government. In the following year the government share was increased to 60%, with a further agreement whereby Oman's share of any new oil discoveries would be 85%. This percentage will increase if the production exceeds a certain level determined by the agreement (Ministry of Commerce and Industry, 1980, p. 289).

Oil is the lifeline of the Oman economy; in 1970, 99.5% of revenue came from the oil exports, in 1988, 87.5% was accounted for by oil, and in 1990, 80% of the Gross Domestic Product was accounted for by oil (Directorate General of National Statistics, 1990, p. 376).

The non-oil manufacturing sector is growing rapidly. Its contribution to the GNP increased from OR 82 million in 1985 to OR 151 million in 1990. This contribution notwithstanding, it still plays a relatively modest role in terms of revenue, in the overall Oman economy (in 1985 only 4% of GDP). (Directorate General of National Statistics, 1990, p. 377).

In spite of this rapid growth in the oil sector, Oman has been unable to capitalise on the oil fortune to develop the non-oil manufacturing sector. Consequently, there has been a rapid increase in the import of foreign goods, foreign manpower and technological transfer to enhance the development of Oman.

1.4 METHOD OF PRESENTATION

The first chapter is an introduction. The second chapter is concerned with the review of technological transfer involving many issues, such as the definitions of technology and technology transfer, elements of transfer, stages of transfer, cost of transfer and know-how transfer. Chapter three examines the International Transfer of Technology - A Historical Perspective, Multinational Corporations - in Technology Transfer and the choice of technology, both government policies in the developing countries as well as the behaviour of the suppliers of technology (which are basically the Multinationals).

There are many forms and channels through which technology can be transferred from industrialised to Third World Countries. The specific concern of Chapter four is to examine the different forms through which technologies are transferred from developed to developing countries, while Chapter five deals with the economy of Oman. Chapter six deals with the Internal and External obstacles impeding the successful application and adoption of foreign technologies transferred to Oman from industrialised countries.

The adaptation of technology by developing countries - a study in Oman and the concept of "Appropriate" technology are reviewed in Chapter seven. The aim of Chapter eight is to examine the methods of transfer of technology to some selected developing countries and to see how they compare with that of Oman.

Research methodology is explained in Chapter nine, and an analysis of the research findings from the recipients of technology is presented in Chapter ten. Several important points were discussed among which are: the mechanisms most used by Omani organisations to obtain foreign technology and its impact on the development of national capabilities. The duration of the agreements, elements of technology and the availability of efficient scientific in recipient organisations, evaluation of the research hypothesis, are some of the issues examined in that chapter. Chapter eleven examines the higher education institutions and transfer of technology - A field survey in Oman.

The role of Government in the transfer of technology is examined in Chapter twelve. The principal issues are Oman Government regulations for the transfer of foreign technologies to Oman, and the legislation adopted by the developing countries of Indonesia, India, Nigeria, Thailand and Brazil.

Chapter thirteen draws conclusions and discusses the limitations of this study for Oman and other countries, and finally chapter fourteen gives recommendations and suggestions for further research.

CHAPTER 2

TECHNOLOGY TRANSFER: MAJOR ISSUES

CHAPTER 2

TECHNOLOGY TRANSFER: MAJOR ISSUES

CHAPTER 2

TECHNOLOGY TRANSFER : MAJOR ISSUES

2.1 INTRODUCTION

Technology is a vital part of the development process, an essential input into economic activity. The transfer of technology has been widely used in the literature to include various issues; those of the cost of technology and stages of transfer as well as those concerned with know-how transfer.

This chapter is divided into seven parts. The first part examines definitions of technology and technology transfer as perceived by different writers in the field, and the second examines the elements of transfer. Part three looks at the stages of transfer. The fourth part examines the costs of transfer, and the fifth deals with "know-how" transfer. Then the concept of the appropriateness of technology follows in part six. Finally, conclusions are drawn.

2.2 DEFINITIONS

The term technology has been variously defined. One of the simplest definitions is attributable to Root (1968) and is "The body of knowledge that is applicable to the production of goods and the creation of new goods." It is often seen not only as a factor contributing to greater production but also as an asset which improves the quality of a product, reduces its cost and constantly leads to the creation of new, and often sophisticated products. A definition of technology seen as a commercial element, basically embodied in machines, documents and human beings is provided by UNCTAD (1972),

> "Technology is an essential input to production, and as such it is bought and sold in the world market as a 'commodity' embodied in one of a number of forms. (1) in capital goods and sometimes intermediary goods which are bought and sold in markets, particularly in connection with investment decisions; (2) in human labour, usually qualified and sometimes highly qualified and specialised manpower, with capacity to make correct use of the equipment and techniques and to master the problem solving and information producing apparatus;

(3) in information, whether of a technical or commercial nature, which is provided in markets, or kept secret as part of monopolistic practices."

Another way to look at technology is to distinguish between product technology and process technology. OCDE (1982, p. 11) and Siggel (1983, p. 86). The former consists of the specifications and characteristics of the product, and the latter comprises all the know-how necessary to produce a product. (Fig. 2.1 may clarify these definitions).

The term 'technology transfer' has been defined in the following ways:

Brooks, (1966, p. 18):

"Technology transfer is the process by which science and technology are diffused throughout human activity. Wherever systematic rational knowledge developed by one group or institution is embodied in a way of doing things by other institutions or groups, we have technology transfer."

US Congress (1967, p. 15):

> Technology transfer is "... the use of knowledge to serve a purpose other than the one for which the R and D was undertaken."

Sercovitch (1974, p. 3):

> "The transfer of technology from advanced to underdeveloped countries may by taken to cover the transfer of those elements of technical knowledge which are normally required in setting up and in operating new production facilities and which are characteristically in very short supply in the developing countries."

Rubenstein (1976, p. 145):

> "Technology transfer involves the transfer of capability to not only use, but also to adapt and modify and, in many cases, to innovate with respect to a product, process, piece of equipment, or field of technology (broad and narrow)."

UNCTAD (1982, P. 6):

> "Transfer of systematic knowledge for the manufacture of a product, for the application of a process or for the rendering of a service and does not extend to the transactions involving a mere sale or mere lease of goods."

Hoffman (1985, p. 73):

> "The transfer of knowledge which improves a country's technological capacity."

The transfer of technology is broadly distinguished in two types, which Brooks (1966) calls vertical and horizontal. Vertical transfer is a process by which scientific knowledge becomes part of a technological system, by making a technology out of unrelated and different techniques, and horizontal transfer is the adaptation of a technique from one use to another, or from one country to another. The transfer of technology to developing countries is mainly related to the second type of transfer; it could be defined as any group of measures used to set up and extend production facilities by improving machinery and elements of technical knowledge from abroad.

The definitions above open the way to many questions as to whether such a transplantation does occur in reality, whether knowledge is transferable or whether it is tied to a particular locality. Some authors, particularly those representing the dependency school of thought, Dos Santos (1970) and Amin (1973), argued that technology transfers necessarily lead to ever-increasing economic and technological dependence. Siggel (1983) notes, however, that these statements of dependence depend on the nature and completeness of technology transfer. If that transfer is merely viewed as transplanting modern technologies into developing countries without generating learning effect, then it could be said that it obviously leads to economic dependence, whereas if technology transfer focuses on acquiring technological capacity through learning, it can contribute successfully to economic dependence.

2.3 ELEMENTS OF TECHNOLOGY TRANSFER

Hoffman finds that there are many elements of technology incorporated in transfer agreement. He cites the following factors as typical examples of elements of technology:

Provision of blueprints, technical formulae, specifications etc.

Provision of plant and equipment.

Provision of materials and components necessary for a process's operation.

Initial instruction at the time the technology is acquired.

Ongoing provision of instruction and training throughout the period of the contract.

Continued provision of information on technological improvements and further developments made by the supplier.

Information and training on marketing, company organisation, etc. (Hoffman, L. 1985, p. 77).

Specifically, however, I propose to concentrate on those elements of technology imported into Oman from industrialised countries. They include:

a - Provision of maintenance facilities by the exporter of the technology.

b - Provision of technical support.

c - Provision of research and development facilities.

d - provision of marketing know-how.

e - Provision of management techniques.

f - Design and construction production techniques.

The above elements are particularly important to Oman in enhancing its local capabilities.

First, the provision of maintenance facilities will enable Oman to carry out routine maintenance and repair of the imported technology. This will also help to minimise costs while maximising efficiency of local labour. Second, the provision of research and development facilities will enable Oman to conduct research, particularly in the oil and petrochemical industries, into vital areas. This would include research into the use of the by-products of petroleum. Through this new scientific knowledge, ideas and innovations may evolve, which, in turn, will help to improve the local capabilities of Oman. Last, the provision of marketing know-how will enable Oman to sell its products in competitive markets as well as plan, organise, co-ordinate and control, and manage the marketing strategies.

Figure 2.1 summarises the major elements of technology which are mainly comprised of product and process technologies. This figure may usefully be used to differentiate between proprietary technology and non-proprietary technology, as first distinguished by Quinn (1969). The former category comprises technologies owned by the technology supplying firm, most often transferred through private foreign investment; usually the ownership is guaranteed by patents in the case of product technologies. Non-proprietary technologies are generally bought in a freely available market, and do note involve any proprietary right to the seller; in transfer agreement for non-proprietary technologies, the product and process technology play a major role compared to management and training, which in this case constitute the main elements.

Technology should, therefore, not be viewed simply as a basic factor of production, when examining technological transfer, but mainly as a commercialised

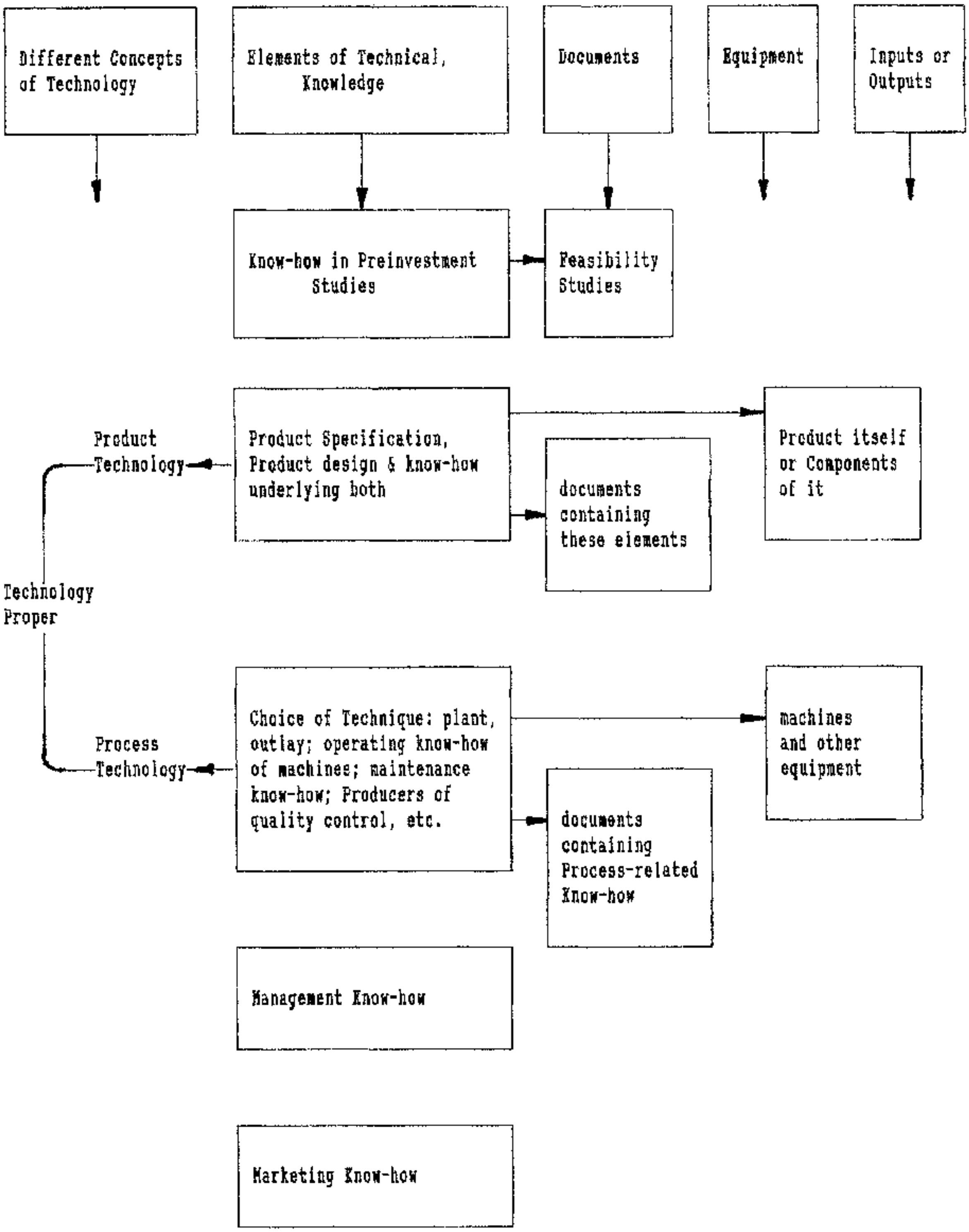

Fig. 2.I

Elements of Technology

Source : Siggel, E. (1983, p. 111)

asset bought and sold in a technology market which is imperfect due to the features of technological know-how on one hand and to the nature of the buyer and seller on another. UN (1974, p. 47) and Balogh and Graham (1979, p. 184).

2.4 STAGES OF TRANSFER

The fulfilment of project implementation requires foreign technological expertise at more than one of the following stages of transfer. Okita and Tamura (1975, p. 72) and UNIDO (1973, p. 4) discuss these stages as follows.

The first stage of the transfer usually takes place when a country imports the machines along with the flow of technological know-how, and start to learn to operate them. The second stage requires the maintenance and repair technology, sometimes the machines may be complex and automatically controlled which requires specialised tools and parts. The third stage is the establishment of engineering technology, which requires a great accumulation of productive facilities, various kinds of specific material and skilled workers. The planning and design technology constitute the final stage, it includes the research and development activities for new products, and the design of actual products. It is this stage which permits the developing country to develop its own technology. The local expertise for most of these stages is practically non-existent in the receiving country and often, even the plants and equipment are installed by the transferor.

Effectiveness of technology transfer can be satisfied when the last stage of transfer is attained, that is, when the receiving firm has mastered the technologies. There are, according to Siggel (1983, p. 99), three factors responsible for the effectiveness of transfer. Firstly, technologies must be transferred in all their required parts, an incomplete technology transfer may be acquiring a turnkey plant without training the personnel, on the other hand, a pure training arrangement is an incomplete technology transfer if the receiving firm does not obtain the documentation and managerial know-how it needs for operating the training. Secondly, the effectiveness depends on how the transfer mechanism is organised, there is particularly a high risk that the transfer may be incomplete when it is in an 'unpackaged' form with independent dealers, as preliminary studies, the delivery of equipment as well as the training of personal and management are not sufficiently co-ordinated. Thirdly, it depends on the receptivity of the receiving firm, that is, management capacities and technical absorption.

2.5 COSTS OF TECHNOLOGY TRANSFER

Most of the literature has focused on the cost aspect of technology transfers as an imperfect market, Vaitsos (1974) and Stewart (1979) among others. Moreover, since the market for technology, protected by patents, trademarks, commercial secrets and by semi-monopolistic control is largely imperfect, it is difficult to assess the cost of a particular technology. The price and the conditions for the transfer of technology from one enterprise to another may differ from case to case, and depends greatly on the value the recipient firm attaches to it. The licensee is usually unaware of the complexities of negotiating a licenses agreement and, therefore, he is in a particularly weak position vis-a-vis the licenser, whose bargaining strength is much bigger. (UNIDO, 1973, Chapter 3).

Stewart (1979) divides the cost of technology into actual or direct costs and indirect costs. The former constitute the payment of technology royalties, profits, and transfer pricing mechanism. The indirect costs, on the other hand, which may account for over-pricing, etc., represent the largest part of the transfer cost; in doing so, the activities of recipient enterprises are greatly restricted. These operations have often been called manipulations of transfer pricing by the multinationals, see Lall (1978 a, p. 209) for instance.

The major element weighing most heavily is the cost of knowledge. Siggel (1983, p. 107) reports that foreign supervisors and managers which represent only three to five percent of employment often account for a larger proportion of the production cost than ordinary labour.

In Oman, the situation is different. The cost of importing technology, be it direct or indirect, is a less critical factor. Oil resources have provided the necessary capital required for the socio-economic development of Oman within a very short period of time. However, such rapid development appears not to have brought with it the means as well as essential skills, i.e., appropriate indigenous managerial and manpower capabilities. The required labour force has become much greater than the local workforce could provide, hence the need for importation of foreign manpower and expertise.

As will be seen in these empirical findings later in this study, the types of technology imported into Oman are sophisticated. Consequently, the low educational standard of the local people often makes the comprehension of such technologies difficult. In turn, this perpetuates dependence on both foreign technology and foreign manpower.

2.6 KNOW-HOW TRANSFER

The most important part of technology transfer is the transmission of know-how through education and training combined with practical experience. There exist several means for the transmission of know-how, formal local training programmes, training programmes abroad, in-plant courses, on-the-job training, education abroad, circulation of books and periodicals, etc. Vaizey (1969) suggests that job-oriented training programmes and on-the-job training are the most efficient means. Education abroad has often been criticised as impractical to the actual needs of developing nations, Young (1966).

In general, failure to transfer satisfactorily the knowledge required for the absorption of technology has led to the failure of technological transfer; a relevant study by Peterlongo (1977) is worth mentioning at this point; it consists of co-ordinating the transfer of educational systems with the transfer of technology. The usual path followed to accomplish both transfers can be described as: economic study-choice of the technology-transfer of the technology then transfer of organisational and training systems. This simple uncoordinated pattern has created serious difficulties to the recipient country. Improvement of this pattern is suggested by Peterlongo is presented in Fig. 2.2.

From these considerations, there appears to be two new aspects, which are the redesign of technology and redesign of educational transfer. The redesign of technology is very similar to the approach of modification of technology used in the 1870's for the silk industry and then in the 1950's for the other industries in Japan; this phase requires an enormous contribution of the country receiving the technology, which should dedicate more resources and more time for the forecasting and planning of industrial development. The competence and abilities of the country of origin are obviously very important and are required in this phase.

The concept of redesigning the organisational as well as the educational and training systems correspondingly to the redesign of technology allows the receiving country to take into account the requirements and the general situation of the country and, therefore, of being able to assimilate and adapt the

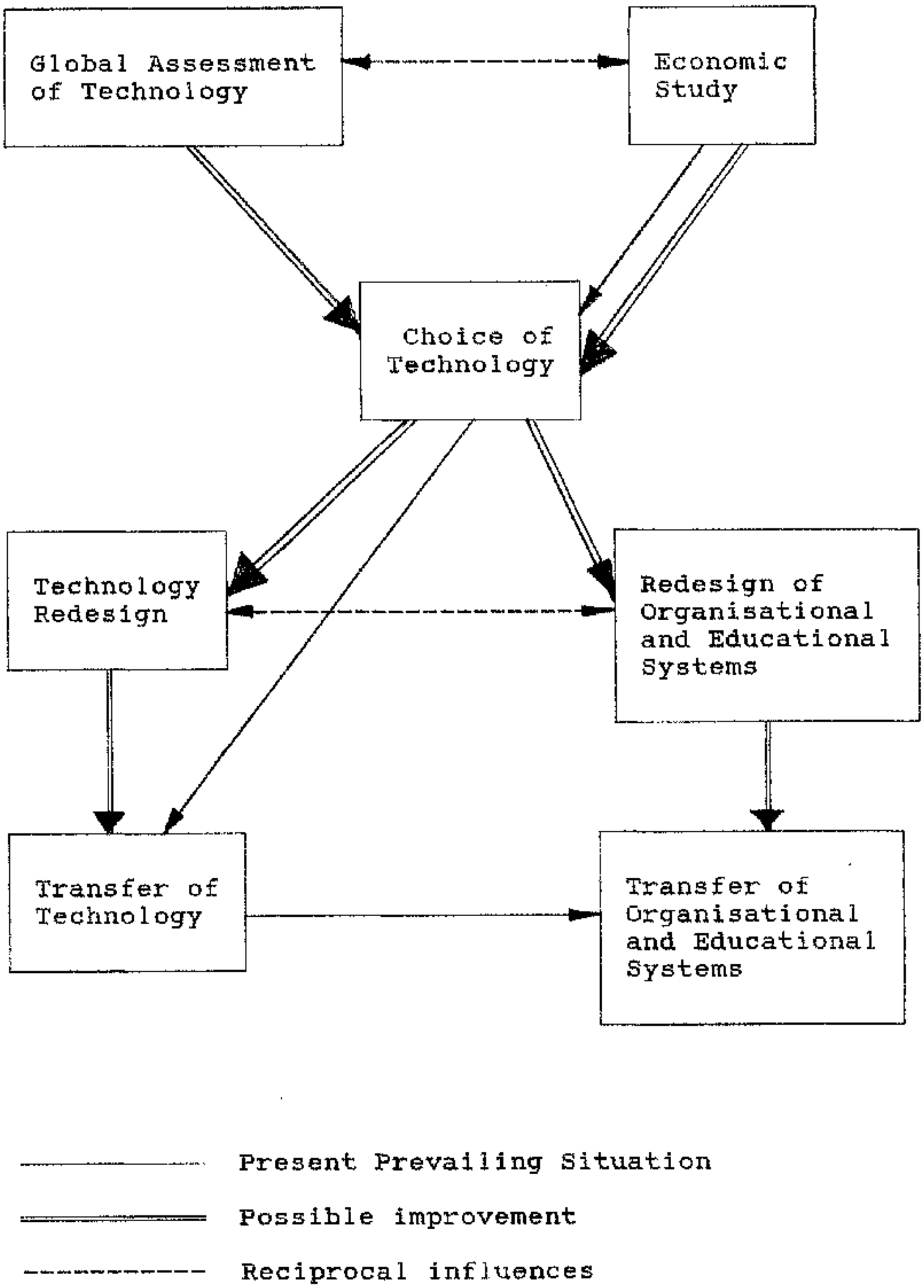

Fig. 2.2

Scheme of the Technology Transfer Process

Source : Peterlongo (1977, p. 174).

technology. The two activities of redesign should be performed contemporaneously and not, as often happens at present, sequentially. The aim is to obtain reciprocal influences in order to benefit from both aspects of the transfer.

The phases of redesign in order to modify the technologies and education transferred will direct the training and educational systems towards the proper use of technology. Although the costs involved for these operations are high, this approach will not only compensate, in the long run, the allocated resources but also, it will ensure a well-planned, and successful technological transfer.

Peterlongo (1977, p. 178) concludes his paper with the following original idea, which may be related to technological transfer, to some extent; he says:

> "The suggestion here proposed could perhaps improve the present situation. They are based on resources, such as creativity and reflection, which by their nature are much more evenly distributed among the nations than capitals and raw materials."

The modernisation theorists, (see Rostow, 1960), will certainly not agree with the above statement. They stipulate that third world countries are "backward", "late-starters" and lack the attributes of modernity, as Fitzgerald (1981) reports. One should therefore not restrict one's views when looking at developed and developing nations and at their technological differences, as knowledge exists everywhere, what is lacking is enhancement and encouragement for the use of knowledge to profitable ends.

2.7 CONCLUSIONS

The preceding literature examined the terms and conditions of transfer of technology and has identified the problems encountered. The term technology has been variously defined. One of the simplest definitions is attributed to Root 1968 and is "The body of knowledge that is applicable to the production of goods and the creation of new goods". It is often seen not only as a factor contributing to greater production but also as an asset which improves the quality of a product, reduces its cost and constantly leads to the creation of new, and often sophisticated products.

The transfer of technology is broadly distinguished in two types, which Brooks (1966) calls vertical and horizontal. Vertical transfer is a process by which scientific knowledge becomes part of a technological system, by making a technology out of unrelated and different techniques, and horizontal transfer is the adaptation of a technique from one use to another, or from one country to another.

Hoffman finds that there are many elements of technology incorporated in transfer agreement. He cites seven factors as typical examples of elements of technology. According to Siggel (1983) there are three factors responsible for the effectiveness of transfer. Firstly, technologies must be transferred in all their required parts. Secondly, the effectiveness depends on how the transfer mechanism is organised, there is particularly a high risk that the transfer may be incomplete when it is in an 'unpackaged' form with independent dealers. Thirdly, it depends on the receptivity of the receiving firm, that is, management capacities and technical absorption.

Stewart (1979) divides the cost of technology into actual or direct costs and indirect costs. Direct costs constitute the payment of technology royalties, profits, and transfer pricing mechanism. The indirect costs, on the other hand, which may account for overpricing, etc., represent the largest part of the transfer cost. These operations have often been called manipulations of transfer pricing by the multinationals, (see Lall, 1987) for instance.

The most important part of technology transfer is the transmission of know-how through education and training combined with practical experience. There exist several means for the transmission of know-how, formal local training programmes, training programmes abroad, in-plant courses, on-the-job training, education abroad, circulation of books and periodicals, etc. Vaizey (1969) suggests that job-oriented training programmes and on-the-job training are the most efficient means. Education abroad has often been criticised as impractical to the actual needs of developing nations, Young (1966).

One may be tempted to conclude, based on overall review, that Oman should have acquired sufficient foreign technologies over the years to enable it to develop its local capabilities aimed at sustaining and maintaining some elements of technological independence.

CHAPTER 3

THE INTERNATIONAL TRANSFER OF TECHNOLOGY

CHAPTER 3

THE INTERNATIONAL TRANSFER OF TECHNOLOGY

CHAPTER 3

THE INTERNATIONAL TRANSFER OF TECHNOLOGY

3.1 INTRODUCTION

The multinational companies are the most usual suppliers of technology to developing countries. This chapter is divided into three parts. The first part introduces the International Transfer of Technology - A Historical Perspective. In the Second part, two related aspects of the Multinational activities will be examined. These include their willingness to engage in various forms of operations in developing economies, and the exploitation of their managerial and technological capabilities. The third part deals with the choice of technology, both government policies in the developing as well as the behaviour of the suppliers of technology (which are basically the Multinationals). Finally, conclusions are drawn.

3.2 THE INTERNATIONAL TRANSFER OF TECHNOLOGY : A HISTORICAL PERSPECTIVE

In the world's long history of industrialisation, the transfer of technology has played a predominant role in the establishment of new industry in many countries. Hence, the transfer of technology is not a recent phenomena but has been going on throughout all history. About four hundred years ago, Francis Bacon observed that three great mechanical inventions, printing, gunpowder and the compass, have changed the whole course of life, particularly literature, warfare and navigation; see Dunning (1982). However, none of these great inventions had originated in Europe; rather, they represented a successful technology transfer from earlier civilisations.

The beginning of the industrial revolution took place in England and the resulting technologies provided the basis for industrial and then a number of other countries which had favourable conditions, such as Canada, Australia, Japan and the Soviet. These examples proved that the technological transfer required high levels of skills and technical competence in the recipient country and that a successful transfer of technology is not merely transporting machines from one location to another. International transfer of technology between industrialised countries is continuously increasing as a result of better transportation and communication between countries.

During the 1960's, when most of the developing countries obtained their political independence, there was a growing awareness of the importance of international co-operation, based on the transfer of technology. However, the conditions and environments of the recipient countries were not as yet favourable for successful technological assimilation and the international environment did not appear to be a promoter of technological integration; indeed, the strengthening and rising technology transfer between industrialised countries, which led to a broad exchange of knowledge and to a rapid technological progress, has most certainly contributed to the continuous widening of the gap between industrialised and developing countries.

The crucial importance of international transfers of technology, as a means to improve the efficiency of the investment and the general effectiveness of the productive process, is constantly stressed. The transfer of technology is a complex phenomenon, involving a wide variety of forms (see Chapter 4). The classical, and perhaps the most dominant form, is the transfer by Multinational Corporations (MNCs), in either partly or wholly owned subsidiaries; the other form is simply the export and import of capital goods embodying technological knowledge.

Although these forms of technology transfer are widely used among the developed market economies as well, they may not be fully efficient way of transmitting the use of modern technologies between economies at different levels of development. Some would take the view that they may increase the dependence of the less developed countries and hence widen the gaps in development between exporters and importers of technology.

Moreover, the operation of the MNCs under the packaged nature of the investment which have to be viewed as promoters of development, by what is often called a "business school approach", Quinn (1969), are not widely shared; instead, many agree that the MNCs are continuing their historic dominance with a new economic dependency.

Some of the risks that can arise from the dependence on technology may place the purchasing firm in a position of unjustified disadvantage with regard to the exporter requesting higher undefined prices. It is often suggested that there are no official regulations for royalty agreements, nor systematic policy of technology imports, and that, often, firms may be remitting profits as well as royalties where they should be paying only one of the above.

The imperfect character of the international market may result from the very nature of intellectual property; Streeten (1972, p. 381) defines the know-how in relation to the market. He states:

> "Technical knowledge cannot be marketed like other products or factors because it possesses the following peculiar features: indivisibility, inappropriability, embodiment in other factors, uncertainty, and impossibility to know its full value until bought".

In other words, as technological know-how is embodied to machinery and equipment as well as technical skills. The buyer cannot have more or less of it. The characteristics of technical knowledge, therefore, explain why the sale of licences and patents often restricts the recipient's use of the imported technologies.

The successful absorption of foreign technologies does not depend only on the transfer of technical knowledge and methods. Often it is the inability to introduce new and foreign development in administrative, financial and social fields that subjects a host society to serious pressures. Much of the discussion on the transfer of technology to developing countries is linked with the 'choice of techniques' (see Section 3.4 below). This question arises from the unsuccessful repercussions of the nature of the technology transferred.

When dealing with the problem of technological transfer, one is treating one of the basic problems of development and, therefore, it is important to examine certain problems related to economic development in order to establish the framework within which the transfer of technology operates. According to Myint (1967), the recent interest in development economies has its roots on the one hand in a number of policies regarding the help of the developing countries and on the other, in the need for an economic understanding of the problem of underdevelopment. A wide development theory is:

> "a discernible rise in total and per capita income, widely diffused throughout occupational and income groups, continuing for at least two generations and becoming cumulative."

According to this definition, an underdeveloped country is one in which this process has not taken place where per capita income can be explained by the shortage of capital which necessarily implies a low productivity of the labour force, and by other limitations due to lack of technical and managerial skills and lack of education. Sunkel (1969) approaches the problem in a different way; he explains underdevelopment as a state where the capital goods sector does not exist. He goes on to argue that the imports of capital goods necessary to produce consumer goods have been substituted for the imports of consumer goods themselves.

It follows, therefore, that the capital goods sector should be encouraged as the imports of machinery directly serve as a training ground for human resources. Taking this viewpoint, capital goods constitute an important vehicle for technological trade. The transition for machine-operation skills to machine-building capability can be effectively bridged within a reasonable period, provided suitable technological assistance and efficient training is provided in the early stages as Singh (1975) argues.

Turning to policies, some questions that may occur to economists are to ask why has the market system not provided incentives for the development of science and technology in developing countries, and why do the industrial countries that have a comparative advantage in manufacture and in industry, tend to protect heavily their technologies, by trying to gain the maximum out of developing economies and not diffusing the know-how. It is unfortunate that these points, obviously greatly affecting the assimilation of technology, can only be answered by going beyond economic boundaries. It is clear, however, that the developing economy serves as a market for the technology as well as the manufactured products of the rich countries; it also serves to expand and develop the economies of the developed world through the operations of the Multinationals, and serves as low cost sources of raw material for the developed world. If the developing countries have to become scientifically and technologically independent, the developed world will as a result suffer the consequences and it will no longer retain its present privileges. Hence, one may understand why an existing and continuing developing world may be encouraged and kept as it is by the dominant world. Sometimes, political pressures may be created and encouraged in order to maintain these nations under control.

3.3 THE ROLE OF THE MULTINATIONAL CORPORATIONS (MNCS) IN TECHNOLOGY TRANSFER

A Multinational corporation is defined as "one which commits financial, technological, managerial and human resources to a foreign operation through direct investment and which attempts to maximise global profit through centralised control and co-ordination", Okada (1983, p. 116)

The Multinationals are considered as the prime agents of technology transfer. They are mainly American-owned, and they carry out about eighty percent of technological transfers especially through direct foreign investment (in either wholly or partially controlled subsidiaries). Delorme (1982, p. 90) classifies the characteristics of these firms in the following:

(1) they have the ability to operate globally and to survey the inputs and outputs of their technical field;

(2) they have the ability to organise this field by rationalising their subsidiaries' production world-wide;

(3) they have the ability to take maximum advantage of favourable wage conditions and of the probable opening up of potential markets by world-wide relocation of operations.

They are mainly seen as global maximisers of profit in locating their R and D activities and transferring technology internationally, as Hirshey and Caves (1981, p. 128) put it. The main criticisms, as has been pointed out by Wilkins (1974), is that they engage in transfer rather than in true diffusion of technology.

The main reasons pushing the Multinationals to operate in developing countries, are due to conditions in both countries. First, the product cycle theory of Vernon (1971), which integrates the theory of international trade with the theory of direct investment, shows that the expansion of the product which benefits the Multinationals necessities the latter to produce abroad (and particularly in developing countries) as a move against potential competitors. Vernon's findings may be explained by the 2,904 subsidiaries of which sixty-five percent had been set up by acquisitions rather than by new investments by the end of the 1960's, and Lall (1978, p. 230) reports. These acquisitions are due to the immense financial and other resources, that put local competitors in a difficult position which leads the Multinationals to buy them at ridiculous prices. Second, the entrepreneurs in developing countries desirous of acquiring foreign technology, lack the technical knowledge and therefore have to undertake negotiations with foreign companies, which are often Multinationals and have experience in international licensing, UNIDO (1973, p. 16).

The circumstances in which the Multinational firms will supply the technology and their decision process have already been the subject of considerable studies, see Stopford and Wells (1972) in particular. Helleiner (1975, p. 86) notes that these preferences mainly depend upon tax structure (tariff structure, profits taxes, taxes on royalties and other international transactions), legal provisions and restrictions of various kinds (related to capital repatriations, foreign exchange control etc.) and other factors such as their size, the nature of the technology and the country of origin.

When comparing the productivity of a Multinational operating in a developing economy, or a domestic enterprise, Lall (1978, p. 218) asks the following questions:

> Would the local enterprise have been set up in the absence of the Multinationals' investments? Did they gain or lose by having the Multinationals as major customers? Is the host economy capable of creating the same linkages at lesser cost, by replacing a Multinational by local firm? Are the linked local enterprises desirable from the social point of view? Whether negative linkage were created by stifling potential local investment?

These questions arise from the impact itself an MNC has on the economy of the recipient country. The relationships that it has with local suppliers or purchasers constitute a powerful mechanism for stimulating or retarding industrial growth. Other effects resulting from the Multinationals' operations may concern the performance of the economy as a whole; in particular, they may affect the profitability and growth of indigenous firms as well as alter financing, marketing, technological and managerial operations of the sectors they enter.

In general, the literature suggests that there exists a vast potential for linkages with domestic producers, who may manufacture components or whole products for foreign firms or for the Multinationals' affiliates in developing countries. Moreover, it has been reported by Lall (1978, p. 232) that the Multinationals are fairly profitable in less developed countries and that on average they perform better than local firms.

The adaptability of Multinationals' technologies has been an area of great interest and controversy. The main questions involved with this point are put forward by Lall (1978, p. 237). These are:

(a) whether the technologies used by the Multinational corporations are adaptable to low-wage, labour-abundant conditions in less developing countries;

(b) whether they do in fact adapt the technologies they transfer;

(c) whether they adapt better or worse than local firms.

Studies suggest that technologies used by the Multinational firm are, in some cases, adapted to the local environment and objectives, and in other cases they are not, UN (1974, p. 2). However, it is often argued that there is no adaptation, in the sense of alterations to the low-wage conditions of developing economies, see Stewart (1974) in particular. The main consequence of non-adaptation is the non-absorption of low-wage workers, which affects heavily the unemployment problem in these countries, and which allows more advantage for the Multinationals' affiliates, as they avoid the expensive adaptation costs to suit the relatively small markets and to absorb employment. It would, however, be interesting to see whether the adaptation of technologies by the Multinationals would, in the long run, benefit both parties, as these operations may encourage more contracts and projects.

When studying the MNCs one notices the steady shift from earlier focus on international capital flows and the direct investment package to the unpackaging of direct foreign investment, that is, capital technology, marketing, management, etc. No attention is being focused on the international market for technology, which proves to be complex and highly imperfect. In fact, most criticism is related to the high cost involved as mentioned earlier; also the "package" nature of transfer tends to create and increase dependence.

Such dependence tends to be frustrating no matter how the MNCs behave and no matter what the regulations are by the host country. The power of the enterprise to take actions in relation to production, employment and exportation, and to affect the diversion of local activities, may harm the interests of the developing economy. The frustration is reinforced as the costs and benefits associated with the presence of Multinationals are difficult to quantify as they involve social costs. UN (1974, p. 1) attributes these costs to the difficulty in evaluating the cost of certain types of imported goods and services, to social costs related to the restrictive business practices they create, there may be loss when parent firms cause a displacement or unemployment of local resources, such as savings, entrepreneur and skilled labour. Other cost may be political, in the sense that the Multinational firm's operations may have an impact on internal and international relations in turning the economy to foreign firms.

These few remarks show how difficult it is to deal with the phenomenon of technology transfer, which is further complicated by the differing characters of the parties concerned, two firms and two states, each of whom has its own policy, as Delorme (1982, p. 91) puts it. With regard to the firms' policy, the Multinational has got rigid and institutionalised organisation, which may not be flexible in certain circumstances.

As the cost is difficult to determine, one therefore ignores whether an alternative source could provide the same services at a lesser cost and with less dependence; all too often the alternative source is not available and the Multinationals remain the main suppliers. In this case the acceptance of the "package" of capital, technology and management embodied in the MNCs may still be an attractive source of technology for some developing countries. In some other cases, alternative types of sources, or some non-traditional arrangements with the Multinationals, which do not involve proprietary rights, may be obtained and may, as is often argued, see UN (1974, p. 2) and Baranson (1979), appear to be both feasible and more socially profitable than direct foreign investment of the traditional form. Furthermore, it seems that these new arrangements lend themselves to a more systematic and quantitative analysis.

3.4 THE CHOICE OF TECHNOLOGY

The issue of technological transfer to developing countries is very much linked with the choice of techniques imported. Increasingly, many economists and policy-makers place some of the blame for the failure of industrial development on the technology imported from the advanced countries.

Many developing countries are experiencing a serious and increasing rate of unemployment which is said to be due to the capital-intensive techniques used. The recipient firms (wholly or partially owned subsidiaries) are accused of selecting manufacturing process that do not combine capital and labour according to their availability in the country. Some studies have shown that the impact of the kind of technologies in use in some plants use twice as many workers as an automated plant.

A large amount of research has, therefore, concentrated on finding out the factors that influence the selection of technologies for the developing economies. It is argued that both government policies in these countries as well as the behaviour of the suppliers of technology (which are basically the Multinationals) are responsible for the choice of capital-intensive techniques.

Two criteria are usually distinguished, price and brand-name both resulting from the competitive position of the firm. Wells (1972) found that whether that the company is foreign owned or domestic, it is more likely to import a capital-intensive technology if it is competing primarily on brand-name basis than it would if it was competing primarily on price. When the company is subject to a strong price competition, its aim may be to choose a technology that minimised the costs, that is choosing a more or less labour-intensive technology.

The managers of both the foreign owned or domestic firm seem to respond to certain factors that lead them to prefer a more capital-intensive alternative. The manager is influenced by the problem of managing a larger number of workers associated with the labour-intensive technologies; Wells notes that generally, they prefer to design the plant on a small labour force basis to avoid this problem, despite the low cost of a labour-intensive plant.

Furthermore, the managers are greatly influenced by the high degree of risk and uncertainty that may be encountered when the plant design is of a labour intensive technology type. Wells finds there are two kinds of insurance against risks that can be offered by a capital-intensive plant. First, in a capital-intensive plant, the manager is more able to respond to unexpected fluctuations in demand or in production levels; and second, the perception of capital-intensive plant itself is designed to allow the manager to reduce the risks facing further liquidity problems, such as shortage of working capital etc.

Just as there are factors affecting the selection of capital-intensive techniques, there are also other forces that constrain this choice. Some research suggests that the scale of the plants in developing countries may be the most important constraint, for example, Yeoman (1968) suggests that generally the pieces of capital-intensive equipment not only come in discontinuous units, but also some parts may operate at only a fraction of their capacities, as a result of being originally designed for large scale sophisticated plants. Therefore, this factor may have been the major element constraining the Multinationals to transfer a highly capital-intensive technology.

Other constraining factors may be due to the difficulty of finding spare parts for sophisticated equipment in developing countries, as well as the scarcity of skilled repairmen. In addition, the above research suggests that Labour Laws have served as restrictions to the automation of plants, as they are based on employing more workers, as was pointed out by Wells.

One may summarise from the above discussion that basically, the choice of capital-intensive techniques is related to management, engineering and maximisation of profit elements; it seems that the socio-economic factors within which the plants operate are ignored.

3.5 CONCLUSIONS

The Multinationals are the most usual suppliers of technology to developing countries. The preceding literature examined the International Transfer of Technology and has identified the problems encountered. The issues covered are relevant in the sense that one could see the changing pattern of transfer. In particular, the developing countries are becoming increasingly aware of their bargaining power, and the suppliers of technology, the Multinationals more specifically, are confronted by an increasingly competitive environment, which may result in an alteration of their terms of trade in favour of developing countries.

CHAPTER 4

THE FORMS AND CHANNELS OF TECHNOLOGY TRANSFER

CHAPTER 4

THE FORMS AND CHANNELS OF TECHNOLOGY TRANSFER

CHAPTER 4

THE FORMS AND CHANNELS OF TECHNOLOGY TRANSFER

4.1 INTRODUCTION

There are many forms and channels through which technology can be transferred from industrialised to Third World Countries. The specific concern of this chapter is to examine the different forms through which technologies are transferred from developed to developing countries.

4.2 FORMS, MECHANISMS AND CHANNELS OF TRANSFER

The various elements of technology required for setting up production facilities and technical assistance are transferred in forms involving a wide variety of contractual agreements which take broadly two organisational forms, the most predominant form, which can be divided into two, is a direct foreign investment by a multinational firm in a wholly-owned subsidiary or a joint venture with majority or minority participation by the foreign firm, the second form is basically a transfer agreement between independent enterprises, either private, semi-public or public.

Many projects may involve a combination of two or more of these methods, the majority owned direct investment may be subject to a contractual plan or be of indefinite duration. Each of these methods has its advantage and disadvantages to the importing country.

The major considerations of the host nations are the objectives of sharing the gains and of asserting control; the suppliers of technology, on the other hand, have their own judgement on the cost and benefits in entering these contractual agreements, United Nations (1974, p. 23). They protect their interest by registered brand, agreement with government for monopoly positions and by various forms of contracts, Siggel (1983, p. 90).

In fact it is often true that direct foreign investment remains a substantial source of capital and is sometimes the only source of specific technology. The United States as well as other major capital exporting countries prefer, for economic as well as ideological reasons, to transfer their capital outflows through private investment, and it is most probable, as Root and Ahmed (1979) put it, that developing countries will continue to rely on foreign direct investment to carry out their development programs. There are, however, certain conditions in developing countries that could either be attractive or unattractive to foreign direct investments; the above study found that substantial urbanisation, a relatively advanced infrastructure, a comparatively higher growth of per capita G.D.P. and political stability were major factors in attracting foreign investment.

For the second form of transfer which is a transfer agreement between enterprises, and which do not involve proprietary rights to the transfer, the decision of transfer may be left to a local private enterprise, although governments are increasingly intervening in such decisions, either in local or public firms.

Technology is transferred through mechanisms ranging from the completely packaged in the form of direct investment overseas in a wholly-owned subsidiary, through joint ventures, turnkey arrangement and licence contracts between independent customers. Usually, as Stewart (1979, p. 12) argues, these mechanisms called indirect tend to be adopted when the country lacks the capacity to undertake direct purchase, or when for marketing or other reasons the recipient wishes to acquire trademarks. Technology may also be transferred through direct forms such as training local people for special production projects.

4.3 INDIRECT FORMS OF TRANSFER

Foreign Direct Investment

Foreign direct investment takes place in a packaged form, that is, in a combination of funds, management and marketing skills, technological know-how, etc. There is, however, a growing concern of host countries to increase joint venture types of transfer. It seems, according to Stopford and Wells (1972) that certain multinationality oriented firms are favouring such joint venture arrangements. This is due to their lack of financial resources and to the tendency to increase their vertically integrated organisation so as to ensure that supply of a product over which they have quasi-monopolistic control.

Other factors are most probably linked with the changing balance of world economic relations and with a tendency towards greater autonomy on the part of certain developing countries, also as Vaitsos (1974) put it, the increasing shift from fully-owned subsidiaries by multinational companies towards joint venture arrangement may be due to the enhanced knowledge and increasing concern of government authorities in developing countries over the nature of multinational enterprise activities.

Joint Ventures

Joint ventures can be a majority or minority participation of the multinational firms, or it could be equally distributed between foreign and local interests. Joint ventures may behave like subsidiaries when they have a major participation, they exercise full control of the company, however, most often they are used to acquire the technology while retaining national control over a firm or an industry. Because they participate in the holdings, the multinational enterprises will be interested in the efficient and profitable operations of these firms, as they will share the profits.

This method is often viewed as an important advantage to the recipient firms. When operating in joint ventures, the multinationals provide the machinery and equipment, the know-how and patents, and the recipient firm supplies the capital funds. The know-how supplied by the foreign participant may be related to the construction phase, to the production process and may involve brand-names and marketing skills, which involve a licensing agreement.

Licence Agreement

Technology licensing varies from developing country to another, and hence the impact of foreign technology also varies. Nevertheless, the basic problems of licensing tend to be similar. According to UNIDO (1973, p. 2) a licence means:

> "The consent given by the owner of an exclusive right (licenser) to another person (licensee) to perform certain acts which are covered by an exclusive right, or consent as to use of knowledge".

A licence agreement is, according to U.N. definition, see Cooper and Sercovitch (1970):

> "A contract under which the licensee is granted certain rights to manufacture and sell products utilising inventions, process techniques and other industrial property rights of the licenser".

This definition applies irrespective of whether the licensee is a fully-owned subsidiary, a joint venture or a locally-owned firm. The contractual agreement may be related to patents, trademarks as well as other forms of proprietary and non-proprietary technology.

The licensing agreement contract include, according to UNCTAD (1975), certain restrictive clauses related to the acquisition of technology, to its use in the production process and to the distribution of the commodities produced. Through these clauses, the licenser can exert control over a series of operations of the licensee, in particular those concerning the production; the clauses often refer to the quality of the product, the choice of process technologies, and possible technical innovations, improvements and modifications that would be carried out by the licensee.

Other clauses are concerned with the procurement of raw materials, parts, intermediates and machinery, which put the licensee in a position to purchase from the referred supplier. There may also be restrictive clauses as to the quantities the licensee is entitled to produce, pricing policies, packaging and marketing, such as advertisement and sales promotion, Stewart (1979, p. 12).

The reasons for all these limitations are aimed at reducing the uncertainty as there is always a danger that the recipient firm may exploit the technology transferred after the contract expires, Sercovitch (1974). Thus this serves the licenser not only in avoiding competition but also in appropriating the returns, which are effected through royalties, the payment of technical fees, and through over-pricing of the materials supplied on a tie-in-clause basis.

The licensing agreement may provide a good arrangement for the recipient firm in that it enhances their competitive position in the local market and often secures profitable operation because of the use of brand-names etc., however, and most often, because of the restrictive clauses it may restrict the growth prospects of the firm.

Turnkey Contracts

Another form of technological transfer (other than foreign direct investment, joint ventures or licence agreement) is the turnkey contract. Turnkey agreements are made particularly at an early stage of industrialisation, when the country lacks local skills and when the operations involved are technologically complex. This form of contract implies a completely packaged transfer, that is, a supply of technical and managerial operations required to run the enterprise for the allocated period of time. Depending on the nature of the plant and the technology involved, the turnkey contractor may be either the owner of the technology or the main supplier of machinery or a consulting engineering organisation. When the project is large, many foreign organisations may combine to take up turnkey operations, UNIDO (1973, p. 9).

The main problems with this arrangement is the substantial foreign exchange costs involved. It is increasingly believed that a gradual "unpackaging" of the technology package and the increasing reliance on more direct types of transfer, such as technical services agreement, management contracts, etc., will restrict the contractor's control over price setting, procurement of materials, etc.

One of the disadvantages of such an arrangement is represented by the delivery of a plant together with instructions for operating it under the conditions assumed in its design, but failing to provide the recipient with an understanding of the full details of how and why the plant works to obtain maximum productivity or how it could be adapted for even better results. Agreement may involve proprietary and non-proprietary technologies, Cooper and Sercovitch (1971, p. 34).

4.4 DIRECT FORMS

Direct forms are used when the recipient enterprises are in direct contact with the suppliers of technology. Among the factors included in direct forms are:

(a) Training local people for special production projects;

(b) Subcontracting part or all of a project;

(c) Supply technical information and/or importing of equipment/machines direct from the supplier;

(d) Transferring the process technology embodied in capital goods by importing of equipment purchased directly from machine manufacturers, (see Cooper and Sercovitch, 1971, p. 15).

Siggel (1983, p. 85) also classified direct forms as:

(a) The acquisition of productive equipment;

(b) The transfer of the technology proper, i.e., the transmission of technical know-how concerning the plant and its operation, embodied in feasibility studies, plant designs, equipment, product design, quality control specifications, etc.;

(c) The provision of technical and managerial know-how for the use of the technology through employment of foreign skilled manpower;

(d) The training of local personnel.

The productive equipment is usually available from machine producers at market prices without proprietary restrictions, a certain amount of know-how transfer is included in the purchase of machines with the operating instruction. However, there are certain types of machines that may not be freely available from the producers unless they are acquired within a larger package, such as licensing contract, or they may involve proprietary rights to the supplier, in the form of direct investment.

Siggel (1983, p. 85) argues that the acquisition of machinery, which constitutes the hardware of a technology, is the most costly part of the transfer; and that the element that constitutes the most important part of the transfer is software, which is either disembodied knowledge (know-how and experience of managers, and technicians) or the knowledge embodied in documents, which may require a high level of training to be understood. The actual transmission of productive know-how may involve the employment of foreign experts, the training of personnel, the inflow of information through documentation and visits by specialists to domestic plant.

Despite the variety of forms and channels mentioned earlier, the most effective and efficient mechanism for transfer seems to lie in the movement of people (Brooks, 1968, p. 59; Rothwell, 1973, p. 220; Davidson, 1974, p. 7; Gee, 1981, p. 19).

It is the combination of the desire of the supplier of technology to supply the technology and know-how in a particular form, and the ability of the purchaser to acquire it in a particular form that determines the mechanism of transfer in a particular case. Generally speaking, the most important issue of transfer lies in the case where supplies play an active role of providing information in an immediately operational form such as foreign direct investment, licensing, turnkey agreements and technical service contracts. These (indirect forms) tend to predominate where a country lacks the capacity to undertake direct acquisition or the ability to negotiate or to put the package together. However, modes where foreigners play a passive role, which means locals have to acquire the knowledge and later translate it into technology (By consulting foreign technical, training, and copying foreign operations), appear to be channels of technology transfer of as much significance. But in both cases the aim should distinguish between, in the transfer of technology used, three types of capabilities:

(1) Production capability - that required to operate a technology;

(2) Investment capability - that required to expand existing productive capacity or to establish new capacity, and

(3) Innovation capability - that required to develop new methods of doing things. Dahlman and Westphal (1983, p. 7).

In both technology transfer cases however, the last two components seem to be missing. This is mainly due to the fact that technology transfer is considered as the goal rather than the means of enhancing the local capabilities and technologies which would lead to technological independence.

4.5 CONCLUSIONS

Channels abound through which technology can be transferred from one country to another, particularly from industrialised nations to developing countries. Many means exist by which technological know-how is transferred from developed to developing countries. Methods range from joint venture, licensing and turnkey agreement to engineering and management consulting. The developing countries may employ these means singly or jointly depending on the nature of the technology and the precise circumstances of each individual case. The most important issue of transfer lies in the case where suppliers play an active role of providing information in an immediately operational form such as foreign direct investment, turnkey contracts and technical service contracts, these tend to predominate where a country lacks the capacity to undertake direct acquisition or the ability to negotiate or to put the package together.

CHAPTER 5

THE ECONOMY OF OMAN

CHAPTER 5

THE ECONOMY OF OMAN

CHAPTER 5

THE ECONOMY OF OMAN

5.1 INTRODUCTION

Despite new discoveries, announced by the government, in oil and gas reserves which are now expected to last well into the twenty-first century, the strategy in Oman has been to diversify the national revenue sources on the basis of long term plans. Government efforts have concentrated on agriculture, fisheries and light industries, with the aim of underpinning the country's development and creating more wealth. This chapter describes present social, economic and human resource development activities in Oman. It is divided into four parts. The first part discusses the social affairs and their development. The second examines the economic development in oil revenue, agriculture, fisheries, industry and electricity. Part three deals with human resource development. Finally, conclusions are drawn.

5.2 SOCIAL AFFAIRS

A system of social welfare has traditionally existed in Omani society over the centuries as the payment of Zakat is one of the pillars of Islam. Zakat, it should be explained is a religious tax, originally representing 5 to 10 percent of earnings from the land. (Oman, 1985, pp. 187-190). Nevertheless, it was clear at the beginning of the new era, on the accession of His Majesty Sultan Qaboos, that there was a requirement for a social security system within a developing modern society.

The current law stipulates all the categories of people who are entitled to social security payments. The scheme provides shelter for those suffering from poverty and need, and guarantees them security and ability to lead a useful life. Up to the end of 1990, monthly benefits had been paid to 39,135 families under the Social Security Law, which provides social assistance for families in need in the following categories: Widows, orphans, those unable to work, divorced and abandoned women, unmarried girls and the aged. (Ministry of Social Affairs, 1990, pp. 130-139).

The two foremost needs of the Omani people at the time of the accession of His Majesty Sultan Qaboos were education and health services. The achievements over the past two decades in both these fields have been remarkably successful. By the end of 1990 there were 800 Government Schools in Oman, including institutions and intermediate teachers' training colleges. The General Education Schools total 309 boys' schools, 287 girls' schools and 183 mixed school, all of which are at the primary and secondary level. In the academic year 1990/91 the expected total of students in the three levels (Primary, Preparatory and Secondary) is 351,217, of which 163,342 are expected to be girls and 187,875 boys. (Ministry of Education 1990, pp. 143-149).

High on the list of major success stories in Oman modern development are its health services, and no less important the development of preventative medicine services. By 1990 there were 47 hospitals, 88 health centres, three maternity centres, 96 preventative health centres and 5 mobile rural health centres with a total of 3,360 beds, in Oman. Today, over 90 percent of the population is covered by the Ministry's health services, there are hospitals in all major population centres and more are to be constructed under the current five-year plan. (Ministry of Health , 1991, pp. 156-162).

5.3 ECONOMIC DEVELOPMENT

Oil Revenue

Oil is the corner-stone of the Omani economy. Despite the progress of all economic sectors achieved during the recent year, oil is still the major economic driving force thanks to the following considerations:

(1) Oil is the main generator of GNP and constitutes the principal part of the production base as is vividly demonstrated in Table 5.1.

(2) Oil is Oman's main source of financial resources as it generates around 90% of domestic public revenues.

(3) Oil constitutes the main source of foreign exchange proceeds constitute around 99% of foreign exchange receipts (See Table 5.2).

Although the oil revenue has raised the standard of living, and provided subsidies of varying degrees to Omani citizens, it has brought with it some problems. These include:

(1) Increasing dependence of the the country on foreign exchange earnings, since oil is the main export.

TABLE 5.1

THE CONTRIBUTION OF OIL SECTOR TO GDP

(1970-1979) "IN OR MILLION"

Year	GDP	Contribution of Oil Sector	
		Absolute	" % "
1970	103.6	71.6	69.11
1971	124.0	73.9	59.59
1972	139.2	76.4	34.88
1973	167.7	94.5	56.35
1974	566.2	389.0	68.7
1975	721.7	486.8	67.5
1976	822.5	505.2	61.4
1977	875.5	525.4	60.0
1978	888.2	481.2	54.0
1979	1164.4	750.3	64.4

Source : Ministry of Commerce & Industry,
"The Economy of Oman",
July 1970 - July 1980, p. 93.

TABLE 5.2

OMANI COMMODITY EXPORTS IN 1970-1979

"PERCENTAGES"

Year / Item	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Oil exports	99.6	99.6	99.6	99.5	99.9	99.8	98.7	97.6	94.5	94
Non-oil exports	0.4	0.4	0.4	0.5	0.1	0.2	0.2	0.3	0.6	0.8
Re-export	--	--	--	--	--	--	1.1	2.1	4.9	5.2
Total	100	100	100	100	100	100	100	100	100	100

Source : Ministry of Commerce & Industry,
"The Economy of Oman",
July 1970 - July 1980, p. 385.

(2) Most capital goods are imported for domestic use.

(3) The shift of the national Labour force from the traditional industries (fishing, boat-building, agriculture, etc.) to the oil sector. The result is that these traditional industries appear not to have enough workforce to maintain and sustain them. Consequently, some of the traditional industries seem to be gradually collapsing.

Agriculture

Before the discovery of oil in the 1960s, Oman had a largely subsistence economy based on farming and fishing. Now the economy is over 90 percent based on the production of oil and gas. During the 1970s when the infrastructure of the country was being developed at great intensity there was a drift from the land to the urban areas, where high wages were attractive. However, during the 1980s, the Government took urgent measures to support farmers and thus encourage them to stay on the land (Oman, 1990, pp. 97-105).

Oman is considered the most green and fertile country in the Arabian Peninsula. Agriculture is one of the main pillars of the Omani economy. It not only provides food for the country but is still the main occupation for more than half of Oman's population, who have been experienced farmers for generations. The most suitable agricultural land covers about 240,000 hectares, some 56,000 hectares of which is currently under cultivation (Ministry of Agriculture & Fisheries, 1990, pp. 66-72).

Consequent upon the shift from the traditional industries to the oil sector, as stated earlier, the government of Oman should introduce new agricultural methods and technology to strengthen the agricultural sector, to improve the standard of living of farmers and to provide work for the national labour force.

The priorities of the agricultural development plan should be:

(1) To develop new land, and cultivate and manage farmland effectively;

(2) To provide support and guidance to farmers;

(3) To develop agricultural industries and revive the date-palm sector;

(4) To develop research work in agriculture;

(5) To provide loans for agricultural investment.

The plan should be extended to farmers by providing them with seeds, fertilisers, insecticides, improved species, animal feed and the means of marketing their produce.

Fisheries

Fishing, together with agriculture, has been and still is, a traditional Omani occupation and a major source of employment. Nevertheless, until very recent years it met only the needs of the local coastal communities. Formerly, it was impossible for the inhabitants of the Interior to obtain fresh fish. Bedouins of the Janaba tribe used to trade dried fish conveyed on camel-back from the coast in the region of Masirah Island in the north for dates from the Interior around Nizwa.

The Sultanate of Oman has a 1,700 km long coastline extending from the Musandam Peninsula in the north, at the entrance to the Arabian Gulf, to the borders with Yemen in the South, along which there are immensely rich fishing grounds, the potentialities of which have yet to be fully evaluated. A 200-mile exclusive economic zone extends seaward from the shores of Oman. (Oman, 1991, pp. 106-109).

More than 150 species of fish have been identified in Omani waters, ranging from sardines to tuna. Some 35 species of grouper, or hamour as they are known in Oman, are found in the waters of the Sultanate. In Dhofar (South of Oman), sardines are still bought by Jebali tribesmen as feed for their cattle during the dry season, when the grazing has been exhausted; although this is a dying practice as fodder becomes increasingly available from farms on the Salalah plain. Large numbers of lobsters are now caught off Masirah Island and the cost of Dhofar, and exported to the north. (Ministry of Agriculture & Fisheries, 1990, pp. 85-91).

During the first stages of development in the early 1970s many fishermen left their communities for the towns where they could earn higher wages. The Government was aware of the depletion of these communities and the threat it presented to the fishing industry. It was only natural that the fishing industry should receive special attention during the current revival. To modernise the industry and introduce new techniques, the government established the Fisheries Department in 1972. This later became part of the Ministry of Agriculture and Fisheries. The department invited a number of specialised foreign organisations to conduct the necessary research to estimate the development potential of the industry. The first report, published in 1975, estimated a potential increase in catches of deep-water fish from 7,000 to

300,000 tonnes and tuna fish to 600,000 tonnes. On the basis of these encouraging reports, the first five-year plan allocated 15 million Omani Rials to the development of the fishing industry. (Ministry of Agriculture & Fisheries, 1990, pp. 92-98).

The first and second development plans concentrated on setting up an infrastructure to develop and expand the fishing industry. This included the construction of refrigerated storage containers, fish storage depots, piers, ice-making factories, fish sales outlets, and repair and maintenance workshops which provide free services to fishermen.

Oman is now self-sufficient in the provision of fresh fish for its population, and plans that the fisheries will become one of the major export contributors to the national economy in the years ahead.

Manufacturing

Before the discovery of oil, Omani industry was limited to crafts such as weaving, pottery, silverwork, boat-building, and other traditional handicrafts practised by Omanis since ancient times. By 1988, however, there were 8,189 registered companies with a total investment capital of 358.7 million Omani Rials (One Omani Rial = $ 2.45 approximately).

As manufacturing industry is one of the most important sectors contributing to the diversification of the economic base of the country, the first five-year plan (1976-81) concentrated on building an infrastructure that would create suitable climate for investment in manufacturing projects which would utilise the natural resources of Oman. The plan aimed at widening the vocational training base. (Ministry of Commerce and Industry, 1989, pp. 77-92).

In 1979 the government passed legislation regulating and providing incentives to companies working in industry. These include:

Total or partial exemption from income and other taxes for registered or licensed companies for a five-year period from the date of registration or licensing, or the start of production, renewable for a further five-year period.

Total or partial exemption from customs duties on imported machinery, components or raw and secondary materials required by the manufacturing industries.

Exemption from all export duties on industrial products.

Imposing or increasing customs duties on all goods which compete with local products banning or restricting their import. (Ministry of Commerce and Industry, 1990, pp. 172-174).

The establishment and development of the Rusayl Industrial Estate (RIE) is one of the largest and successful economic projects to have been undertaken in Modern Oman.

The RIE was established in 1983 by Royal Decree No. 51/83, with the aim of promoting industry in Oman using local companies and Omani workforce. The RIE is a legal entity with administration and financial independence and powers extending to the estate itself and its annexures. It is managed by a board of Directors, appointed by H. E. the Minister of Commerce and Industry, which consists of representations from Ministers and Government departments.

The RIE is 45 km from Qaboos Port and 6 km from Seeb International Airport, and has road links with Muscat and other ports of Oman. The RIE is a base for a number of medium-sized light industries. Factories now in production, are producing truck chassis, electrical cables, water pumps, pipes, fencing-wire, nails, batteries, aluminium, tyres, insecticide, metal furniture and fibreglass. (Ministry of Commerce and Industry, 1990, pp. 81-87).

The development of Oman's industry should play a major part in the government's national strategy. Oman's policy of protecting national industry should be based on the following principles:

(1) maintaining the quality of Omani products;

(2) restricting government interference in free trade, applying protective tariffs only when necessary;

(3) taking into account the interests of the consumer to obtain low-priced goods and the national interest, which is to protect Omani products against foreign competition;

(4) establishing a sustainable national industry; industries which exploit local manpower and local raw materials.

Electricity

Electricity is not only basic household service, but is the energy that turns the wheels of the economy, and an essential element in the progress of the national revival.

Before 1970, there was only one power station in Oman. In 1988 there were 40 electric generating stations, while between 1987 and 1988 the number of substations increased from 3,774 to 4,471 (Oman, 1191, p. 118).

The second five-year plan (1981-85) allocated 92.1 million Omani Rials to electricity, but due to increasing demand, this was raised to 140.7 million Omani Rials, or an increase of 53%. The third five-year plan (1986-90) allocated 128 million Omani Rials which were invested in such projects as:

(1) expanding the electricity distribution network in towns and villages;

(2) buying, transporting and installing diesel generators;

(3) installing an extra generating unit at Rusayl power station.

The Ministry of Electricity and Water ensures that projects comply with Omani specifications and standards, and are aimed at meeting the requirements of the country. The Ministry is also responsible for improving and maintaining the electricity network, expanding emergency and general maintenance team (Ministry of Electricity & Water, 1991, p. 123)

Despite all this progress in the electricity industry in Oman, the Ministry is still depending on expatriate skilled labour because of the lack of indigenous Omani engineers working in this sector. It should be an urgent need for local skilled manpower able to to operate, monitor and develop such a vital sector.

5.5 HUMAN RESOURCES DEVELOPMENT

The development of human resources is a necessary ingredient in the socio-economic and technical development of any country. According to Al-Musa,

> "Labour force is the prime activator of social and economic development. Its structure and distribution are but reflections of the country's population and manpower. This force is one of the most, if not the most, important determining factor of development directions. By and large, changes in the economic sectoral activities of the labour force would show the relative trends of the country's economy." (Al-Musa, A., 1975, p. 99).

Human resources development in the developing countries has been the subject of debate by world economists dealing with development problems. In fact, it is often argued that the development of the under-developed nations lies mainly in the effectiveness of developing their human capital. This, in effect, means that the development of local manpower should be given top priority. This is particularly important in Oman where the main source of labour is the foreign population.

In the early years of development Oman was heavily dependent on expatriate skilled and semiskilled labour, mostly Indian and Pakistani, as well as Europeans in management posts, because of the lack of Omani workforce. Nevertheless, if no adequate action is taken now, to depend entirely on foreign labour may delay or even impede the Omani government's plan to achieve and sustain its local capabilities and thus reducing, to a large extent, its dependence on foreign technology. Generally, manpower is defined as:

> "that part of the nation's population that is engaged in the production of goods and entering into the Gross National Product". (Frisendahl, 1970, p. 2).

Table 5.3 shows the population by age group, sex and region in 1990. Manpower comprises all population of working age who are physically and mentally capable of practising an economic activity. Only children, the very old (over 65 years) and the disabled remain outside the manpower of the population.

We can see from Table 5.3 that the number of Omani males in the economic activity was higher than the number of Omani females. This may be explained by the fact that women's participation in the economic activity has been hindered by social and cultural factors.

The Distribution of Economically Active Population

The distribution of the Omani and non-Omani population by economic activity (see Table 5.4) has been uneven, and has shown a tendency for concentration in the 'Production' Sector. The distribution can be summarised as follows:

(1) The highest proportion of the labour force is concentrated in the production and service workforce.

(2) In 1990, the production sector employed 55% non-Omani manpower, of which only 20% were Omani.

TABLE 5.3

Year - 1990

نسبة السكان العمانيين النشطين اقتصاديا (10 سنوات فأكثر) حسب الفئة العمرية والجنس والمنطقة

Economic Activity Rate for Omani Population (10 Years +) by Age Group, Sex & Region

Region	FEMALE اناث					MALE ذكور					المنطقة
	Age Group									الفئة العمرية	
	الجملة Total	65+	64-50	49-20	19-10	الجملة Total	65+	64-50	49-20	19-10	
The Sultanate	3.99	1.12	3.88	6.56	1.48	59.03	41.49	76.03	93.65	14.14	السلطنة
Muscat	7.50	2.52	5.97	12.84	1.40	65.83	52.21	82.98	94.66	18.36	مسقط
Quriyat	4.84	2.20	3.91	8.20	1.42	57.21	25.40	65.36	95.05	14.38	قريات
Dhofar	13.53	6.64	19.27	16.88	7.31	63.58	64.71	92.45	94.06	15.65	ظفار
A' Dakhliya	2.41	0.79	3.18	3.49	1.14	54.46	32.69	72.31	93.15	11.73	الداخلية
A' Sharqiya	4.63	2.30	5.71	6.89	1.78	56.71	30.00	69.76	92.63	17.18	الشرقية
Al Batinah (1)	1.60	0.67	1.46	2.74	0.64	57.77	36.47	72.75	94.30	13.36	الباطنة
Al Batinah (2)	1.51	0.85	3.35	1.74	0.73	58.08	48.99	77.96	93.10	11.39	الباطنة (2)
Western Hajar	0.57	0.35	0.54	0.84	0.19	61.98	38.89	78.71	95.13	14.01	الحجر الغربي
A' Dhahira	0.75	0.07	0.24	2.49	0.30	54.61	44.39	73.46	92.65	8.74	الظاهرة
Musandam	0.98	0.50	0.74	2.17	0.58	65.50	56.45	74.78	92.54	17.76	مسندم

Source : Directorate General of National Statistics, "Statistical Year Book", 1990, p. 57.

TABLE 5.4

Year - 1990

التوزيع النسبي للسكان (عماني وغير عماني) النشطين اقتصاديا (10 سنوات فأكثر) حسب المجموعة المهنية والمنطقة

Percentage Distribution of Economically Active Population (Omani/Non-Omani) (10 year +) by Occupation Group & Region

Region	NON-OMANI غير عماني						OMANI عماني						المنطقة
	المجموع Total	العاملون في الانتاج ومشغلو معدات النقل Production & Related Workers	العاملون في الزراعة والغابات وصيد الأسماك Agriculture, Forestry & Fishery Workers	العاملون في البيع والعاملون في الخدمات Sales Workers / Service Workers	الكتبة ومن اليهم Clerical & Related Workers	الاختصاصيون والفنيون ومن اليهم الاداريون والمدراء Professional Technical & Related Workers / Administrative & Managerial Workers	المجموع Total	العاملون في الانتاج ومشغلو معدات النقل Production & Related Workers	العاملون في الزراعة والغابات وصيد الأسماك Agriculture, Forestry & Fishery Workers	العاملون في البيع والعاملون في الخدمات Sales Workers / Service Workers	الكتبة ومن اليهم Clerical & Related Workers	الاختصاصيون والفنيون ومن اليهم الاداريون والمدراء Professional Technical & Related Workers / Administrative & Managerial Workers	
The Sultanate	100.0	55.15	5.75	19.61	4.76	14.48	100.0	20.09	20.00	17.78	12.14	7.18	السلطنة
Muscat	100.0	56.47	0.44	21.74	7.63	13.43	100.0	30.03	2.79	16.38	26.50	14.03	مسقط
Quriyat	100.0	46.85	17.63	21.41	0.50	13.60	100.0	23.31	16.74	18.79	19.20	6.26	قريات
Dhofar	100.0	61.32	4.25	17.85	4.45	11.98	100.0	12.34	27.50	14.23	9.91	6.41	ظفار
A' Dakhliya	100.0	51.95	8.48	17.20	1.38	20.75	100.0	24.64	17.47	17.81	9.63	7.39	الداخلية
A' Sharqiya	100.0	55.45	6.27	20.73	1.19	16.34	100.0	17.71	31.14	16.76	8.05	6.23	الشرقية
Al Batinah (1)	100.0	52.19	20.81	12.51	1.97	12.46	100.0	19.58	20.39	22.04	9.66	4.38	الباطنة (1)
Al Batinah (2)	100.0	45.73	16.60	21.61	0.72	15.23	100.0	12.99	26.61	19.10	6.14	3.72	الباطنة (2)
Western Hajar	100.0	64.28	3.65	10.69	0.97	20.05	100.0	20.97	21.05	18.95	9.92	4.03	الحجر الغربي
A' Dhahira	100.0	46.81	13.00	18.91	1.62	19.02	100.0	15.22	18.19	18.00	6.00	4.98	الظاهرة
Musandam	100.0	56.31	4.14	15.73	5.80	16.77	100.0	14.41	35.64	18.50	11.00	7.69	مسندم

Source : Directorate General of National Statistics, "Statistical Year Book", 1990, p. 54.

(3) Despite the fact that the professional technical and managerial workers are the backbone of the economy, the numbers employed in this sector remain extremely low by Omani workers.

Table 5.4 also shows that non-Omani manpower outnumbered Omani manpower in the most important occupations. Oman is highly dependent on a foreign labour force to achieve its socio-economic development. Shortages are acute in the following professions: technicians, engineers, doctors and scientists; top management and administrators; and skilled labour and supervisors.

5.5 CONCLUSIONS

A review of the past and present portrays Oman as a young country with ambitious plans to develop its socio-economic structure. The imbalance in the distribution of manpower between the indigenous Omanis and the foreign expatriates is damaging the realisation of this objective. Migrant workers outnumber native Omanis, and this is impeding the development of the local capabilities of Oman, and promoting dependence on foreign technologies.

As discussed earlier, it is observed that: (1) Oman is short of local manpower, particularly technical and managerial manpower; (2) The percentage of foreign workforce in Oman is higher than that of the local workforce; (3) Local Omani consulting and service departments do not take active part in important areas relating to the process of technology transfer (e.g. the unpacking of the technology components).

The local departments still have enormous tasks to perform, to enable Oman to reduce its dependence on both foreign manpower and foreign technology. There is need for departments to take the following actions:

(1) To establish effective training and development programmes for indigenous people to be trained for technical and managerial jobs.

(2) To enter into collaborative arrangements with the Sultan Qaboos University to satisfy Oman's development need.

(3) To involve indigenous firms in their operations which, one hopes, would give local firms confidence in developing their capabilities.

(4) To co-operate with the Ministries, in order to optimise the national resources.

(5) To establish more research and development facilities and permit effective local participation.

The absence of a native workforce means that the importation of more foreign technology is likely to attract yet more expatriates into Oman. In turn, this will create even more technological dependence problems.

CHAPTER 6

THE TRANSFER OF TECHNOLOGY TO OMAN

CHAPTER 6

THE TRANSFER OF TECHNOLOGY TO OMAN

CHAPTER 6

THE TRANSFER OF TECHNOLOGY TO OMAN

6.1 INTRODUCTION

It is evident that technology is an essential tool for development in the developing countries. However, rational policies and strategies need to be established in order to ensure that the transfer technology is in harmony with the economic, social, and ecological set-up of the country. This chapter examines the various factors impeding the successful application and adoption of foreign technologies transferred to Oman from industrialised countries. It is divided into three parts. The first examines the internal obstacles. The second part looks at the external problems, and the third draws some conclusions.

6.2 INTERNAL OBSTACLES

Although the application of science and technology has had an enormous impact on the development of Oman's economy, some internal obstacles tend to hinder or delay further application of science and technology. Among these are:

Shortage of Manpower

Despite the effort being made by the Government of Oman to tackle illiteracy, which effort is well expressed by the total commitment to expand and improve local education, the situation still poses a barrier to economic and social development. In almost all sectors of the economy a shortage of manpower constitutes a major constraint in the application of science and technology.

There are many reasons why Omanis form a low percentage of the country's workforce. First of all, women are generally not encouraged to work to avoid mixing with men. The reasons for this are related to the religious background and social structure of the country. Second, a large proportion of the population is under 15 years of age. Oman has come to realise that these young people could provide the answers to future labour requirements if they were properly educated and trained, thus reducing the country's dependence on expatriates. Third, there is an excessive supply of Social Science graduates from university and high school levels. Table 6.1, at the end of the chapter, shows that the number of students enrolled in Humanities is found to be quite high compared with the actual need of the country. Fourth, In spite of the fact that the rate of illiteracy is falling, there still is a large number of Omani population who can neither read nor write (see Table 6.2).

Other reasons for the low percentage of Omani manpower include: (1) The poor level of proficiency among graduates of vocational schools. This is shown in Table 6.3. (2) The import of labour-saving or capital-intensive methods of production being hindered by the shortage of the highly skilled manpower normally required to operate such technology-intensive equipment. (3) The slow rate of economic development in the non-oil sector, due in part to an inadequate infrastructure. If a better infrastructure were provided, these industries would, in turn, require the import of a large skilled and unskilled workforce, which might disrupt the delicate balance in the composition of Oman's social fabric.

Inadequate Management of Natural resources

The second major obstacle to the further application of science and technology is the management of natural resources. Oman is blessed with many resources such as oil, natural gas, agriculture and fish (see Chapter 5). The problem now lies in formulating a sound management programme. The aim is the effective use of these resources in order to achieve national objectives:

(a) To survey the area to determine the availability of these resources in order to foster their effective utilisation.

(b) To strengthen the national capability in order to employ the correct modern scientific and technological techniques in the exploration of these resources.

(c) To develop an integral centre of qualified staff to enhance the nation's exploitation and conservation efforts.

(d) To foster regional and international co-operation in conducting research and development programmes relative to the development of these resources.

This inadequacy of proper planning and modern management methods does not only apply to natural resources. It also extends to other areas, such as the nation's ability to utilise scientific techniques to develop a co-ordinated and comprehensive plan to effectively deal with definite problem areas. One of such areas, for instance, is the country's inability to develop a detailed manpower policy regarding the demand and supply of labour in each skill category. For example, no plan exists which takes into account waste, leakage, storing facilities (in case of any acute shortage), or reuse of residential and industrial effluent (i.e., discharge of waste liquid matter, sewage, etc.)

Purchasing modern equipment is one thing, and applying modern scientific techniques to solve problems in specific areas is quite another. Oman appears to be very active in the former but less active in the latter. So to what extent has the Omani government exploited the advantage of the massive buying of this modern equipment which was intended to solve the problems enumerated above? To what extent has Oman applied the modern scientific equipment and techniques to solve its own specific problems?

Inadequate Dissemination of Technological Information

The importance of information systems in the selection of appropriate available technology cannot be overemphasised. It helps in the proper selection of new technologies, particularly in Oman where foreign technologies are largely depended upon. The selection of the right technology depends on the right timely information. However, to obtain right and timely information in Oman, the system should be made more efficient via the creation of information gathering and dissemination centres at say, regional and international levels. So far, one agency - the Ministry of Commerce and

Industry - has been created to collect and disseminate information about science and technology in Oman. This does not seem to be sufficient to provide all the country's requirements in this respect.

6.3 EXTERNAL OBSTACLES

Many uncontrollable factors impede the successful application and absorption of foreign technologies in Oman. Among them are:

Cultural and Social Problems

Oman lacks indigenous skilled manpower. Consequently, the majority of the skilled scientific and technical personnel in most of the sectors (electrical utility, oil, petrochemical, etc.) are immigrant workers. These workers subscribe to different cultures, customs, and living habits. They have also been educated and trained to different standards, outlooks, and methods. The problems of co-ordinating such an assortment of ethnic groups, to achieve a common goal, is indeed a difficult job. In such an environment, productivity and efficiency are bound to suffer. This assortment of ethnic groups of technical personnel is not stable. Because of the fast turnover, a high rate of recruitment is necessary to balance the high rate of resignations.

The Problem of Dependence on Foreign Technology

In this study, Al-Hassan found that a number of socio-economic problems face developing countries (among them Oman) who import technologies from industrialised nations. These are:

Dependence on foreign technology

Unlike the purchase of conventional goods, buying foreign technology is not a single operation. It leads to a long term and unequal relationship between the recipient developing country and the advanced country supplying the technology. However, this relationship is not usually limited or restricted to the installation and tuning of the plants by the supplier country. It involves repairs and maintenance, renewals, purchasing new patents and licences, constant technical advice etc. Sometimes serving such relations may render the installed foreign equipment particularly useless by making it impossible to run. Therefore, the transfer of technological Know-how from industrialised countries to Third World countries often leads to new forms of dependence, particularly technical dependence which, in turn, could threaten the socio-economic and political independence of Third World nations.

Foreign interference

Technological transfer, like other forms of international relations, involves countries with different political and socio-economic settings. However, the countries which provide most of the technology for developing countries, often seek to push them alongside their own way of development. For example, it is often claimed by developed countries that for developing countries to be able to use the imported foreign technologies effectively, they must have the same social and technical conditions as those of the supplier countries. In most cases, this causes problems in developing countries because of the environmental differences.

The clash between traditional and modern technology

Sometimes the changes in the technical base of production results in changes in the entire socio-economic and democratic structure of the Third world countries. In most cases, these changes are prerequisite for the successful application, adoption and absorption of these imported technologies. Nevertheless, it is worthy of note that the destruction of this traditional way of life brought about by the use of modern technologies often conflicts with traditional technologies which, in turn, tends to cause political conflicts, and often breed disenchantment and resentment in developing countries.

Many foreign technologies are not designed to meet Third World local needs

Often many Third World countries fail to adapt foreign technologies to their needs because in most cases these foreign technologies were originally created to meet the needs of advanced countries. Consequently, these technologies do not always suit the conditions and needs of developing countries. the result is the need for a high degree of scientific and technical expertise, experimental and design facilities and, of course, finance. As said earlier, although Oman has no problem with funds to finance such projects, it does have problems with local technical and scientific expertise. (Al-Hassan, I., 1977, p. 6).

6.4 CONCLUSIONS

To achieve successful application and absorption of foreign technology, developing countries (including Oman), must attempt to ensure:

1 - Adequate training and education of the local personnel.

2 - Adequate sources of raw material.

3 - Suitable markets (domestic and international) through which the products of the new technology can be sold.

4 - An adequate feasibility survey is carried out before any foreign technology is imported so the local needs are fully satisfied.

to understand the full implications of technological transfer, and particularly the reasons Oman so largely depends on imported technologies and performs less successfully in developing its own local capabilities geared towards achieving technological independence or reducing dependence on foreign technologies, it is important to examine the methods and approach adopted by some selected developing countries.

TABLE 6.1

الطلبة العمانيون الدارسون في الجامعات والكليات بالخارج حسب الدولة ، التخصص والجنس

Omani Students Studying in Colleges and Universities Abroad by Countries, Sex, and Field of Study

91 / 1990

Field of Study	G.C.C. Countries دول مجلس التعاون																		التخصص موضوع الدراسة
	الجملة Total			الامارات U.A.E			الكويت Kuwait			البحرين Bahrain			قطر Qatar			السعودية Saudi Arabia			
	الجملة T	أ F	ذ M	الجملة T	أ F	ذ M	الجملة T	أ F	ذ M	الجملة T	أ F	ذ M	الجملة T	أ F	ذ M	الجملة T	أ F	ذ M	
	No.																	عدد	
Medicine	34	18	16	–	–	–	–	–	–	24	18	6	–	–	–	10	–	10	طب
Pharmacology	2	1	1	–	–	–	–	–	–	–	–	–	–	–	–	2	1	1	صيدلة
Engineering	14	1	13	5	–	5	–	–	–	5	1	4	–	–	–	4	–	4	هندسة
Science	15	3	12	2	–	2	–	–	–	4	1	3	8	2	6	1	–	1	علوم
Agriculture	3	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	–	3	زراعة
Culture	14	7	7	5	3	2	–	–	–	–	–	–	5	3	2	4	1	3	تربية
Computer	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	كمبيوتر
Literature	6	1	5	3	1	2	–	–	–	3	–	3	–	–	–	–	–	–	آداب
Law	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	حقوق
Business & Administration	10	4	6	7	3	4	–	–	–	1	1	–	–	–	–	2	–	2	تجارة وعلوم ادارية
Islamic Law	5	–	5	4	–	4	–	–	–	–	–	–	–	–	–	1	–	1	شريعة ودراسات اسلامية
Other Subjects	1	–	1	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	تخصصات اخرى
Total	105	35	70	26	7	19	–	–	–	38	21	17	13	5	8	28	2	26	الجملة

Source : Directorate General of National Statistics
"Statistical Year Book", 1991, p. 593.

Table 6.1 Continued

Field of Study	Arab Countries الدول العربية الاخرى																		التخصص موضوع الدراسة
	الجملة Total			اخرى Others			المغرب Morocco			الاردن Jordan			تونس Tunisia			مصر Egypt			
	الجملة T	أ F	ذ M	الجملة T	أ F	ذ M	الجملة T	أ F	ذ M	الجملة T	أ F	ذ M	الجملة T	أ F	ذ M	الجملة T	أ F	ذ M	
	No.																	عدد	
Medicine	9	3	6	-	-	-	-	-	-	2	1	1	-	-	-	7	2	5	طب
Pharmacology	1	1	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	صيدلة
Engineering	6	1	5	-	-	-	-	-	-	-	-	-	-	-	-	6	1	5	هندسة
Science	5	2	3	-	-	-	-	-	-	1	1	-	-	-	-	4	1	3	علوم
Agriculture	12	3	9	-	-	-	-	-	-	-	-	-	-	-	-	12	3	9	زراعة
Culture	16	12	4	-	-	-	-	-	-	11	11	-	-	-	-	5	1	4	تربية
Computer	12	5	7	-	-	-	-	-	-	10	5	5	-	-	-	2	-	2	كمبيوتر
Literature	11	-	11	-	-	-	2	-	2	2	-	2	-	-	-	7	-	7	آداب
Law	21	1	20	-	-	-	5	-	5	4	1	3	-	-	-	12	-	12	حقوق
Business & Administration	122	15	107	-	-	-	3	-	3	39	5	34	-	-	-	80	10	70	تجارة وعلوم ادارية
Economics/Political Science	15	3	12	-	-	-	-	-	-	15	3	12	-	-	-	-	-	-	اقتصاد وعلوم سياسية
Information	6	-	6	-	-	-	-	-	-	6	-	6	-	-	-	-	-	-	اعلام
Islamic Law	4	-	4	-	-	-	-	-	-	1	-	1	1	-	1	2	-	2	شريعة ودراسات اسلامية
Other Subjects	11	2	9	-	-	-	-	-	-	-	-	-	-	-	-	11	2	9	تخصصات اخرى
Total	251	48	203	-	-	-	10	-	10	92	28	64	1	-	1	148	20	128	الجملة

Table 6.1 Continued

Field of Study	الإجمالي العام Grand Total			Foreign Countries الدول الأجنبية: اخرى Others			الولايات المتحدة U.S.A.			المملكة المتحدة U.K.			التخصص موضوع الدراسة
	الجملة Total	أ F	ذ M	الجملة Total	أ F	ذ M	الجملة Total	أ F	ذ M	الجملة Total	أ F	ذ M	
	No.											عدد	
Medicine	116	38	78	9	3	6	–	–	–	64	14	50	طب
Pharmacology	13	8	5	1	1	–	1	–	1	8	5	3	صيدلة
Engineering	163	15	148	5	1	4	70	3	67	68	9	59	هندسة
Science	31	12	19	–	–	–	6	4	2	5	3	2	علوم
Agriculture	24	4	20	–	–	–	5	1	4	4	–	4	زراعة
Culture	32	21	11	–	–	–	1	1	–	1	1	–	تربية
Computer	30	6	24	–	–	–	12	–	12	5	1	4	كمبيوتر
Literature	21	3	18	–	–	–	4	2	2	–	–	–	آداب
Law	21	1	20	–	–	–	–	–	–	–	–	–	حقوق
Business & Administration	161	22	139	1	1	–	19	2	17	9	–	9	تجارة وعلوم ادارية
Economics/ Political Science	29	4	25	–	–	–	6	–	6	8	1	7	اقتصاد وعلوم سياسية
Int. Relations & Secretarial	5	–	5	–	–	–	4	–	4	1	–	1	علاقات دولية وسكرتارية
Information	6	–	6	–	–	–	–	–	–	–	–	–	اعلام
Sociology													اجتماع
Islamic Law	9	–	9	–	–	–	–	–	–	–	–	–	شريعة ودراسات اسلامية
Languages	4	2	2	–	–	–	–	–	–	4	2	2	لغات
Other Subjects	39	10	29	1	–	1	14	4	10	12	4	8	تخصصات اخرى
Total	704	146	558	17	6	11	142	17	125	189	40	149	الجملة

Table 6.1 Continued

الطلبة العمانيون الدارسون في الجامعات والكليات العربية والأجنبية حسب التخصص والجنس

Omani Students Studying in Colleges & Universities Abroad by Sex & Field of Study

91 / 90 - 90 / 1989

Field of Study	الدول العربية الاخرى Other Arab Countries						دول مجلس التعاون G.C.C. Countries						التخصص
	91/90			90/89			91/90			90/89			
	الجملة Total	اناث F	ذكور M	الجملة Total	اناث F	ذكور M	الجملة Total	اناث F	ذكور M	الجملة Total	اناث F	ذكور M	
	NO.											عدد	
Medicine	9	3	6	10	3	7	34	18	16	36	19	17	طب
Pharmacology	1	1	–	1	1	–	2	1	1	3	1	2	صيدلة
Engineering	6	1	5	1	–	1	14	1	13	24	3	21	هندسة
Science	5	2	3	16	6	10	15	3	12	35	18	17	علوم
Agriculture	12	3	9	23	1	22	3	–	3	4	–	4	زراعة
Culture	16	12	4	24	6	18	14	7	7	18	4	14	تربية
Computer	12	5	7	14	6	8	1	–	1	1	–	1	كمبيوتر
Literature	11	–	11	55	6	49	6	1	5	12	5	7	آداب
Law	21	1	20	58	1	57	–	–	–	4	1	3	حقوق
Business & Administration	122	15	107	142	13	129	10	4	6	10	5	5	تجارة وعلوم ادارية
Economics/ Political Science	15	3	12	15	3	12	–	–	–	6	1	5	اقتصاد وعلوم سياسية
Information	6	–	6	–	–	–	–	–	–	1	–	1	اعلام
Sociology	–	–	–	15	6	9	–	–	–	–	–	–	اجتماع
Islamic Law	4	–	4	12	2	10	5	–	5	9	3	6	شريعة ودراسات اسلامية
Other Subjects	11	2	9	8	2	6	1	–	1	13	1	12	تخصصات
Total	251	48	203	394	56	338	105	35	70	176	61	115	الجملة

Table 6.1 Continued

Field of Study	الاجمالي العام Grand Total 91/90 الجملة Total	اناث F	ذكور M	90/89 الجملة Total	اناث F	ذكور M	الدول الاجنبية Foreign Countries 91/90 الجملة Total	اناث F	ذكور M	90/89 الجملة Total	اناث F	ذكور M	التخصص
Medicine	116	38	78	122	41	81	73	17	56	76	19	57	طب
Pharmacology	13	8	5	12	6	6	10	6	4	8	4	4	صيدلة
Engineering	163	15	148	223	12	211	143	13	130	198	9	189	هندسة
Science	31	12	19	70	33	37	11	7	4	19	9	10	علوم
Agriculture	24	4	20	39	2	37	9	1	8	12	1	11	زراعة
Culture	32	21	11	52	14	38	2	2	–	10	4	6	تربية
Computer	30	6	24	74	20	54	17	1	16	59	14	45	كمبيوتر
Literature	21	3	18	69	11	58	4	2	2	2	–	2	آداب
Law	21	1	20	63	2	61	–	–	–	1	–	1	حقوق
Business & Administration	161	22	139	213	27	186	29	3	26	61	9	52	تجارة وعلوم ادارية
Economics/ Political Science	29	4	25	43	6	37	14	1	13	22	2	20	اقتصاد وعلوم سياسية
Int. Relations & Secretarial	5	–	5	20	2	18	5	–	5	20	2	18	علاقات دولية وسكرتارية
Information	6	–	6	2	–	2	–	–	–	1	–	1	اعلام
Sociology	–	–	–	15	6	9	–	–	–	–	–	–	اجتماع
Islamic Law	9	–	9	21	5	16	–	–	–	–	–	–	شريعة ودراسات اسلامية
Languages	4	2	2	3	2	1	4	2	2	3	2	1	لغات
Other Subjects	39	10	29	60	12	48	27	8	19	39	9	30	تخصصات اخرى
Total	704	146	558	1101	201	900	348	63	285	531	84	447	الجملة

TABLE 6.2

Year - 1991

التوزيع النسبي للسكان العمانيين (6 سنوات فأكثر) حسب الجنس ، المستوى التعليمي والمنطقة

Percentage Distribution of Omani Population (6 Year +) by Sex, Educational Level & Region

Region	FEMALE اناث					MALE ذكور					المنطقة
	المجموع Total	الثانوية فما فوق Secondary & Above	الإعدادية Preparatory	الإبتدائية Primary	أمي Illiterate	المجموع Total	الثانوية فما فوق Secondary & Above	الإعدادية Preparatory	الإبتدائية Primary	أمي Illiterate	
The Sultanate	100.0	2.51	5.26	34.13	58.10	100.0	6.49	12.04	42.63	38.84	السلطنة
Muscat	100.0	8.12	9.27	32.44	50.18	100.0	11.31	15.63	38.36	34.69	مسقط
Quriyat	100.0	2.36	6.23	35.84	55.57	100.0	6.04	13.94	46.31	33.71	قريات
Dhofar	100.0	1.35	4.88	32.01	61.76	100.0	6.22	11.61	44.68	37.49	ظفار
A' Dakhliya	100.0	1.33	4.03	35.93	58.70	100.0	7.75	11.70	44.41	36.13	الداخلية
A' Sharqiya	100.0	2.23	5.62	32.25	59.90	100.0	6.55	12.50	40.34	40.61	الشرقية
Al Batinah (1)	100.0	0.89	3.62	34.79	60.71	100.0	3.68	10.47	45.25	40.60	الباطنة (1)
Al Batinah (2)	100.0	1.52	4.23	38.30	55.95	100.0	3.81	10.64	45.98	39.58	الباطنة (2)
Western Hajar	100.0	0.41	1.72	24.21	73.65	100.0	2.00	6.94	40.07	50.99	الحجر الغربي
A' Dhahira	100.0	2.16	6.22	39.48	52.14	100.0	6.83	12.87	44.72	35.58	الظاهرة
Musandam	100.0	0.90	3.92	26.63	68.55	100.0	4.44	9.50	31.10	54.96	مسندم

Source : Directorate General of National Statistics
"Statistical Year Book", 1991, p. 51.

TABLE 6.3

طلبة معاهد التدريب المهني بالمرحلة الثانوية حسب فئة العمر والصف
Students of Vocational Training Institutes in Secondary Level by Age & Grade

Year/Grade — السنة/الصف

No. — عدد

العمر بالسنوات Age in Years	89/88 الأول First	89/88 الثاني Second	89/88 الثالث Third	89/88 الجملة Total	90/89 الأول First	90/89 الثاني Second	90/89 الثالث Third	90/89 الجملة Total	91/90 الأول First	91/90 الثاني Second	91/90 الثالث Third	91/90 الجملة Total
14	40	2	-	42	10	2	-	12	3	-	-	3
15	190	23	25	238	122	16	3	141	67	7	1	75
16	285	174	91	550	176	148	14	338	158	84	31	273
17	229	232	161	622	198	187	145	530	207	143	131	481
18	162	212	167	541	142	155	177	474	136	149	176	461
19	83	136	157	376	80	102	178	360	92	123	138	353
20	30	66	90	186	33	56	110	199	41	44	102	187
21	5	27	72	104	16	22	67	105	8	13	40	61
22 & Over اكثر	8	22	42	72	2	11	58	71	3	2	13	18
Total الجملة	1032	894	805	2731	779	699	752	2230	715	565	632	1912

Source: Directorate General of National Statistics
"Statistical Year Book", 1991, p. 607.

Table 6.3 Continued

طلبة معاهد التدريب المهني بالمرحلة الثانوية حسب فئة العمر والتخصص

Students of Vocational Training Institutes in Secondary Level by Age & Field of Study

91 / 1990

No. عدد

Grade الصف												
Total الجملة			Third الثالث			Second الثاني			First الاول			العمر بالسنوات Age in Years
الجملة Total	فني Technical	تجاري Commercial	الجملة Total	فني Technical	تجاري Commercial	الجملة Total	فني Technical	تجاري Commercial	الجملة Total	فني Technical	تجاري Commercial	
3	2	1	–	–	–	–	–	–	3	2	1	14
75	42	33	1	1	–	7	5	2	67	36	31	15
273	154	119	31	23	8	84	42	42	158	89	69	16
481	285	196	131	78	53	143	85	58	207	122	85	17
461	300	161	176	111	65	149	103	46	136	86	50	18
353	237	116	138	92	46	123	85	38	92	60	32	19
187	132	55	102	74	28	44	27	17	41	31	10	20
61	46	15	40	30	10	13	9	4	8	7	1	21
16	16	–	12	12	–	2	2	–	2	2	–	22
2	2	–	1	1	–	–	–	–	1	1	–	23
1912	1216	696	632	422	210	565	358	207	715	436	279	الجملة Total

CHAPTER 7

THE ADAPTATION OF TECHNOLOGY BY DEVELOPING COUNTRIES - A STUDY IN OMAN

CHAPTER 7

THE ADAPTATION OF TECHNOLOGY BY DEVELOPING COUNTRIES - A STUDY IN OMAN

CHAPTER 7

THE ADAPTATION OF TECHNOLOGY BY DEVELOPING COUNTRIES - A STUDY IN OMAN

7.1 INTRODUCTION

Oman, whilst continuously importing foreign technologies to elevate its social and economic development, still faces problems of adapting them to suit the country's needs. This chapter is divided into six parts. The first examines adapting imported technology by developing countries. The second describes the role of design in adaptation, and the industrial design in oman is set in part three. Part four discusses the concept of "Appropriate" technology, and the adaptation of technology by Oman is dealt with in part five. Finally some conclusions are drawn.

7.2 ADAPTING IMPORTED TECHNOLOGY

Contreras (1975) in his paper cites Herrera's concept that technology should be geared and used to satisfy the community need and increasing the people's control over the environment. However, while technology, simply defined as "a way of doing something" (Langrish, 1975), can be contributive to elevating the living standards of the Third World, the bombardment and the increase of the technology's domination could affect the people's social traditions and cultural patterns which the majority desperately wanted to maintain and cherish. Murphy (1985) stresses that technology must be appropriate and be the servant rather than the master, and not just introduced because it is possible. (See Section 7.5 for more details).

Langrish (1975) stated imitation, adoption and adaptation as three possible modes of transferring technology. While imitation involves merely copying the technology of the transferor, by paying certain technological royalties, adoption, which is common among most developing countries, requires the transferee to change the people and make them abide by the requirements of the transfer. This not only affects the various systems in receiving countries but also often results in no development or absence of indigenous technology and capabilities on the part of the transferee, and making them agent of foreign domination. Adaptation is to modify or change the technology, in a manner where technical ideas are put together in new combinations to suit the needs and requirements of the receiving countries.

Yoshioka (1983) blamed the contrast imitation and adoption of western technologies as one of the major factors that has resulted in and contributed to the social and cultural chaos and moral problems among the younger generations in the developing countries.

Though the transfer of technology has generally enabled some countries to benefit from the advances, and to progress towards modernisation, problems remain regarding the ability to absorb and assimilate in the most efficient manner (UNCTAD, 1978). Differences in culture, environment, government policies, skills and technological capabilities make the importation of technology difficult. Important factors that may contribute to a successful and effective transfer are a close interrelationship and understanding between the donor and the recipient, and expertise in evaluating and adapting imported technology to suit the special needs of the receiving countries (Golden 1976, Solo 1966).

Multinational Corporations (MNCs) are frequently considered as one of the most efficient tools for the transfer of technology (See Chapter 3 for more discussion), since they incorporate a complete package of know-how to ensure a successful transfer. However, in recent years awareness has grown of the problems that MNCs can cause to developing countries. The monopolisation of activities and decisions within the

MNCs has created not only more problems of unsuitability of products (Stewart & Francis, 1972), but has also contributed to less development of indigenous technology and a problem of falling employment where traditional manufacturing methods are displaced.

Countries like Brazil, Mexico and India which have imported high intensive technology for industrialisation have failed to meet problems of income distribution, employment and poverty of the peripheral people (MacDonald & Lamberton, 1983). In Iran, it has been reported that there were 13 car assembly plants, serving a relatively small market, with the result that the final products cost twice as much as on the open world market (Summer Report, 1969). In addition, the very recent industrial disaster of the Union Carbide in Bhopal, India, that took about 1200 lives, with more thousands hospitalised, is a very visible example of the danger of MNCs moving production to parts of the world with less concern for safety.

Various ways of tackling the problems of MNCs have been suggested. Streeten (1972) suggested closing off economies. Ozawa (1971) emphasised the need for small scale production and labour-intensive techniques as some of the reasons making transfer promising. One way of tackling problems is to have some form of government control over technology transfer.

Wallender and Holland (1976) have said:

> "The desire of recipient governments and firms to be independent of foreign control or domination and to permit host country nationals to manage local productive activities in a manner that is most beneficial to the recipient government and company development is very understandable."

Studies on joint ventures in some countries have shown that the less the foreign company was concerned with the formal ownership of the joint ventures, the more beneficial and profitable it was to the recipient (Tomlinson, 1978).

Even though joint ventures are improvement on simply allowing any foreign firms to do what they like, certain problems remain. One such problem is the degree of adaptation.

Adaptation or modification of imported technology is required to make it appropriate to the needs and conditions of the recipient countries (Bradbury, 1978).

Technology is said to be appropriate when it harmonises with its environment (Stepanek, 1978), maximises its benefit (Rubenstein, Schlie & Jedlicka, 1978) and minimises its harmful effects (Hetman, 1973), and also according to Schlie (1974) requires an intelligent balance, namely:

> "... a balance of labour-intensive and capital-intensive technologies; of domestic savings and employment, of imported and indigenous research of large and small-scale production".

Foreign firms have often been criticised for the unsuitability and inappropriateness of their technologies for the developing countries in which they operate. Instead of adopting and developing the technologies to satisfy the need and conditions of the new environment, which presumably requires expansive costs (UNCTAD, 1978), tested advertising and promotional techniques already developed in their domestic markets, which are less costly, are used to attract and shape the consumer tastes to the product (Barnet & Muller, 1974). Consumers being ill-informed will be mostly influenced by the prestige of the product, which is normally heavily biased by foreign values, the trademark and brand name, without actually knowing whether it is right or wrong, appropriate or inappropriate to the needs and social environment.

The impact and implication of such blind imitation to the environment, social and behavioural standards seems obvious, and has ironically made the people lose their self-confidence in their autonomous and indigenous designs and regard their own culture, life-style and solutions as backward. Papanek (1974) said:

> "It is a sad comment on the loss of cultural pride, endangered by coco colonisation, that most Guatemala farmers hope to sell enough of their lovely clay vessels to enable them to buy one plastic pot."

Genevience C. Dean (1976) stresses the need for adaptation to be made in the recipient countries in order to take into account all the relevant conditions of the recipients. However, if this is possible, donors may normally insist that the adaptation be done by their own people. This inhibits the growth of an adaptive capacity by the recipient.

7.3.A THE ROLE OF DESIGN IN ADAPTATION

Although there are frequent references in the literature to the importance of adapting technology to fit new environment in an appropriate manner, little has been written about how the adaptation could take place, and very few people have considered industrial design as a way of looking at the process of adaptation.

Yoshioka (1983), at the Asian Productivity Organisation (APO) seminar, stressed the need for the services of industrial designers to contribute to the satisfaction of local needs, preferably with local materials and locally developed technology.

The view of Bonsiepe (1977) is that:

> "Industrial design has spread to dependent countries through many different channels to produce technology transfer. According to my view, however, there is only one form of effective design transfer that is in the interests of dependent countries; design transfer that helps to uncover and stimulate local design capacity, without paternalism."

7.3.B INDUSTRIAL DESIGN

According to the view of Baynes (1967) industrial design originated with the reaction against aesthetic problems created by the 19th century industry. It is often claimed that as a separate profession industrial design was first introduced to the world as early as 1907 by a group of German architects, designers, manufacturers and merchants. The group known as the 'Werkbund' was formed with the object of raising the technical, functional and aesthetic quality of products for consumers. However, it is possible to consider earlier origins in the work of engineers, architects and craftsmen.

Germany in the 1920s became the focus of experiment in industrial design which was said to have influenced the mass production of consumer goods of various countries in Europe and across the Atlantic as well.

7.3.C INDUSTRIAL DESIGN TODAY

Today, industrial design has grown much in scope and has generally been accepted in many parts of the world, even though issues are often debated regarding the conflict between the interests of industry and society and also the designer's role towards society and his employer (DRS Conference, 1984). As expressed by Baynes (1967):

> "The designer is the servant of the community,
> but he is also its prisoner."

Essentially, an industrial designer is a specialist in the field of creating products that appeal to the purchaser. But that job also requires a good working knowledge of engineering, familiarity with modern materials and a firm understanding of production techniques. And since all products are meant to be sold and used, the designers familiarise themselves with marketing requirements and proficiency in anticipating buyer needs and design trends. Their work is thus directed toward increasing the value of products to both the producer and the user.

It is the background of the designers, and the nature of their job, that requires and enables them to work in close co-operation with other departments and specialism making valuable contribution throughout the decision making process valuable.

Fritz Eicher said:

> "Industrial product design is not created in a vacuum. It is in principal, the final result of a long line of risky, complicated processes, with others - engineers and marketing people - taking influence and rendering their own creative contributions. The work of one group is a determinant for the work of others. The better and more qualified their co-operative basis is from the start of

the job, the better the result will be - for the final design too." (Burkhardt & Franksen).

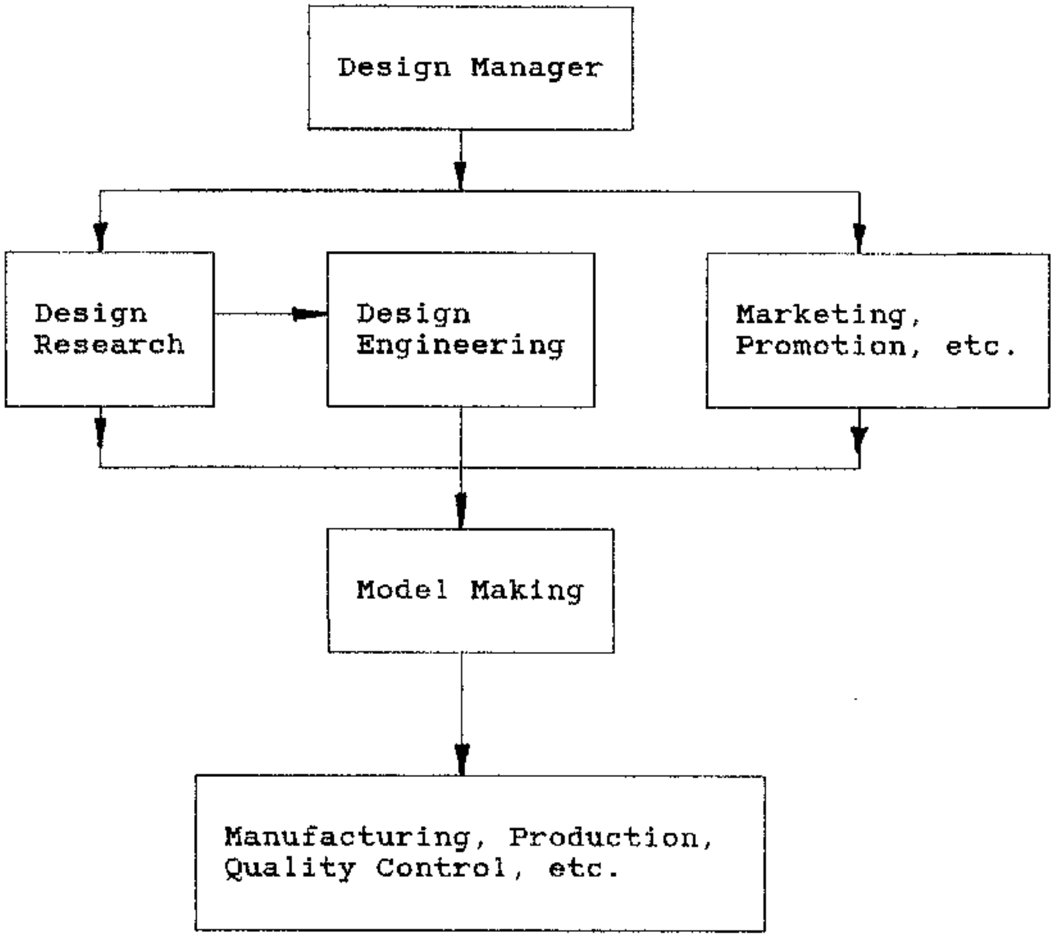

DIAGRAM OF A DESIGN TEAM

The services of industrial designers in contributing towards market success are documented. A study of the plastic industry conducted by the Open University showed that design-conscious firms grew faster and were more profitable than the others (CNAA, 1984). The Italians, Germans and Scandinavian Companies are well-known for their special interest in and awareness of the importance of industrial designers to market success (Hayes, 1983).

Awareness has also grown among the developing countries concerning the need for industrial designers in their manufacturing activities. In Hong Kong for instance, as part of the economic development process, in the manufacturing of goods, emphasis is concentrated by the government's Science Advisor upon the quality of products, standards and certification. This has resulted in some companies beginning to invest in design and selling quality products abroad under their own trademarks (CNAA, 1984).

However, while some developed countries have been reported to benefit from the skills and services of industrial designers, there exist in the Third World many countries where designers are overlooked and not given the opportunity to exhibit and exercise their potential and contribution to decision-making (APO, 1983). One such example is the deemed status, and the inappropriate roles played by the Oman industrial designers. Whether this is due to the designers being unqualified or lacking in the necessary capabilities required for the job or just plain unwillingness of the employers to recognise the designers' skills is not fully understood. Part three reports an investigation of the current status and reasons that contributed to the existing situation of the industrial designers in Oman.

7.4 THE INDUSTRIAL DESIGN IN OMAN

Little is known about the origins of industrial design in Oman. However, it seems possible to consider the local craftsmen as the initiators and originators of the country's design activities. These craftsmen who also designed their own specialised tools considered their craft as an extra source of income in addition to their daily farming and fishing. Some of their tools are seen today in the country's national museum. It is interesting to note that even today, some of the traditional ways of making craft items are still practised in certain rural areas in the country. A common example is the firing of pots using saw dust, instead of the modern kiln.

In modern times the importance of designing for manufacture was stressed by His Majesty Sultan Qaboos bin Said. He often stressed the need for national identity, and the importance of having local designers to explore and use indigenous knowledge and technology as tools for the nation's development (Oman, 1985).

The improved standard of living of the general public and growth of industry since the country's accession in 1970 have generated a demand for an ever-growing range of consumer and industrial products. In the 1980s the establishment of the New Economic Policy, encouraging local participation, gradually led to the replacement of imports by locally assembled and manufactured goods. Recently, in government efforts at strengthening and diversifying the country's industrial base, the trend has been toward the domestic and export orientated production of manufactured products which have been locally designed and fabricated.

Today, many products are manufactured in Oman, mainly for local consumption. However, most of these are either products locally assembled from parts designed and manufactured elsewhere, or products locally designed and produced, is much more limited, and covers chiefly intermediate and low technology articles like footwear and textiles, handcrafted items, household items such as domestic furniture and plastic products of various kinds.

Most of the manufacturing industries in Oman are rather recent, generally established after the government's New Economic Policy. The general features of the design-production-consumer chain in respect of locally designed products, as reported by the author during a visit to the Rusayl Industrial Estate (RIE), which emerge rather clearly are:

1 - Industries that produce locally designed products are small to medium scale private enterprises with limited capital, production facilities and design capability; their design staff mostly have had little and probably insufficient formal training in industrial design, though staff in the larger establishments may have some kind of engineering or technical training.

2 - The practice of design generally progresses as a narrow piecemeal drawing office exercise, without any consideration of the impact of the product being designed on its production environment or on the overall environment in which the product will be distributed, consumed and disposed of.

3 - Unsatisfactory product design and quality is made by the consumer, i.e., the general public, the government organisations which are the major consumers and industries themselves. The general public may contribute to poor design product, through lack of design consciousness. Government organisation which are the major consumers are also partly responsible, through tolerance of goods purchased which could, for their price, be of a very much higher quality.

Compared to manufacturing industries in developed countries, where industrial designs are sometimes given vital roles, in Oman, the designers' capabilities are neglected, mainly due to firms being less appreciative of the profession. Such attitude by the firms have in most instances, as mentioned before in this chapter, resulted either in products of foreign standards not being adapted to satisfy the people, or products being wrongly or not well adapted due to lack of necessary expertise.

One problem often faced by manufacturing firms in Oman is the lack of a skilled or trained workforce. However, despite this, it seems necessary to state that other professions could also, if given the opportunity, be able to carry out some of the functions of an industrial designer. Thus, it is important to note that what is discussed in this part of the this chapter is based on the responses and data collected during researching the various firms in Oman.

7.5 THE CONCEPT OF APPROPRIATE TECHNOLOGY

With the incredible variety of technologies available in today's world, it has become very difficult for less developed countries to choose the right technologies which will respond to their needs. Unemployment is a serious and growing problem in most developing countries, and advanced technology from developed countries is viewed with suspicion largely because of its failure to provide sufficient jobs (Stewart, 1974; Baer, 1976, p. 121; Forsyth, 1980, p. 371; Santikarn, 1981, p. 16). The fact is that most of the existing technologies in advanced industrial countries have been developed in response to the needs and conditions of that society, particularly with regard to markets which are normally large, and with comparatively high income. More than 50% of world investment in science and technology is directed towards the production of ever more sophisticated weapons and armaments and about two thirds of the remainder towards marginally increased consumption of nonessential goods (Sagasi, 1979, p. 28).

In this respect, Lall argues strongly that much of modern technology is "inappropriate" in one or both senses: it uses too much capital and too little labour, and it produces commodities which are unnecessary, over-sophisticated or over-specified in relation to the needs of poor countries (Lall, 1980, p. 131). It would, therefore, be very difficult to use them in an optimal way before extensive adjustment has been applied to them, especially in the Third World nations where there is a shortage of capital and skilled labour, and where markets are of low income.

Adapting imported technology, as it has been stated by Bradbury (1978), is required to make it "appropriate" to the needs and conditions of the recipient countries. The term "Appropriate" in its turn has been described in different ways by different authors such as "intermediate", "convenient", "optimum" and "correct" technology. Appropriate technology may be defined as:

> "a set of techniques which makes optimum use of available resources in a given environment. For each product or process, it is the technology which maximises social welfare if factors and products are shadow priced." (Morawetz, 1974).

A similar definition of appropriate technology was given by Young:

> "a technology which makes efficient use of available resources in a particular country or contributes to developing objectives." (Young, 1979, p. 40).

As the above definition clearly indicates, the introduction of appropriate technology is an essential ingredient for maintaining and sustaining the Third World economy. This is important because in many developing countries, sophisticated equipment is often seen standing idle because of the lack of organisation, raw material supplies, transport and so on.

Shumacher criticised the strategy of sending inappropriate technology to developing countries for the reason advanced above. He asserts:

> "If we define the level of technology in terms of 'equipment cost per workplace' we can call the indigenous technology of a typical developing country - symbolically speaking - a £1 technology, while that of the developed countries could be called a £1000 technology. The gap between these two technologies is enormous that a transition from the one to the other is simply impossible. In fact, the current attempt of the developing countries to infiltrate the £1000 technology into their economies inevitably kills off the £1 technology at an alarming rate, destroying traditional workplaces much faster than modern workplaces can be created, and thus leaves the poor in a more desperate and helpless position than ever before. If effective help is to be brought to those who need it most, a technology is required which would range in some intermediate position between the £1

technology and the £1000 technology. Let us call it - again symbolically speaking - a £100 technology." (Shumacher, 1979, p. 175).

Despite the wide range of definition related to appropriate technology, the main characteristic is that it makes optimum use of available resources. Consequently, to choose the best alternative, it is necessary to evaluate its associated benefits and costs in order to reach the highest net benefit. In other terms, five levels have to be considered:

1 - The objectives of the decision-making unit.

2 - Resources availability.

3 - The action needed

4 - The actors: who were going to participate and in what way.

5 - The result. (Bourrieres, 1979, p. 10).

The selection of appropriate technology is a crucial step towards the transfer of technology. UNIDO identifies three factors which should be taken into consideration when making choice of technology:

1 - Development goals. This involves increase in employment and production through better utilisation of local resources; development skills; closing the gap between upper and lower wage earners; satisfying the fundamental needs of poor people, improving the general quality of life; and fostering self-confidence.

2 - Resource endowments. This means the extent to which local labour, managerial competence, electricity, water and mineral resources are available for the exploitation of the imported technology.

3 - The conditions of application. What is the level of infrastructure? How suitable is the climate and natural environment? Are the cultural and traditional values and education standard comparable with the technology to be imported? Are there any markets (domestic and foreign) for the products the technology will produce? What is the state of foreign exchange? All of these are questions which must be answered in order to make the right choice of technology. (UNIDO, 1981, p. 14).

In the view of Drucker

"appropriate is not what uses the most capital or labour nor does it have to do with what is 'small' or 'big', 'pre-industrial' or a 'scientific marvel'. What is appropriate is quite simply what makes an economy's resources most productive. (Drucker, 1979).

Although the term 'appropriate' is often used to describe technology as an effective instrument for economic advancement rather than a dominating factor, it nonetheless seems to undermine the dual role of 'appropriateness' usually used to describe various technologies exported to underdeveloped countries.

A similar definition is presented by Jasinski who defined the term "appropriate technology" as the

> "... application by a country of such production and technological solutions which are of maximum use to a particular branch of industry and to economy as a whole... the use of appropriate technology must be considered in terms of optimum conditions not only on the micro but also on the macroscale." (Jasinski, 1979, p. 57).

On the other hand, the selection of "inappropriate technology" may arise in developing countries for several reasons. Firstly, there may be a shortage of local manpower skilled in scientific and technical areas which is essential in identifying needs and in searching for appropriate technology suitable for the country concerned. Secondly, sometimes firms supplying technology (products and services) are not keen on spending a large amount of money on the development of special equipment for a particular developing country as they are uncertain of recovering their research and development expenses. As a result, such firms usually supply technologies which are available but not necessarily appropriate to the conditions of a specific developing country. Thirdly, the type of agreement between certain industries in the developing countries and private foreign firms might affect the choice of appropriate technology. For instance, agreements on direct foreign investment results in certain limitations for the developing countries to transfer them into the fields of labour-intensive technologies. Last but not least, inappropriate selection of technology may arise through weak communication channels either on an inter-country level or within the country. (Stewart, 1974, p. 17).

7.6 THE ADAPTATION OF TECHNOLOGY IN OMAN

Whilst many people agree with the fact that adaptation of technology could offer the best transfer mechanism, in Oman, problems remain in the ability to absorb in the most efficient manner. The differences in environment, social, economic, and technological capabilities etc. that exist between the donor and the recipient countries often cause barriers and contribute to difficulty in making imported technology appropriate unless certain differences are taken.

The major problem facing Oman today is that of absorbing socially appropriate technology. It is necessary to create educational and professional training schemes that will enable the gradual take-over of new technologies by the indigenous workforce. As will be seen in our empirical findings, there is the urgent need to develop the local capabilities aimed at reducing dependence on foreign technologies. To make the appropriate choice of technology, the following factors should be given attention:

(1) Develop local skills to exploit the imported technology successfully.

(2) Devise a mechanism for making the appropriate choice of technology. This must be enshrined in the national plan.

(3) Ensure that available local raw materials are fully used to reduce dependence on foreign resources.

(4) The government should hold the technology momentum by making money available for Research and Development aimed

at application, adaptation and absorption of imported technologies.

The value of a new technology does not depend on its economic viability and its technical soundness, but in its ability to fit in the local, social and cultural environment. The contemporary technology is criticised by ignoring the social values in the society. Hence, it is high time that Oman emphasised the need for adopting appropriate technologies on the basis of its economic and social needs. The social preferences will help to promote indigenous self-reliance through social participation and control.

One of the main purposes for generating the appropriate technology is to use renewable rather than depletable energy resources. This will also help in production and consumption of reusable goods through which Oman accomplish capital saving and minimise environment deterioration. In general, appropriate technology seems to be the best solution for most of the problems generated by modern technology.

7.7 CONCLUSIONS

The transfer of technology from advanced nations to developing countries is very complex and needs consideration of many varied factors including the differences in environment, political systems, cultures, and technological capabilities etc. The adaptation of technology is a multinational process and requires participation and integration of various disciplines of thought. In examining the potential of Omani designers to contribute towards the process of adaptation of technology transfer, it was revealed that the unavailability of designs in the country, and the attitude of firms have contributed to the low usage of professional designs.

To make the appropriate choice of technology, the following factors should be given attention:

(1) The importance of the appropriate technology, technology of production rather than consumer goods, that satisfies the basic needs of the people.

(2) Adaptation of the imported technology to the local conditions and creation of strong national technological capacity which necessitates the promotion of the national Research and Development.

(3) Control of MNCs through laws and regulations to insure the appropriateness of the technology they transfer and to enforce their contribution in the creation of national technology capacity.

One may be tempted to conclude, based on overall review, that Oman should have acquired sufficient foreign technologies over the years to enable and develop its local capabilities aimed at sustaining and maintaining some elements of technological independence.

CHAPTER 8

THE TRANSFER OF TECHNOLOGY TO SELECTED DEVELOPING COUNTRIES

CHAPTER 8

THE TRANSFER OF TECHNOLOGY TO SELECTED DEVELOPING COUNTRIES

CHAPTER 8

THE TRANSFER OF TECHNOLOGY TO SELECTED DEVELOPING COUNTRIES

8.1 INTRODUCTION

The main aim of this chapter is to examine the methods of transfer of technology to some selected developing countries and to see how they compare with that of Oman. It is divided into five parts. The first discusses the transfer of technologies to Egypt. The second deals with Brazil, and Nigeria is examined in the third part. India is then discussed in the fourth. Finally some conclusions are drawn.

8.2. THE TRANSFER OF TECHNOLOGY TO EGYPT

Egypt is in the north-eastern part of Africa, has an area of 386,900 square miles and a population of 48.5 million (Lloyds Bank Report, 1986, p. 1). Egypt's 'open door' policy in 1973 helped to speed up its economic growth. The public sector was decentralised, the private sector broadened and foreign investment increased. Economic activity gathered momentum between 1973 and 1975. The GDP grew in real terms from 2% in 1973 to 3% in

1974, with a projected growth of 8% in 1975. Both agriculture and oil exploration have remained the backbone of the Egyptian economy - contributing significantly to the GDP and foreign exchange (Egypt-British Chambers of Commerce, 1984, p. 5). Nevertheless, since the world oil glut, earnings from oil have fallen from $2.7 billion in 1981/82 to $2.3 billion in 1983/84 (Lloyds Bank Report, 1986, p. 12).

Until recently, Egypt did not pay much attention to the import of technology in its official policies, but this is rapidly changing. There is a growing awareness of the benefits of imported technology as well as the realisation of the country's possession of both scientific and technological potential to tap these benefits. Egypt now has an 'open door' policy. Egypt now seeks the best technology relative to its needs from any source. In turn, this appears to require clear policies for negotiating with suppliers of such technologies. In this respect, the state has a very dominant role. The state plans, organises and executes all major industrial projects through its agent, the General Organisation for Industrialisation (GOFI), which has a workforce of about 1,300, of whom about 800 are engineers, technicians and commercial staff (UNCTAD, 8th January 1986, p. 10).

However, GOFI has other functions. It undertakes, for instance, feasibility studies before any investment is embarked upon. It also has a number of technical functions. Among them are:

1 - Spreading of information, innovative ideas and technical know-how

2 - Helping in providing solutions to technological problems.

3 - Taking part in negotiating agreements, such as technical co-operation.

4 - Taking part in the preparation of tender documents and specifications. It also helps in conducting contracts for delivery of equipment, machines and spare parts. The modernisation and expansion of industrial projects as well as aiding the establishment of technical know-how are also parts of the Agent's activities.

5 - Through the Engineering and Industrial Design Development Centre, GOFI also fosters industrial design in the mechanical, electrical and electronic sectors.

6 - Examines application submitted to the Ministry of Industry for licences to set up and/or expand domestic private sector businesses (UNCTAD, 8th January 1986, p.

10).

The essence of Egypt's 'open door' policy is primarily to offer incentives to both Arab and foreign investors. This was made clear in Law No. 43 of 1974 (amended by Law. 32 of 1977). The Law states that,

> "The investment of Arab and foreign capital in the Arab Republic of Egypt shall be for the purpose of realising objectives of economic and social development within the framework of the state's general policy and national plan, provided that the investment is made in projects in need of international expertise in the spheres of modern development or in projects requiring foreign capital." (UNCTAD, 1980, p. 12).

The aims of looking for foreign investment are clearly set out in the government statements stipulating the major objectives of the policy. These include: increasing employments and improving all levels; increasing national income, taxable revenue and supply of goods and services for which the demand cannot be met locally; making further use of Egyptian natural wealth (resources); earning foreign currency; increasing competition and hence productivity of local enterprise;

and introducing modern technology. (UNCTAD, 1980, p. 13).

It is clear that opportunities in the technological transfer sector is well recognised in Egypt. According to UNCTAD, "One consequence of this realisation has been the establishment of a Transfer of Technology Committee within the framework of the Academy of Scientific Research and Technology." (UNCTAD, 1980, p. 21).

To summarise, the objectives of this committee are as follows:

(a) Studies and evaluation, primarily:

- Evaluation of Egypt's experience with transfer of technology;

- Identification of Egypt's technological needs;

- In the light thereof, a realistic evaluation of what foreign technology actually involved. This includes the experience of and sources provided by developing countries.

(b) Action programmes intended to introduce major reforms in policies and institutions, notably:

- Establishment within the Academy of a central agency for techno-scientific planning, inter alia, joining techno-scientific policy with local development planning;

- Devising of a formula for agreement concerning the transfer of technology;

- Enhancing the information system for the benefit of the productive system, including ensuring proper use of the patent office;

- Strengthening the co-ordination of activities among the different agencies related to technology transfer;

- Encouraging "customer-oriented" research, particularly related to local objectives, inter alia, by increasing the total resources allocated to R and D and sharply changing the ratio between basic and applied research, as well as finding assured sources for funding;

- Promoting the link between R and D and the productive sector;

- Increasing the personnel involved in R and D by promoting university graduates to undertake research and development, and in particular raising the proportion of research auxiliaries, changing the motivation of R and D manpower by incentives, etc., and solving the brain drain problem.

<u>(c) Action programmes intended to be carried out on a continuing basis, notably:</u>

- Controlling the technology transfer operation;

- Linking technology contracts to the development of national capabilities.

In addition to the above objectives, Egypt also appears to be considering the establishment of a national centre to be specifically charged with the responsibility of importing technologies into Egypt. The following are the guidelines aimed at achieving the objectives of technology transfer imports:

1 - seeking from as many resources as possible the technology required for a given purpose.

2 - Systematic evaluation of the foreign technology available in relation to alternatives.

3 - Unpackaging to be able to associate local inputs of technology.

4 - Elimination of restrictive conditions.

5 - Assistance to local companies in the negotiation of technology contracts.

It is important to note that Egypt has no specific law governing the transfer of technology. The use of patents, trademarks or technological know-how is usually authorised through licensing agreements which must receive the approval of the General Organisation for Industrialisation, particularly when the agreement involves the payment of royalty (Wahba, W., 1982, p. 13).

Like some other Third World countries, Egypt has some obstacles constraining the import of foreign technologies. These include:

(a) Organisational complexities.

(b) Lack of managerial and technical competence.

(c) Lack of an adequate system of incentives.

(d) Lack of regulations governing production decisions in enterprises.

(e) Inadequate selection and adaptation of the available knowledge. (Wahba, W., 1982, p. 4).

Although Egypt has the potential for mobilising technological resources, it nonetheless appears to lack the means whereby these technological resources can interact effectively with the economic, technical, managerial and organisational indicators that determine the rate of technological advancement in both private and public sectors.

8.3 THE TRANSFER OF TECHNOLOGY TO BRAZIL

Brazil is a Latin-American country with a population of 138 million, and an area of 3.27 million square miles. The main exports are : metallurgical products (12%), transport equipment (9%), iron ((8%) and soya beans (8%). The main imports are capital goods (24%), crude oil and derivatives (23%), chemical products (18%), and coal (4%). Most of the imports are supplied by the USA (22%), West Germany (8%), and Japan (8%). (Lloyds Report, 1988, p. 2).

The aim is for a growth of about 7% per annum for period 1986-1989. Growth may be delayed or slowed down because of Brazil's massive external debt. "Debt outstanding at the end of 1989 is expected to be $112.0 billion." (Lloyds Bank Survey, February 1989, p. 2).

The Technology Transfer Process : An Example

Following the formation of COBRA, a Brazilian Computer Company in 1974, a contractual agreement was reached between it and Ferranti.

The Transfer Agreement

Under the agreement, COBRA intended to acquire from Ferranti computer technical know-how and information. The objective was to use the information in the manufacture of COBRA's own products.

The technological transactions contained in this agreement were a mixture of patented and unpatented technologies, for capital and intermediary goods, human skills and information. Assistance and training were also ensured in the agreement, hence the agreement was called "Agreement of Technical Information, Assistance and Training." (Oliveira, L. 1982, pp. 263-267).

The types of technologies to be exported involved a mix of manufacturing, product and management technologies. These were:

1 - Capital Goods, including peripherals not designed by Ferranti such as line printers, disk storage units, magnetic tape deck, plotters, papers, tape punch, paper and tape reader, teleprinters, etc.

2 - International Goods, referring to hardware modules, equipment and components related to the manufacture of Argus-700 computers. They include various electronic and electromechanical components such as central processor

module, monitor units, store access units, general purpose logic elements, input/output units, printed circuit boarders, registers, cooling fans, power supply units, etc.

3 - Human resources, including the training of engineering and managerial personnel at the supplier's premises in the U.K., and the support of Ferranti's engineers of COBRA's plant in Brazil.

4 - Information was divided into two main components:
(a) Software, including basic auxiliary and application designed to control the internal operations of the computer and the execution of specific tasks.

(b) Technical Data Packages which include documentary information which describes how to assemble the modules, parts, components, materials and techniques used to carry out the production process. They include specifications for materials, photographic processes, design standards, quality assurance testing, layout of production area, etc. (Oliveira, L., 1982, pp. 271-273).

Emerging Problems

The Ferranti manager who took part in the negotiation of the technology from Ferranti (U.K.) to

COBRA (Brazil) identified the following problems:

> "The problems we had to deal with the National Institute of Industrial Property (INPI) gave us very good impression that the technology was the last thing on earth they wanted."
>
> "They were very bureaucratic and appeared not to take any notice of everybody else in Brazil."
>
> "Basic rule number one seemed to be no money should be paid for an exchange, for know-how and there should not be any royalties..."
>
> "I think that a lot of malpractice which had been going on... (evasion of currency regulations, disguised payments for know-how and royalties, etc.)... made life very difficult not just for us but for all the people who were trying to do genuine straightforward, sensible commercial deals." (Oliveira, L., 1982, pp. 260-269).

Other problems include:

Problems associated with negotiating the contract under which various forms of technology would be transferred.

No specific policies to orient both the supplier and the recipient of the technology.

No proper estimation of the value of the technologies in relation to the current economic priorities.

Overall, the training of technological engineering and managerial personnel at the Ferranti premises in the U.K. appeared to be considered as an important factor in the process of technological transfer. This was manifested in a statement, made by a Ferranti Director, which reads:

> "We are well aware that transfer of technology was not simply sending pieces of paper together with the hardware. We would have sent drawings, service manuals and all that, but it isn't... It is too complex a subject. We were aware that there had to be a lot of training ..." (Oliveira, L., 1982, p. 268).

Among those trained are administrative and planning managers, sales and support engineers, hard and software engineers, maintenance and production engineers.

This statement is particularly relevant to this study because without adequate training it becomes extremely difficult to improve the local capabilities necessary for reducing dependence on foreign technologies.

8.4 THE TRANSFER OF TECHNOLOGY TO NIGERIA

Nigeria is a country in West Africa which has a land of 356,669 square miles, about four times the size of Britain. It has a population of about 100 million (Lloyds Bank Report, 1986, p. 1). Like Oman, it is heavily dependent on oil as its main source of revenue. For example, oil accounts for about 90% of its foreign exchange earnings. A rapid transformation from an agriculture-based economy to a major oil producer and exporter resulted from the discovery and exploitation of rich oil wells during the 1960s and 1970s. Nigeria's GDP increased in real terms at an annual average growth rate of 30% during the period 1960-1970, and 7% between 1970 and 1980 (Lloyds Banks Report, 1986, p. 3). However, Nigeria like Brazil has a huge external debt and this may slow down the importation of foreign technology. The light manufacturing sector of the Nigerian economy has undergone considerable expansion since independence. Production increased at an annual average rate of 9%

between 1960 and 1970, and during the period 1970 to 1980, was 12% on average. Because Nigeria is inward-looking, import substitution has for some time now been given priority in its economic policy. (Lloyds Bank Report, 1986, p. 10).

An Example of the technology Transfer Process

In 1973, the Dunlop and Michelin Tyre manufactures signed an agreement with the Federal Nigerian Government to transfer technology to Nigeria in a 'Package'. The content of the package has been classified into three main types of technology. They include:

1 - Organisational Technology. This comprises skills and know-how to provide organisation and management functions in the company.

2 - Non-Proprietary Production Technology. This is specifically concerned with the pure technical elements in the technology package which are basic and general to the industry.

3 - Proprietary Production Technology. This specifically deals with process technology.

Methods of Transfer

Adikibi identified four main mechanisms through which technologies have been transferred to Nigeria: (1) Machinery supply, (2) Expatriate personnel, (3) Licence agreements, and (4) Intra-firm communication.

He points out that:

> "the significance of each of the mechanisms differs, corresponding in a sense to the phase of operations of the industry and the circumstances of each phase." (Adikibi, O., 1981, p. 268).

In some cases, however, the four mechanisms complement each other.

8.5 THE TRANSFER OF TECHNOLOGY TO INDIA

India is a large poor country with a population of about 700 million, situated in Asia. It seems not to be worse off in terms of economic growth when compared with other developing countries. It has a massive reserve of human resources capable of exploiting potential in foreign technology. The foreign technologies transferred to India are mainly through turnkey arrangements and licensing. Other include collaborative arrangements with foreign firms, joint venture, importation of machinery, consultancy, and so forth. Licensing is the commonest method through which multinational companies have transferred most of their technologies to the developing countries.

The Technological Transfer Process

Most technology in India has been transferred from the Soviets. Among them are the 'Koyali' refinery, the 'Bakaro' Steel plant called 'Bakaro', and the 'Korba' aluminium smelter. (Mehrotra, S., 1985, pp. 106-107).

The Koyali Refinery - An Example of Technology Transfer

This refinery contract between India and Russia was signed in 1961. Tiazhpromexprt Company was to supply India with the following: (1) Working drawings for construction of the units of the plants. (2) Supply of technical assistance in erection and commissioning of the project. (3) Supply of soviet equipment. (4) Training of Indian operatives. (Mehrotra, S. 1985, p. 107).

On the other hand, while the designing and equipment supply is a soviet responsibility,

> "The customer (i.e., India) shall carry out at its own expense and by it own means all the excavation, construction, erection and adjusting work as well as putting the 'Koyali' oil refinery and the 'Captive' Thermal Power

Plant into operation with the technical consultations of the supplier's (i.e., soviet) specialists." (Mehrotra, S., 1985, p. 109).

Indeed according to the Koyali Refinery contract:

"The customer shall prepare the detailed project report and the working drawings for units outside the refinery limits, viz., the township, approach and other roads, transport and communications, power and water supply, sewerage system purification and other structures, etc., which are required for normal operations of the refinery." (Mehrotra, S., 1985, p. 109).

The Bokaro Steel Plant

The contract for the Bokaro Steel Plant was signed in 1965. Under this contract:

"The Indian and Soviet parties shall promote maximum possible participation of the indian organisation in carrying out the designing work and in the supply of equipment and materials for the construction of the works." (Mehrotra, S., 1985, p. 111)

To ensure that any disagreement between the two parties is settled amicably, Article 17 of the Bokaro agreement stipulates:

> "In case of any disagreement between Indian and Soviet organisations on any matter arising from or connected with the implementation of the present agreement, the representatives of the government of India and the government of the USSR shall immediately consult with each other and endeavour to reach a mutual settlement." (Foreign Affairs Record, 1965, p. 62) (Mehrotra, S., 1985, p. 114).

The Bharat Aluminium Corporation (Balco)

The contracts for the Balco aluminium project were signed between 1968 1nd 1971.

Under the agreement with Tiazhpromexprt it was stipulated that:

> "The seller shall collaborate and utilise skilled Indian engineers of the buyer for participation in designing works in a number of specific cities and for periods to be agreed upon by the buyer and seller." (Mehrotra, S., 1985, p. 111).

In addition,

> "The seller will prepare its portion of the DPR... with a view to maximum utilisation of Indian-made equipment and materials." (Mehrotra, S., 1985, p. 111).

Later, Balco signed a consultancy agreement with VAW of west Germany. In the main, the agreement states:

> "It is agreed that VAW will ensure that maximum use is made of the industries, services and materials of India for the construction projects. In particular, VAW will promote the above objectives by direct contacts with Indian suppliers or by recommending to the non-Indian contractors the maximum use of such Indian suppliers, provided the liability of the contractor will not be affected by such subcontracts." (Mehrotra, S., 1985, pp. 111-112).

8.6 CONCLUSIONS

The methods, processes and mechanisms for the transfer of foreign technologies from industrialised countries to Egypt, Brazil, Nigeria and India differ in a number of ways, which may be explained by differences in individual countries economic strength. Comparing these four countries with Oman, we can note certain similarities and dissimilarities.

Similarities

Firstly, all of the countries (including Oman) import both established and sophisticated technologies. Secondly, the elements of the technologies transferred are similar in most cases. Thirdly, the methods of transfer also appear to be similar in some cases. Supply of equipment, and training of recipient personnel, for example, are common to all.

Dissimilarities

Firstly, when compared with Egypt, Brazil, Nigeria and India, Oman appears to have no problems as far as financing of technology transfer projects is concerned. Secondly, politically, Oman is more stable than the other countries. This means that Oman may attract more foreign investors, and possibly may get a better deal. Thirdly, the other four countries have a larger skilled and able workforce than Oman. This is where Oman has a major problem. This means that the development of local capabilities by Oman may be much more difficult which, in turn, may continue to promote rather than reduce dependence on foreign technologies. Fourthly, whereas there is local participation in India, Brazil, etc., there is little or no participation in the execution of projects in Oman. Fifthly, whereas in the other countries the agreements with foreign suppliers of technology insist that maximum use must be made of all local materials and services before sourcing outside, the situation is different in Oman.

CHAPTER 9

RESEARCH METHODOLOGY

CHAPTER 9

RESEARCH METHODOLOGY

CHAPTER 9

RESEARCH METHODOLOGY

9.1 INTRODUCTION

This chapter describes the methodology used in the research, and it is divided into eight parts. The first part states the title and hypotheses of the research and the second describes the sources of the data. Part three deals with the major stages of the study, and part four examines the recipients of the technology in Oman. The aims of the questionnaire are set in part five, and the educational institutions are examined in part six. Part seven then discusses the government regulations, while part eight discusses the methods used in collecting the data. Finally some conclusions are drawn.

9.2 TITLE AND HYPOTHESES OF THE INVESTIGATION

Title

An Examination of Technology Transfer: The Channels through which technology can be transferred to and acquired by recipient organisations in Oman.

Hypotheses

1 - That Oman is almost totally dependent on foreign technology.

2 - That Oman has shortage of manpower and management capabilities.

3 - That Oman encounters difficulties related to the differences in the social, cultural, and environmental backgrounds of the foreign technology.

4 - That Oman should consider some fundamental aspects such as developing local skills and making the appropriate choice of technology.

5 - That Oman's technological independence is a function of the development of local capabilities.

In addition to testing the above hypotheses, this research was basically exploratory in nature. Therefore, some of the questions were designed to provide background data to improve understanding of the country's dependence on foreign technologies or know-how, as well as examining the reason why Oman lacks skilled manpower and labour.

9.3 THE SOURCES OF DATA

The empirical research here, was designed to test a number of hypotheses, and followed a number of stages. The first was to identify the recipient firms which were importing technology from developing countries. The selection of these firms was based upon the types of technology they imported, and their relationship with the local sector. A pilot sample of 10 firms was selected in the Rusayl Industrial Estate in order to test the questionnaire.

A final sample of 120 firms was ultimately identified. Of these, 80 responded, from which a detailed study was obtained. The author also studied Sultan Qaboos University and the Vocational and Technical Institutions to examine their contribution to the transfer of technology and the development of local capabilities. Finally, the role of government regulations for directing and controlling the flow of foreign technologies and the encouragement of local technologies was studied and, in particular, the Ministry of Commerce and Industry.

9.4 MAJOR STAGES OF THE STUDY

The major stages which characterise this study are as follows:

1 - The selection of Omani firms.

2 - The selection of the educational institution.

3 - The selection of the source issuing Industrial Laws (Ministry of Commerce and Industry).

4 - General findings

5 - Eventual problems

6 - Conclusions and recommendations.

9.5 THE RECIPIENT FIRMS

This section looks at the recipients of technology in Oman. For the purpose of this research three main important sectors were selected.
They are namely:

1 - The Rusayl Industrial Estate, consisting of 80 companies of which 53 companies found to be co-operative,

was chosen.

2 - The Ministry of Electricity and water (M. E & W).

3 - The Petroleum Development of Oman (P.D.O.)

To perform this part of the research, a visit to Oman was arranged in 1991. A preliminary Questionnaire was designed, and a few gaps discovered, which required the author to make alteration before setting up the final design. Questionnaires were then printed in Arabic and English (see end of this chapter) and were taken personally to the director or chairman of the firm concerned, follow-up visits and calls to the sectors' premises were regularly needed due to the difficulties encountered of poor co-operation from the firms concerned.

9.6 THE AIMS OF THE QUESTIONNAIRE

The questionnaires were administered personally to the managers or directors who had been highly involved in technology usage. The face-to-face comments with the respondents considerably supplement their responses to the questions already submitted in the form.

The questionnaire was designed to collect information about most technological projects which had been carried out during the ten years 1980-1990 in the Rusayl Industrial Estate, the Petroleum Development of Oman and the Ministry of Electricity & Water.

The questionnaire was divided into 12 Sections:

Section A: This section asked for information about the recipient of technology. Information such as:

(a) Name of the recipient organisation

(b) Year of establishment

(c) Type of ownership

(d) Type of products and/or services that the recipient organisation produces.

(e) Name of countries which import those products and/or services.

(d) Name and title of the person filling in the questionnaire

(g) Name and nationality of the company(ies) responsible for accomplishing the project.

Section B: This section investigated the total cost of the project. Furthermore, it looked into how much money and time spent on the project:

(a) Consulting and feasibility study.

(b) Import and installation of machines and equipment.

(c) Training

(d) Maintenance

Section C: This section identified the source of technology in each project for the following:

(a) Consulting and feasibility study

(b) Training

(c) Machinery and equipment

(d) Manpower

Section D: This section investigated whether the imported technology caused any environmental, health, technical, and marketing problems.

Section E: This section examined the selection of the technology, including which source of information has been most utilised in the selection of technology, and who and what criteria has been considered in the selection of technology.

Section F: This section examined methods of acquiring technology, stating:

(a) Which methods are preferred by the recipient organisation.

(b) Which methods are commonly used, and

personally.

(c) Which methods are preferred by the respondents

Section G: This section was concerned with whether the technological agreement included the following:

(a) The introduction of theoretical courses.

(b) Providing theoretical and practical training

(c) Local participation in R and D, design and construction, marketing, management, etc.

Section H: This section asked whether the technological agreement included the following restrictions:

(a) The use of local natural resources (oil, gas, etc.)

(b) The use of other foreign natural resources.

(c) The use of local machines and equipment.

(d) The use of other foreign machines and equipment.

(e) Restrictions on the development of machines, equipment, and production methods.

(f) Restrictions on the use of local technical manpower. All of these factors helped to determine whether this technology, once well utilised, could develop these natural resources, including technical manpower, in order to reduce dependence on foreign technology.

Section I: This section aimed to examine the role of local participation in the design, construction, installation, supervision, and Research and Development during completion of the project.

Section J: This section examined technological development and adaptation. This section identified or examined whether there had been any modification of the technology imported, as well as identifying the sources held responsible for so doing.

Section K: This section examined whether the recipient organisation faced any difficulties in obtaining permission to acquire technology.

Section L: This last section was divided into two subsections.

(a) Whether there is a Research and Development department in the recipient organisation, and if any;

(b) Whether there is any relation with another Research and Development in other organisations.

Secondly, it examined the role of the importer educational institutions in the selection and acquisition of the imported technology.

9.7 EDUCATIONAL INSTITUTIONS

In this section an investigation was carried out to identify the role of the Educational Institutions in Oman in the transfer and development of technology imported to Oman. The institutions were:

(a) Sultan Qaboos University

(b) The Applied Educational Institutes.

Structural interviews with the management and directors of these institutions were carried out, and several relevant questions were examined. The objectives were:

(a) To examine the role of the Omani Educational Institutions in the selection of:

- the appropriate technology
- the methods (channels) of technology transfer
- feasibility study
- the adaptation of imported technology

(b) To examine the role of Educational Institutions in the development of human resources.

(c) To identify the main obstacles which might delay the transfer of technology to Oman.

(d) To identify the existence of any national indigenous institutions with a capability of adapting the imported technology.

9.8 GOVERNMENT REGULATIONS

Government regulations for directing and controlling the flow of foreign technologies and the encouragement of local technologies were studied. The Ministry of Commerce and Industry (M. C & I) is responsible for promulgating these industrial regulations in Oman. Personal interviews with the Head of Industrial Law, and a consultant at the M. C & I took place.

9.9 DATA COLLECTION

The following methods of gathering information were used in this study

1 - Review of the Literature.

2 - Personal Interviews

3 - Postal Questionnaires.

A Review of the Literature

A large body of literature was studied to examine the role that modern technology can play in the development of Third World Countries, especially concerning the development problem and issues of Oman. The main sources of information were:

1 - Official information statistical documents.

2 - Journals and reports published by international organisations such as the United Nations and the O.E.C.D., UNIDO, UNESCO, UNCTAD, etc.

3 - Arabic books and references which are related to the transfer of technology from industrialised countries to developing countries.

4 - English books and references.

5 - Heavy emphasis was placed on the analysis and study of official statistics which present evidence of original investigations.

Personal Interviews

These included both structured and unstructured interviews with Managers, Engineers, Directors and Local Managers who are involved in supplying technology (products and services) to Oman. Government companies as recipients of technology were also included.

Government agencies, Sultan Qaboos University and the Scientific Research were considered as additional sources for gathering information. Despite the problems of systematising information derived from open discussions, data collected through personal interviews is subject to bias derived from the investigator and subjects, related to personalities, attitudes and expectations (Peter, M. Chisnall, P. 1981, p. 216).

Postal Questionnaires

The use of postal questionnaires to gather amounts of data statistically sampled from a given population is now widely accepted in Social Science research. Postal questionnaires can produce large samples at quite a low cost. Since cost is a consideration in all surveys, postal questionnaires are often the most practical way of collecting large samples and thus of minimising sampling error and enabling meaningful analysis.

Poor response rates and consequent bias are often mentioned as insurmountable problems that make postal surveys impractical. However, this need not be so. Using proper procedures postal surveys can produce very acceptable response rated for a range of topics (Devavs, D. 1986 p. 66).

9.10 CONCLUSIONS

Research methodology is an important ingredient in understanding surveys. It explains in a systematic fashion how the entire survey process is carried out. It is the link between literature review and field research.

The survey method is one of the most important data collection methods in the social sciences, and as such it is used extensively to collect information on numerous subjects of research. In recent years, with the public demands for government accountability, there has been an increased emphasis on survey instruments.

QUESTIONNAIRE

QUESTIONNAIRE

Below is the questionnaire which was sent to the firms which had been selected for the investigations, and which were also asked during the visits and meetings with personnel of the selected firms.

PART I : General Information Project No. ( )

1 - Firm name : . . . .

. . . .

. . . .

2 - Year of establishment : . . . .

. . . .

. . . .

3 - Type of ownership : . . . .

. . . .

. . . .

PART II : Information regarding the most important technological project which has been accomplished the last ten years (1980-90).

4 - Name(s) of person(s) filling the questionnaire : . .

. . . .

. . . .

5 - Your title : . . . .

. . . .

. . . .

6 - Name and purpose of executing this project : . . . .

. . . .

. . . .

7 - Name(s) and nationality(ies) of the company(ies) that conducted the execution of the projects : . . .

. . . .

. . . .

8 - Total value of the project : . . . .

. . . .

. . . .

9 - Allocation of the cost in terms of :

- Consulting and feasibility study : . . . .

. . . .

- Machines and equipment : . . . .

. . . .

- Construction and commissioning : . . . .

. . . .

- Training : . . . .

. . . .

- Employees, expertise requirement : . . . .

. . . .

- Maintenance : . . . .

. . . .

- Others : . . . .

. . . .

10 - Time taken to complete the project in terms of :

- Feasibility study : . . . .

. . . .

- Installation : . . . .

. . . .

- Negotiation : . . . .

. . . .

- Commissioning : . . . .

. . . .

- Others : . . . .

. . . .

11 - Source of technology : **Please tick**

- Consultancy	( )
- Training	( )
- Machines and equipment	( )
- Manpower	( )

- Others : . . . .

. . . .

12 - Production capacity : **Please state**

The planned capacity for this project : . . . .

. . . .

The actual capacity : . . . .

. . . .

Reasons in case of difference : . . . .

. . . .

13 - Did this project need new skills?

Yes (   ) No (   )

If yes, please give examples : . . . .

. . . .

14 - Did the technology used for this project caused the following problems :

	Yes	No
- Environmental	( )	( )
- Health	( )	( )
- social	( )	( )
- Technical	( )	( )
- Marketing	( )	( )

- Others : . . . .

. . . .

If yes, please give example : . . . .

. . . .

PART III : <u>Technological Selection</u>

15 - Which of the following sources of information have been used for this project?

(please rate from 1-5)

- periodicals (   )
- Catalogues (   )
- Consulting (   )
- Visiting exhibitions (   )
- Others : . . . .

. . . .

16 - Technology for this project has been selected by :

Please tick

- Chairman of the firm ( )
- Consulting foreign companies ( )
- Consulting national companies ( )
- Others : . . . .

. . . .

17 - Which of the following criteria were considered in the selection of technology for this project? Please tick according to their importance

	V. Imp.	Imp.	Not Imp.
- Economical conditions	( )	( )	( )
- Contract condition	( )	( )	( )
- Mode of payment and facilities	( )	( )	( )
- Complexity of the technology	( )	( )	( )
- Reputation of the supplier	( )	( )	( )
- Latest and proven technology	( )	( )	( )

- Others : . . . .

. . . .

18 - Design of the plant is formed by: Please tick

- The firm acquiring the technology ( )
- National institutions ( )
- Foreign consulting companies ( )
- Others : . . . .

. . . .

19 - Which of the following methods of transfer of technology were used to complete this project?

Please indicate your preference according to their importance

	V. Imp.	Imp.	Not Imp.
- Personal contact	( )	( )	( )
- Machinery supply	( )	( )	( )
- Educational courses (theory)	( )	( )	( )
- Training programmes (theory and practical)	( )	( )	( )
- Know-how license agreement	( )	( )	( )
- Turnkey project	( )	( )	( )
- Direct foreign investment	( )	( )	( )
- Employment of foreign experts	( )	( )	( )

- Others : . . . .

20 - Is there any article in the agreement which obligates the supplier to provide the following:

	Yes	No
- Educational courses (theory)	( )	( )
- Training courses(theory & practical)	( )	( )
- Local participation in R & D	( )	( )
- Local participation in design & construction	( )	( )
- Local participation in management	( )	( )

- Others : . . . .

. . . .

21 - Would you consider the competition condition of the agreement in all its stages as :

	Yes	No
- Monopoly	( )	( )
- Low competition	( )	( )
- Regular	( )	( )
- High	( )	( )

22 - Did the agreement restrict the use of :

	Yes	No
- Local natural resources	( )	( )
- Outside natural resources	( )	( )
- Local machines and equipment	( )	( )
- Outside machines and equipment	( )	( )
- Development of equipment and machines	( )	( )
- Local manpower	( )	( )

- Others : . . . .

23 - Does the technology utilised in this project achieve the following :

	Yes	No
- More profit	( )	( )
- Reduction in dependence on foreign expert	( )	( )
- Optimal use of local natural resources	( )	( )
- reduced dependence on foreign technology	( )	( )

- Others : . . . .

24 - Would you please indicate the rate of local participation in completing this project in terms of : Please tick according to their rate

	High	Medium	Low
- Design	( )	( )	( )
- Construction	( )	( )	( )
- Installation	( )	( )	( )
- Principal services	( )	( )	( )
- Supervision on operation	( )	( )	( )
- Testing and inspection	( )	( )	( )
- Research and development	( )	( )	( )

- Others : . . . .

. . . .

25 - Has your firm faced any problems in terms of productions and operations?

Yes ( ) No ( )

If yes, please give example : . . . .

. . . .

PART IV : Technology Modification

26 - Please state whether there has been any modifications of the imported technology?

Yes ( ) No ( )

If yes, please give example and indicate the source responsible : . . . .

. . . .

. . . .

27 - Did your firm experience difficulty with Government sectors in the acquiring of technology:

Yes ( ) No ( )

If yes, please give example : . . . .

. . . .

28 - Do you have a Research and Development department?

Yes ( ) No ( )

If yes, is there any relation between your R & D Dept.

Yes ( ) No ( )

29 - Did the educational institutions such Sultan Qaboos University, and faculty of technology participate in completing this project?

Yes ( ) No ( )

If yes, please give example : . . . .

. . . .

If no, please state the reasons for not consulting them : . . . .

. . . .

FINAL COMMENTS

Can you please give here any comments, ideas, or suggestions that you feel may be relevant to this study? . . . .

Thank you for your co-operation

QUESTIONNAIRE

(in Arabic)

بسم الله الرحمن الرحيم

المقدمة :

يهتم هذا الاستبيان بدراسة وتحليل القنوات التى من خلالها تنتقل التكنولوجيا الى سلطنة عمان ومدى تأثير هذه التكنولوجيا على تنمية الموارد المحلية (**الموارد الخام - معاهد علمية وطنية - أيدى عامله ....الخ) .**

تتناول هذه الدراسة عدة جوانب ، تهدف من خلالها الى تسهيل المشاكل والصعوبات التى تعرقل مسيرة نقل التكنولوجيا ومدى اعتماد سلطنة عمان على استيراد التكنولوجيا الخارجية .

(الأستبيان)

أدناه الاستبيان الذى سوف يوزع على المؤسسات التى أختيرت للتقصي والتى سوف تخضع ومظفوها لبعض الأسئلة أثناء الزيارات .

الجزء الأول : - معلومات عامة   مشروع رقم (   )

١) أسم المنشأة :________________
٢) العام الذى أسست فيه :________________
٣) نوع الملكية :________________

الجزء الثانى : معلومات تتعلق بأهم المشروعات التكنولوجية التى أقيمت فى العشر سنوات الأخيرة (١٩٨٠ - ١٩٩٠) .

٤) أسم (**أسماء**) الشخص (**الأشخاص**) الذى يجيب على هذا الاستبيان :
٥) الوظيفة :________________
٦) الأسم والغرض من انجاز هذا المشروع :________________
٧) أسم (**أسماء**) وجنسية (**جنسيات**) الشركة (**الشركات**) التى انجزت المشروع :________________

____

٨) القيمة الكلية للمشروع :________________
٩) تخصيص التكلفة على ضوء :________________

- الاستشارة ودراسة الجدوى :________________
- الماكينات والأدوات :________________
- التشييد و التشغيل :________________
- التدريب :________________
- الموظفون ، متطلبات الخبرة :________________
- الصيانة :________________
- أشياء أخرى :________________

____

____

____

١٠) الزمن الذى أخذه انجاز المشروع على ضوء :

- دراسة الجدوى :______________________________
- التركيب :______________________________
- المباحثات :______________________________
- التوريد :______________________________
- أشياء آخرى :______________________________

١١) مصادر المدخلات التكنولوجية : " أرجو وضع علامة ( ) "

- أعمال الخبره والاستشارة. ( )
- التدريب . ( )
- الماكينات والأدوات . ( )
- العمالة . ( )
- اشياء آخرى . ______________________________

____

____

١٢) حجم الأنتاج : (أرجو تحديده) .

- سعة الأنتاج المخطط له هذا المشروع :______________________________
- السعة الحقيقية :______________________________
- الأسباب فى حالة حدوث فروقات :______________________________

١٣) هل يحتاج هذا المشروع الى مهارة جديدة ؟ نعم ( ) لا ( ) اذا كانت الاجابة بنعم أرجو اعطاء بعض الأمثلة .

____

____

____

١٤) هل تسببت تكنولوجيا بناء هذا المشروع فى المشكلات التالية :

	نعم	لا
- بيئية	( )	( )
- صحية	( )	( )
- اجتماعية	( )	( )

- فنية	( )	( )
- تسويق	( )	( )
- مشكلات آخرى	( )	( )

اذا كانت الاجابة بـ " نعم " أرجو أن تعطى أمثلة على ذلك ؟

____

____

____

الجزء الثالث : الأختبار التكنولوجي .

١٥) أى مصادر المعلومات التالية كانت تستعمل لهذا المشروع ؟ " أرجو أن ترقم حسب الأهميـة من (١) الى (٥) "

المصـــدر	الأهمية النسبية من (١) الى (٥)
- نشرة دورية :	( )
- كتالوجات (قوائم مبوبة):	( )
- استشاريون :	( )
- زيارة المعارض :	( )
- مصادر آخرى :	( )

١٦) اختيرت تكنولوجيا هذا المشروع بواسطة : " الرجاء وضع علامة ( ) "

- رئيس المؤسسة :	( )
- شركات استشارية أجنبية :	( )
- شركات استشارية وطنية :	( )
- جهات آخرى :	( )

١٧) أى المعايير التالية كانت قد وضعت فى الاعتبار حين أختيار تكنولوجيا هذا المشـروع ؟ " أرجو أن تضع علامة ( ) وفقا لأهمية كل من تلك المعايير ؟

	مهم جدا	مهم	غير ذى أهمية
- الشروط الأقتصادية .	( )	( )	( )
- شروط التعاقد .	( )	( )	( )
- طريقة الدفع والتسهيلات .	( )	( )	( )

- شهره المورد وسمعته .	( )	( )	( )
- حداثه التكنولوجيا المستخدمة	( )	( )	( )
- أشياء آخرى .	( )	( )	( )

١٨) قام بتصميم المشروع : " ضع علامة ( ) "

- المشروع الذى بحوزته تلك التكنولوجيا .	( )
- مؤسسات وطنية .	( )
- شركات اسشارية اجنبية.	( )
- جهات آخرى .	( )

١٩) أى الطرق التالية فى تزويد التكنولوجيا كانت مستعمله لاكمال بناء هذا المشروع ؟ " أرجو أن تذكر الجهة المقصوده وفقا لاهميتها ؟

	مهم جدا	مهم	غير ذي أهمية
- اتصال شخصى	( )	( )	( )
- تزويد عن طريق الماكينات	( )	( )	( )
- دورات تعليمية (نظرية)	( )	( )	( )
- برامج تدريبية (نظرية وعملية)	( )	( )	( )
- عقود المنتج باليد	( )	( )	( )
- عقود تسليم المفتاح	( )	( )	( )
- استثمار اجنبى مباشر	( )	( )	( )
- توظيف خبراء اجانب	( )	( )	( )
- طرق ووسائل آخرى	( )	( )	( )

٢٠) هل هناك أى بند فى الاتفاق يلزم الممول بتوفير الآتى : -

	نعم	لا
- فترات دراسية (نظرية)	( )	( )
- فترات تدريب (نظرى وعملى)	( )	( )
- مشاركة الكوادر المحلية فى عملية البحث والتنمية	( )	( )
- مشاركة الكوادر المحلية فى عملية التصميم والبناء	( )	( )

- أشياء أخرى . ____

____

____

____

٢١) هل كانت درجة التنافس (لهذا المشروع) فى مختلف نوعيات التعاقد ذو طابع :

	نعم	لا
- الاحتكار	( )	( )
- منافسة ضعيفة	( )	( )
- عادية	( )	( )
- عالية	( )	( )

٢٢) هل يشدد الاتفاق فى استعمال ؟

	نعم	لا
- الموارد الطبيعية المحلية	( )	( )
- الموارد الطبيعة الخارجية	( )	( )
- الماكينات والادوات المحلية	( )	( )
- الماكينات والادوات الخارجية	( )	( )
- تطوير الماكينات والادوات المنتجه	( )	( )
- العمالة المحلية	( )	( )

- أشياء أخرى . ____

____

____

٢٣) هل نجحت التكنولوجيا التى وظفت فى هذا المشروع فى الحصول على : -

	نعم	لا
- ربح أوفر	( )	( )
- تقليل الاعتماد على العمالة الاجنبية	( )	( )
- استغلال المواد الخام المحلية	( )	( )
- تقليل الاعتماد على التكنولوجيا الاجنبية .	( )	( )

أشياء أخرى : ____

____

____

٢٤) هل بامكانك لو تسمح ذكر معدل المساهمة المحلية فى اكمال هذا المشروع على ضوء " أرجو وضع علامة (   ) وفقا للنسبة أو المعدل لكل "

	عال	متوسط	متدني
- التصميم	( )	( )	( )
- الأنشاء	( )	( )	( )
- التركيب	( )	( )	( )
- الخدمات الأساسية	( )	( )	( )
- الاشراف على التشغيل	( )	( )	( )
- الاختبار والتفتيش	( )	( )	( )
- البحث والتطوير:	( )	( )	( )
- أشياء آخرى : -			

٢٥) هل واجه مشروعك أى صعوبات من حيث الأنتاج والتشغيل (نعم) ، (لا) ، اذا كانت الاجابة بنعم ، أرجو ذكر الأسباب ؟

____

____

____

____

الجزء الرابع : تعديلات تكنولوجية .

٢٦) أرجو تبيان ما اذا كان هنالك اى تعديلات قد أجريت على التكنولوجيا المستورده ؟ اذا كانت الاجابة بـ " نعم " أرجو أن تذكر الأسباب مع الاشارة الى سبب ذلك : -

____

____

____

٢٧) هل خاض مشروعك أى تجربة صعبة مع القطاعات الحكومية فى حصوله علىالتكنولوجيا ؟ (نعم) ، (لا) ، اذا كانت الاجابة بـ " نعم " الرجاء ذكر الأسباب :-

____

____

____

____

٢٨) هل لديك قسم للبحوث والتنمية ؟(نعم) (لا) اذا كانت الاجابة بـ " نعم " هل هنالك أي علاقة بين هذين القسمين (نعم) ، (لا) ؟

٢٩) هل شاركت المؤسسات التعليمية مثل جامعة السلطان قابوس والمعاهد العلمية الوطنية فى اكمال هذا المشروع ؟ (نعم) ، (لا) اذا كانت الاجابة بـ " نعم " أرجو ذكرالأسباب ؟

واذا كانت الاجابة بـ" لا " الرجاء أن تذكر الأسباب لعدم استشارتك لهم :

تعليمات وملاحظات أخيره :-

هل بامكانك - لو تسمح - أن تذكر هنا أى تعليقات أو آراء أو اسئلة أو أن تشير اقتراحات تشعر أنها ذات علاقة بهذ الدراسة ؟

لك الشكر على تكرمك بالتعاون معنا ،،،

CHAPTER 10

RESEARCH FINDINGS AND DISCUSSION OF RESULTS

CHAPTER 10

RESEARCH FINDINGS AND DISCUSSION OF RESULTS

CHAPTER 10

RESEARCH FINDINGS AND DISCUSSION OF RESULTS

10.1 INTRODUCTION

This chapter is concerned with an analysis of the contractual agreement between the foreign firms which supplied technology, and the recipient Omani firms which made use of it. Among the Omani recipients were the Rusayl Industrial Estate, the Ministry of Electricity and Water (M. E & W), and the Petroleum Development of Oman (P.D.O.). The impact of the procedures used for importation on the advancement and reinforcement of indigenous capabilities is also discussed.

The chapter consists of three parts. The first part discusses the research findings from the recipients point of view. The initial questions asked were mainly to solicit general information from the respondents. The majority of the questions were then designed to probe the important issues relating to technology transfer in detail. A number of issues are then discussed in detail covering the hypotheses. The second part is a detailed evaluation of the research hypothesis, in the light of the theoretical and empirical data which has been gathered from this study. In the third and final part of the chapter conclusions are drawn.

Information about the Recipients of Technology

The Rusayl Industrial Estate (RIE) was established in 1983 by Royal Decree No. 51/83, with the aim of promoting industry in Oman using local companies and an Omani workforce. The Ministry of Electricity and Water (M. E & W) is a government owned utility which provides electricity and water for domestic and industrial use. The Petroleum Development of Oman (P.D.O.) is a 60% government owned company. Its main activities include: exploration, onshore and offshore surveys, test well drilling, the development of producing oil fields, and the exploratory drilling for and production of crude oil, natural gas and hydrocarbons in Oman.

The Contractual Agreement for the Transfer of Technology

All contractual agreements for the transfer of technology to Oman take place within the framework of Omani Law No. 26 of 1977. All government purchases and contracts pass through the central Tenders Committee. Where relevant pre-qualification is required to show evidence that the supplier company is capable of undertaking the execution of the project.

In almost all of the project agreement selected for study here, the foreign supplier was responsible either directly or indirectly (i.e., as a contractor) for providing technology in the form of a turnkey project. The foreign supplier provided a feasibility study, machines and equipment, installation and commissioning, training , employment of foreign experts, and maintenance services.

The Supplier's Nationality

Several foreign companies were involved in the execution of the projects. They were:

a - Enkotec A. S. (Denmark).

b - Toyo (Japan).

c - Standard Telecommunication Co. (U.K.).

d - W. J. Towell (Norway).

e - JGC Corporation (Japan).

f - Johnson Controls Inc. (U.S.A).

g - Mitsubishi Heavy Industry Co. (Japan).

h - MODO Converting Company (Sweden).

i - D.M.J.M. International Consultant (Italy).

j - Chiyoda Corporation (Japan).

k - Feef Keal Babkook Company (France).

l - Switonro Heavy Industry (Japan).

m - Deylem Industry Company (South Korea).

n - URO Technical (Italy).

o - Hitachi Zosen (Japan).

p - Shampersher Word-Wide Company (France).

The developed countries continue to be the major source of Oman's imports. Japan for instance has maintained its position as Oman's most important supplier with 15.7% of the market during 1989. In the same year, imports from the United Kingdom established it in the second place, with 11.7% of the market share, while the USA was in the third place with 8.4% (Directorate General of National Statistics, 1989, p. 374).

Statistical Year Book of Oman data for 1987 shows that Western Europe was the major source of imports, accounting for 39%. Asia was second with 25%, and the Middle East contributed a third with 24% of the total (Directorate General of National Statistics, 1989, p. 375).

The purpose and Cost of the Projects

Table 10.1, at the end of the chapter, shows the purpose of the projects and their value. Fifty-three projects were selected from the Rusayl Industrial Estate (RIE), fifteen from the Ministry of Electricity and Water (M. E & W) and twelve from Petroleum Development of Oman (P.D.O.). The majority of the technology involved was sophisticated and very high cost.

The sample covers many scales of technology transfer with a range of OR 208,000 to OR 12,429,000, and a Median of OR 880,000.

NOTE : One Omani Rial, OR = $2.45 approximately.

<u>The Cost Distribution of the Projects</u>

In the questionnaire the managers were asked to indicate the cost of the projects, and the cost distribution in terms of the following:

(a) Feasibility study

(b) Import of Machines and Equipment

(c) Installation and Commissioning

(d) Training

(e) Employing Experts

(f) Maintenance

Table 10.2 indicates that the cost of feasibility studies ranged from 2% to 10% of the actual total cost of the projects. The questionnaire also revealed the lack of local participation in recipient organisations in the carrying out of the feasibility studies. It was also discovered that the educational institutions in Oman were not involved in any of the stages of execution of the projects. The recipient organisations were found to be heavily reliant on foreign firms for the conduct of the feasibility studies, rather than consulting indigenous firms. This will hinder the development of local capabilities and thus accelerate the degree of dependence on foreign sources.

The cost of the imported machinery and equipment was very high, and accounted for between 50% and 71% of the actual total cost of the projects. The abundance of capital and the lack of skilled Omani manpower place Oman in a special socioeconomic status that is different from other developing nations. Where labour intensive technology is appropriate for certain developing countries (e.g. India, Egypt, etc.), it is indeed not suitable for Oman. As a result, Oman seeks technology with high capital intensity that is highly priced. The cost of acquiring technology is not as critical issue for Oman as it is in most other developing countries. In fact, Oman's aim in acquiring technology was found to be mainly directed towards sustaining its economy. Little attention was paid to the development of indigenous technical and managerial capabilities.

The cost of installation and commissioning was also found to be high. This fact reflects the lack of indigenous qualified scientists, engineers, middle-level technicians, and skilled workers, able to unpackage the imported technology. Even though Sultan Qaboos University has a College of Science, and a College of Engineering, they do not participate in the selection, unpackaging and adaptation of the technology. In fact, their role in supplying the country with trained skilled manpower is not very effective.

In terms of training and the collaboration of funds, only 43 projects out of 80 considered provided training programmes for their employees, and allocated only between 1% to 3% of the total cost for training. Despite the sophisticated nature of the technology involved, the recipient decision-makers ignored the importance of training in enhancing the individual's knowledge and ability in mastering the technology.

As Table 10.2 indicates, employing foreign experts was also considered by recipients. The employment of foreign experts is an essential mechanism of technology transfer. Their effectiveness in building and developing local manpower depends on whether they are left to work alone, or whether they work with local manpower.

Due to the shortage of skilled manpower and the sophistication of the technology, recipient always allocate a certain amount to cover maintenance. It was found that firms in Oman depend mostly on suppliers for providing maintenance for the technology whenever requested.

The Period of the Contractual Agreement

Respondents were asked about the amount of time spent on conducting the following aspects of the projects:

(a) Feasibility study.

(b) Negotiation.

(c) The import of machinery and equipment, and its installation.

(d) Commissioning.

The duration of the contractual agreement is a significant element in the process of technology transfer, in the sense that the recipient firm might receive outdated and antiquated technology if the duration is too long.

It has been found from the results of the questionnaire that the time between the negotiation for the purchase of the technology (e.g. a turnkey project), and the commissioning of the project itself, takes around 45 months on average. In the best case, only 32 months are likely to have elapsed. Fifty percent of the cases are commissioned within 3 years and 9 months (45 months) from start to finish. However, one can argue that in the worst 25% of instances there is a chance that some technologies may be obsolete by the time they are commissioned for use more than five years later.

Source of Technology

An attempt was made in the questionnaire to study the source of the technology used in the projects. Several options were provided, and the respondents were asked to state which of the following involved the use of local resources, or were acquired from abroad:

(a) The feasibility study

(b) The machines and equipment

(c) The training

(d) The manpower

None of the projects used any local participation in a feasibility study. The recipients in Oman ignored the participation of local consultancy services in the feasibility studies, and relied totally on foreign firms. There was no involvement of indigenous institutions, such as Sultan Qaboos University. It is through local participation in the process of technology transfer that indigenous capabilities can be strengthened. The greater the local involvement in the design, planning construction and implementation of projects, the more rapid is the enhancement of local manpower. On the other hand, the less the participation of local manpower in the conduct and implementation of projects, the less likely is the development of indigenous personnel. The consequence is that the country will remain dependent on foreign manpower for the management of the acquired technology. In a similar vein, all of the machinery and equipment required for the projects was also imported.

In fifty of the projects, which represent 62% of the total number of projects investigated, local manpower was utilised, but large proportion of the total manpower was of foreign nationality, and mainly from India and Pakistan. Omani manpower contributed only 21% to 26% of the total. This means that, on the whole, the local participation is only 15% of the total manpower of the projects investigated.

The fact that the country lacks Omani skilled manpower in almost every field encourages firms in Oman to seek help from other sources to maintain and sustain economic development. Despite the existence of local training institutions in the country, training was offered mostly by foreign rather than local companies (see Table 10.3). A stronger linkage between the recipient sectors and the indigenous training institutions is highly recommended.

Technological Complexity

When asked whether the technology involved in the eighty projects selected, required new skills to cope with complex technology, 86% of the total (69 projects) admitted that they had to seek trained manpower from outside Oman. Due to the fact that Oman lacks skilled manpower able to operate and maintain the acquired technology, Omani firms sought foreign expertise in order to provide services and to solve existing problems.

The Side Effects of Using Technology

An attempt was made to discover whether the imported technology caused any environmental, health, social, technical, or marketing problems. None of the eighty projects was faced with health and social problems. Only in 22 projects did executives report having encountered environmental problems such as, for example, pollution (27%). Seventeen projects encountered technical problems (21%), and only in nine projects was a marketing problem experienced (11%).

The Sources of Information Regarding the Prospective Suppliers

An attempt was made to study the importance of the sources of information contributing to the firms search for a prospective supplier. The following sources were included:

a - Periodicals

b - Catalogues

c - Consultants

d - Exhibitions

Each was ranked from "very important" to "least important". Exhibitions and consultants were found to be very important sources of information by most firms, at 75.8% and 48.7% of the total number of firms respectively. On the other hand, periodicals and catalogues were held to be very important by only 11.2%

and 5.2% of the total number of firms respectively (see Table 10.4).

Technological Selection

In most cases (5.5% of the total of projects), the firm's chairman was the person in charge of making the final decision on the selection of technology. In addition, foreign rather than local consultants were preferred in the selection of technology (45% and 15% respectively).

The lack of an inter-link, and trust, between the recipients of technology and local consultants accelerate the rate of dependence on foreign consultants.

To promote the effective transfer of technology, the import of technology from foreign sources and the building up of an internal scientific and technological base must complement one another.

The Criteria Used for the Selection of the Technology

Six criteria were provided and respondents asked to rank them from "very important" to "least important". They are:

a - Economic Considerations.

b - Contract Conditions.

c - Mode of Payment and Facilities.

d - Complexity of the Technology.

e - Supplier Reputation.

f - Latest and Proven Technology.

In all of the projects, both economic considerations and "latest technology" were considered to be the least important (100%), while contract conditions and supplier reputation each received a 62% vote for "very important". As the above findings indicate, Omani firms try to acquire the latest available technology in the market which at the same time is proven to be economic in use. Surprisingly, only 30% of the selected projects considered the technological complexity as a "very important" factor in the selection of the technology. The point that arises here is that recipient firms depend upon acquiring technology through turnkey projects under which a supplier of equipment undertakes to provide the full range of technical and managerial operations required to establish a certain firm. Thus, whether the technology is complex or not affects them little. In any case, foreign firms would provide short training programmes concerning operation and maintenance, even though they would ignore participation during the early stages of design and construction. It can be seen, however, that expenditure on training is typically a very small part of the value of turnkey projects.

The Design of the Plant

In the majority of the agreements, 58%, plant design and negotiation was done within the firm. In addition, as in the selection of technology, recipient firms preferred to consult foreign rather than local consultants (58% and 25% respectively).

The Types of Technology Transferred to Oman

The types of technology transferred to Oman, from industrialised countries, were categorised into two broad headings:

a - Established Technology

b - Sophisticated Technology

Established Technology

Established technology is defined as that which has been imported into Oman, tested and found reliable.
This includes:

a - Drilling and exploitation equipment.

b - Pumping equipment.

c - Flashing light equipment.

Sophisticated Technology

This is the newest or latest complex technology imported into Oman from industrialised countries. It includes:

a - Underground Water Storages.

b - Metering equipment.

c - Computer equipment, Agricultural equipment (e.g., combined harvesters).

d - Hospital equipment (e.g., sophisticated X-Ray hardware).

It was found that the programmes arranged with equipment firms were ill-planned. The training was not carried out in sufficient depth to provide the necessary skills required to cope with the technical complexities of the imported machines. The technology purchased ought to fit Oman's national resources and needs, and should be capital intensive. Appropriate technology ought to to be selected, and should be in line with the environmental setting of Oman.

Training

Training as a vehicle for the transfer of technology has received considerable treatment in the literature, (UNCTAD, 1978, p. 17; Chudson, W., 1977, p. 41; UNCTAD, 1984, p. 18; Quinn, B., 1969, p. 86).

Education, including training and practical experience, is one of the most effective means of transferring technology. Ways abound through which individuals can receive education, training and practical experience. Among them are:

a - Formal in-house training programmes.

b - Training programmes overseas.

c - In-plant courses.

d - On-the-job training.

e - Literature (e.g., books, journals, etc.)

Training arrangements are usually drawn up by both parties. However, some of the contractual clauses governing training programmes between Omani recipients and the providers of technology were found to be too vague.

The Oil Sector Training Programme

In this example, the agreement stipulated that the supplier would assist the oil sector personnel in operating and maintaining the equipment. The agreement covering this did not indicate the type of training activities, or the category of the personnel which should take part in the training.

A project engineer at Petroleum Development of Oman (P.D.O.) confirmed to the author in a personal interview that:

> "Most of the projects executed in our premises are through turnkey projects. The supplier, through the contractor, would arrange a short training programme to teach us how to operate and maintain the plant. We do have our own experts who are familiar with such technology to provide services when needed."

In fact, in the P.D.O., additional training programmes were found to be provided by the Department of Manpower Planning and Development, who arranged them in several fields. It was also discovered that the recipient firms in Oman (RIE, M. E & W, P.D.O.), often entered into technical agreements with suppliers for periods of about four years, to solve existing technical problems, without recourse to training.

Training Arrangements in the Case Study Firms

In the cases investigated, training appeared to have been neglected by the Omani personnel. Most technology was transferred by the supply of machinery, and an absence of know-how was noticeable. Indeed, one Omani director seemed to perceive technology transfer as posting literature (manuals, catalogues, etc.) with hardware, from the transferor to the transferee. Technology transfer is a complicated process and needs training programmes. Training must be arranged by both the supplier and the receiver, to guarantee an effective transfer, as well as the successful absorption and adaptation of the relevant technology.

Training appears to be neglected by the receiving firms in Oman. They do not consider training to be an essential factor in the development of the local technological capabilities. Most recipients were found to depend on foreign sources to execute the whole project, as well as to provide operational and technical services.

It is important to pay adequate attention to training. This can be achieved by ensuring that training requirements are clearly stipulated in an agreement. An agreement should make it categorically clear whether personnel will be trained on the job in Oman, or in the transferor's overseas depot. Training in the areas of design and engineering services, construction and safety, and standards should also be included.

The Condition of the Agreements

Executives were asked whether the agreements with the suppliers contained the following articles:

a - The provision of educational courses (theory).

b - The provision of practical courses (theory & practical).

c - The provision for local participation in Research and Development.

d - The provision for local participation in Design and Construction.

e - The provision for local participation in Marketing Know-how.

It is essential for the recipient firms to participate in conducting the above-mentioned elements of technology. However, owing to the methods used for acquiring technology, and the lack of understanding of the benefits to be gained from using the transfer of technology in order to build up and strengthen existing local capacity, recipients did not pay the attention required to such activities while negotiating the conditions of the agreements. The data below highlight and clarify this point. Very few agreements (15%) included the provision of local participation in Research and Development. In addition, local participation in Design and Construction, and Marketing, were only provided in 29% and 9% of the total projects respectively. On the other hand, 85% of the total included the provision of practical courses to local manpower, while 48 % included the provision of educational courses.

The Market Conditions

Only eight of the agreements studied, 10% of the sample, dealt with a monopoly supplier, while the remaining seventy-two described their market status as regular competition.

The Restrictions on the Omani Firm's Activities

To ensure virtual control over recipient firms, supplier firms often impose barriers on a transferee's access to the use of imported technology. These restrictions are often a part of the 'packaged transfer' of technology. They Include:

a - Tying the purchase of imported equipment and spare parts to a particular source.

b - Restrictions such as: a total prohibition on exports, or exports only permitted in certain markets but restricted in others.

c - A demand for high specifications of particular products for export (e.g., quality and price specifications).

d - The delegation to firms of executive rights to handle the export trade.

e - An excessive use of foreign personnel in key technical and managerial positions.

f - The transfer of inappropriate technology and products.

g - The prohibition of competition via the imposition of barriers to entry in the domestic market.

h - A limitation on the diversification of product lines by domestic or local firms.

i - a limitation on local firms being engaged in the production and sale of products other than those covered by the licence.

j - A prohibition on the improvement of acquired foreign technology by the recipient firm. (United Nations, 1972, p. 23; UNIDO, 1977, pp. 61-66; UNCTAD, 1985, pp. 8-10).

However, our study showed that only five out of the eighty projects investigated experienced any of the these restrictions, and they included:

a - The use of local natural resources.

b - The use of other foreign natural resources.

c - The use of local machines and equipment.

d - The use of other foreign machines and equipment.

e - The use of local manpower.

f - Development of machines and equipment.

Other limitations, particularly in turnkey projects, (through which most of the foreign technology were transferred to Oman) included:

a - The minimal involvement of indigenous personnel in the unpackaging of the imported technology.

b - local personnel were ill-equipped to apply and adapt the imported technology.

c - Local personnel were largely dependent on foreign expertise for the modification of the acquired technology.

It is important to recognise that local manpower is often available to cope with some of the technicalities, and that the dependence on foreign technical and managerial know-how is in these case essential.

Technological Impact

The possible impact of using foreign technology on the recipient activities as well as the need to obtain self sufficiency was also considered. Respondents were asked to indicate whether the imported technology helped in achieving the following:

a - An increase in the firm's profit.

b - An increase in the use of local manpower.

c - The optimal use of local natural resources.

d - Decreased dependence on foreign technology.

In almost all the agreements (88%), the imported technology helped to increase the firm's profits and its use of local natural resources. However, dependency on foreign technology and manpower did not seem to be affected. In 69% of the cases it was reported that there was a failure to use local manpower. Only 42% indicated that the imported technology in their projects would help to reduce the dependency on foreign technology. The shortage of qualified manpower, and the type of sophisticated technology used in the projects, made it difficult for local people to absorb technology.

Local Participation

An attempt was made to study the extent of the local participation in the execution of the projects. Seven criteria were listed, and the respondents were asked to tick one or more, as well as rate them. The results were as shown in Table 10.5.

As the figures reveal, the recipients personnel depend entirely upon foreign firms in the execution of the projects, from the early stages to completion. Local participation is almost non-existent, except in the supervision and testing stages and in the provision of electricity, water, etc. The recipient personnel must recognise the importance of participation in every stage of the project. As participation in the construction of the plant, and its commissioning, provides the optimal condition for learning how to use the technology, it is at these stages that local scientific and technological capabilities will be strengthened most effectively. Hence, dependence on foreign technology and manpower will be most easily reduced.

Technical Problems

Of the total sample, 65% reported facing technical problems when they started production. Certain operational problems are generally faced in oil refining plants during startup, which are solved on a case-by-case basis. This figure can be looked upon as unusual.

The Adaptation of Technology

The technologies traditionally imported by developing countries are optimally suited to the factor endowments of the rich exporting countries. Adaptation is the process of matching alien technologies to local factor endowments, social customs ad values, and national development objectives. Adaptation is also the means of linking imported technology with domestic R and D centres. Adaptation is therefore, in that it is consonant with the strengthening of the capacity for effective acquisition and mastery of foreign technology and the building-up of an effective research and development system, an essential element of attempts to foster technological self-reliance (UNIDO, 1981, p. 16).

In our study, respondents were asked whether any modification had been made to the imported technology, and to state the name of the source of the modification. Several source options were provided, among which were: Sultan Qaboos University and Local Consultants. Only in twenty projects (25%) did the respondents indicate that they had modified the imported technology, but without local participation. In all cases foreign sources were used instead.

Effective adaptation requires experienced skilled manpower and strong research and development institutions. However, in Oman the shortage of engineers, technicians and research and development institutions hinders the ability of Omanis to adapt the imported technology to suit local needs.

Obstacles to the Transfer of Technology

Respondents were asked to identify those obstacles responsible for hindering the transfer of technology to their firms. In almost half of the projects, firms experienced difficulties with one or more of the following sectors:

a - The ministry of Commerce and Industry.

b - The Ministry of Electricity and Water.

c - The Ministry of Environment.

d - The Customs Department.

The general view regarding obstacles was that the most were the considerable time spent in customs to complete import certificates, and the delays which occurred with the Ministry of Environment, to gain approval for the project's design. Another obstacle was the lengthy administrative routine needed in the Ministry of Electricity and Water, and in the Ministry of Commerce and Industry. This procedure should be reduced if the full benefits of technology transfer are to be realised.

The Availability of Research and Development.

The role of Research and Development in the process of technology transfer is well-documented in the literature. In Oman, R and D centres have definite objectives. Among them are:

a - To assist in the selection and adaptation of existing technological know-how.

b - To maintain contact with current developments and with local education and research establishments.

c - To complement existing knowledge in potential interest areas (e.g., biological and mineral resources, climatical and soil conditions and social problems) which are peculiar to the Omani environment.

d - To update training programmes for technical staff and their instructors. (Jones, G., 1971, p. 26).

The most important aspect is to encourage and promote the establishment of R and D centres in Omani industry, especially in those sectors vital to oil. respondents were asked to indicate if any relations existed between their R and D, and that of other local an foreign R and D establishments. The results show no existence of any collaboration.

The absence of R and D activities in a developing country tends to perpetuate dependence on supplier companies for technical know-how and manpower. This does not encourage the development of local capabilities, which is what Oman (particularly) badly needs.

An attempt was made for this study to identify the role of local educational institutions, such as Sultan Qaboos University, and the Vocational and Technical Institutions, in the selection and transfer of technology. None of the educational institutions in Oman had helped in selection or in providing consultancy. Network links between those sectors and the educational institutions seems to be lacking. The dependency in those sectors on foreign experts to solve urgent problems, and to provide advice when needed, widens the gap between those sectors and the educational institutions.

Scientific and Technological Information

The effective transfer of technology is also dependent on the extent to which technological information can be effectively communicated to recipient firms. Technological information can be obtained from various sources. Among these are:

a - Literature (e.g., books, journals, etc.);

b - Personal contact (e.g., during conferences);

c - Technical reports;

d - Educational institutions;

e - Training institutions.

In some Arab countries, no serious consideration is given to the importance of technological information in the transfer process.

An effort was made to find out whether or not the recipient firms studied have any form of information centres. The Ministry of Electricity and Water has two libraries, a 'technical' and a 'water resources' library. The former holds specialised scientific and technical information references. The latter keeps materials relating to water resources, civil, electrical and mechanical engineering, and health care. The Petroleum Development of Oman (P.D.O.) also have technical libraries.

Problems Emerging

A number of weaknesses have been identified in the sectors concerned, through a personal interview with the selected recipient firms librarian. They include:

a - Limitations on the flow of scientific information, as well as the capacity to absorb and process the information itself in almost all of the recipient organisation investigated.

b - Lack of inter-link between the existing scientific information centres and other local technological information centres.

c - Inadequate national policy on scientific and technological information.

d - Insufficient data on scientific and technological activities.

e - Lack of funds for the maintenance and day-to-day running of the libraries. Consequently, financial limitations are imposed on the purchase of new books.

f - Shortage of Information Institutes and the attendant professional manpower. Training and education in this area is, therefore, limited.

g - Lack of modern facilities in the libraries.

h - Delays in acquiring the most recent books was a result of a basically weak management procedures.

The Methods of Technology Transfer Used

Developing countries cannot easily industrialise without importing technology from developed countries. At the same time, they run the risk of perpetually depending on foreign technology if they fail to develop their own local capability. The usefulness of and benefits to be gained from imported technology depend on how appropriate the technology selected is and how efficiently it is managed.

As mentioned in the previous chapter, technology can be transferred from one country to another by a variety of methods (see Chapter 4). However, other methods of transfer are:

(a) Consultancy. Examples include engineering consultants who will advise on types of machinery for particular cases. This type of consultancy is mainly carried out in the oil and petrochemical industries.

(b) The supply of machines. This tends to depend on selling through catalogues and manuals, often involving the use of middlemen or contractors. the suppliers also guarantee the provision of spare parts and the maintenance of the machinery for a fixed period of time as stipulated in the agreement.

(c) Educational training. Depending upon the nature of the technology, it is often enriched in the agreement that the supplier should provide workshops, educational courses (e.g., in industrial safety), and training programmes.

(d) Employment of foreign experts. Some technology has been transferred to Oman in this way. These experts have, in a number of cases, developed innovative ideas which have then been shared among local personnel, and in this way Oman has enhanced its local capabilities.

(e) Personal contact. Often Omani personnel (e.g. engineers) are sent abroad on technical missions when they come into contact with both users and suppliers of machinery. During the course of interaction they learn techniques, methods, and strategies, which they apply on their return.

The empirical studies conducted in Oman showed that turnkey agreements and the supply of machinery were the main methods to Oman. The former seems to be the most frequent method.

Under a turnkey agreement, the transfer of technology supplies the technical and managerial know-how required to establish the business. This method, nonetheless, has its problems. For example, although the supplier may provide training and maintenance, the local staff are often not involved in the design, construction and installation stages of the project. Another disadvantage is that the supplier often insists upon supplying the whole package for the project.

One can agree that a transferor of technology who has a monopoly of the package is likely to deny the recipient firm the ability to develop its local capability, thus perpetuating the dependence on foreign technology.

The desire for rapid development by the Middle Eastern oil-producing countries (e.g., Oman) has prompted a preference for turnkey projects, to the neglect of the more traditional methods of technology transfer adopted by other developing countries. The result is that the diffusion of most of the technology imported into Middle East countries is not being accompanied by gradual creation of national scientific and technological capabilities. The main reasons behind this are the relatively small populations, low levels of labour force participation and scarcity of labour and managerial skills (Bamakhramah, A., 1981, p. 226).

The 'turnkey' technique appears now to be giving way to a 'turnkey plus' method. Under this new method, the supplier of the production technology delivers the plant, provides completed personnel to operate the plant profitably, and importantly, also undertakes the vocational training of both the local workforce and management. In summary, this method has the following advantages and disadvantages:

A. Advantages

1 - Timesaving. It takes less time in project execution, provided that the supplier is carefully selected and experienced.

2 - Accessibility. The recipients of the new technology can easily gain access to the source of technology, to solve technical and other allied problems.

B. Disadvantages

1 - A failure to fulfil the recipient's interest in acquiring the software, rather than just the hardware. This situation occurs when the whole package together with its design and operation is installed, but no assistance or information is given about how and why the

plant operates.

2 - A high cost is involved in such a method, because of the imperfect market conditions.

3 - Because environments differ, the recipient's cultural needs may not be incorporated in the original design of the technology.

4 - A total dependence on the foreign technology and foreign manpower will impede on-the-job learning.

5 - Restrictive clauses inherent in contractual agreements inhibit the recipient's freedom to, say, buy materials or components from a source of his own choice. Suppliers often insist that materials must be purchased from them, or from sources recommended by them.

10.2 EVALUATION OF HYPOTHESES

In Chapter 9, five hypotheses were put forward for evaluation, to demonstrate how far Omani technological independence is a function of the development of local capabilities. In the next section, data from the surveys and points raised within this thesis are set against the hypothesis to test their veracity.

Hypothesis 1: That Oman is almost totally dependent on foreign technology.

The transfer of technology to Oman has brought with it enormous changes in terms of industrial development and raised the standard of living.

Oman is almost totally dependent on oil production and exports. Oil is an unrenewable asset and dependence on it therefore puts the country in a weak position. Oil is the lifeline of the Omani economy; oil revenues dominate Oman's economy and social life (see Section 5.3).

Despite the availability of income, there are several factors which handicap the industrial sector. Among these are: the absence of raw materials other than crude oil and natural gas; the absence of a clear development plan for the local economy; the limited size of the domestic market; the lack of skilled technical and managerial manpower; and the high cost of labour.

The inflow of income from oil exports caused rapid and drastic changes in the structure of the Omani economy. The fact that Oman has been able to import technology has led to great changes in the country in terms of industrial development, and an increased standard of living for the citizens.

The economy has grown quickly, and Oman has chosen to import sophisticated modern technology. However, so far the application of this equipment has been disappointing. From the results of this study, the technology imported has proven to be too sophisticated for the local people to use (see above, under Technological Complexity). Although training programmes have been arranged with the supplier companies, they have not been well-specified. As a result, the recipients have been faced with difficulties in managing the imported technology, which forced them to seek assistance from abroad.

Therefore, the country relies on the importation of technology of all kinds - equipment, processes, spare parts, and technical assistance. Oman still remains receiver of expensive total packages of technology, which embrace all facets, from the design stage through installation, operation and maintenance, with little local participation (see above, under Technological Impact).

The Omani total reliance on foreign firms to supply technology manifests itself in the type of methods preferred by Omani personnel to acquire the technology. In most cases, the recipients preferred to acquire their technology through turnkey projects, under which the suppliers carry out the full range of technical and managerial operations required to establish an industry, with little participation of local personnel. In addition to this, in all of the eighty selected in Oman, the recipient firms relied extensively on foreign firms for conducting feasibility studies, and in acquiring machines and equipment.

The dependence of Oman on foreign technology has arisen from many causes, among which is the smallness of the local market, which makes it often uneconomical to create a capital goods industry. In addition, there is an absence of a strong and scientific infrastructure that is able to support the establishment of a capital good industry which forms a further limitation. Therefore, it is fair to say that Oman is almost totally dependent of foreign equipment, machinery, and other forms of physical capital.

Hypothesis 2: That Oman has shortage of manpower and management capabilities, and **Hypothesis 3:** That Oman encounters difficulties related to the difference in the social, cultural, and environmental backgrounds of the foreign technology, are discussed here together.

The transfer of foreign technology to Oman has had its obstacles, which made adoption less than fully successful. Some of the obstacles were internal, while others were external. Among the internal obstacles, the most important has been the shortage of qualified manpower in almost all sectors of the economy. This has been the major constraint in the application of science and technology.

There are two main reasons why Omanis form a low percentage of the workforce. First of all, women are not encouraged to work. Second, a large proportion of the population is under 15 years of age. Oman has come to realise that these young people could provide the answer to future labour requirements if they were properly educated and trained, thus reducing the country's dependence on expatriates.

In an effort to tackle the problem of illiteracy, the Government has shown a complete commitment to the expansion and improvement of local educational facilities. However, in spit of this, illiteracy is still a problem which presents a barrier to economic and social development (see Section 6.2). The shortage of trained manpower constitutes a major constraint in the application of science and technology in almost all sectors of the economy.

Besides illiteracy, there are many problems impeding the development of a skilled Omani workforce. The number of students enrolled in the humanities, for instance, is higher than that in sciences (see Table 6.1). In addition, despite the need for middle level workers, Omani students are reluctant to enrol in vocational and technical institutions (see Table 6.3).

Due to the need to develop rapidly, Oman personnel favoured the import of sophisticated technology, without taking into consideration the lack of skilled manpower required for such technology. This technology has proven to be too complex for the Omanis to understand and adapt to the needs of the country. As a consequence, Omani decision-makers have sought foreign assistance, by employing foreign expertise, or by engaging long term agreements with suppliers to provide technical assistance. This was confirmed by 85% of the projects studied in Oman, in that they actually sought foreign expertise from abroad to manage the acquired technology.

A second obstacle has been the inadequate management of national resources, which has led to an inability to formulate an effective management programme for natural resources, or to utilise scientific techniques to develop a co-ordinated and comprehensive plan to effectively deal with problem areas.

The inadequate dissemination of technological information is a third obstacle. An effective information system is essential in the technology transfer process. It is needed for the appropriate selection of new technologies, which depends on timely information.

Other external obstacles are cultural and social problems. Oman lacks indigenous skilled manpower. Consequently, the majority of the skilled scientific and technical personnel in most of the sectors are immigrant workers. These workers subscribe to different cultures, customs and living habits. The problems of co-ordinating such an assortment of ethnic groups, to achieve a common goal, is indeed a difficult job. This assortment of ethnic groups of technical personnel is not stable. Because of the fast turnover, a high rate of recruitment is necessary to balance the high rate of resignations.

The second external obstacle is the environmental differences. Technological transfer, like other forms of international relations, involves countries with different political and socio-economic settings. However, the countries which provide most of the technology for developing countries, often seek to push them alongside their own way of development. For example, it is often claimed by developed countries that for developing countries to be able to use the imported foreign technologies effectively, they must have the same social and technical conditions as those of the supplier countries. In most cases, this causes problems in developing countries because of the environmental differences.

<u>Hypothesis 4:</u> That Oman should consider some fundamental aspects such as developing local skills and making the appropriate choice of technology.

Whilst many people agree with the fact that adaptation of technology could offer the best transfer mechanism in Oman, a problem remains in the ability to absorb it in the most efficient manner. The difference in environmental, social, economic, and technological capabilities etc., that exist between the donor and the recipient countries often cause barriers and contribute to difficulty in making imported technology appropriate unless certain differences are taken (see sections 7.5 and 7.6).

The major problem facing Oman today is that of absorbing socially appropriate technology. It is necessary to create educational and professional training schemes that will enable the gradual take-over of new technologies by the indigenous workforce. As we have seen in our empirical findings, there is the urgent need to develop the local capabilities aimed at reducing dependence on foreign technologies.

The importance of training as a means for a successful transfer of technology is well-expressed in the literature (see, for instance, WIPO, 1977, p. 80; UNCTAD, 1978, p. 17; UNCTAD, 1984, p. 18; UNCTAD, 1981, p. 38; and Quinn, B., 1969, p. 86). Despite the importance of training, the Omani recipients have neglected to specify in contracts the full details of training programmes, covering their duration, qualification requirements, number of persons, and the period over which foreign experts are to be replaced by local manpower. Even where such training has been specified, local participation was very small.

The value of a new technology does not depend on its economic viability and its technical soundness, but in its ability to fit in the local, social and cultural environments. The contemporary technology is criticised by ignoring the social value in the society. Hence, it is high time that Oman emphasised the need for adopting appropriate technology on the basis of its economic and social needs. The social preferences will help to promote indigenous self-reliance through social participation and control.

In conclusion, it is clear from the literature review and the empirical findings, that the country lacks the Omani skilled manpower able to operate, monitor and adapt the imported technology.

Hypothesis 5: That Oman's technological independence is a function of the development of local capabilities.

Oman depends not only on foreign technology but also, in most cases, on foreign technical, managerial, administrative, and labour manpower. The achievement of its objective to develop its socio-economic structure is being damaged by the imbalance in the distribution of manpower between the indigenous Omanis and the foreign expatriates. Oman has a shortage of local manpower, particularly technical and managerial, while the percentage of local people in the workforce is lower than the percentage of foreign workers. Local Omani consulting and service companies have little investment in the important issues in the process of technology transfer such as the unpackaging of the components of technology transfer.

The non-availability of locally qualified manpower (engineers, technologists, technicians, scientists, managers, and administrators) will result in Oman remaining dependent on foreign manpower for a long time.

10.3 CONCLUSIONS

Technology transfer is a complex process which requires clear definitions from the outset, to ensure that both the seller and purchaser of technology clearly understand its implications, and try to maximise the benefits for both. This means that contractual agreements for technology transfer must be clearly spelled out. They should be simple to understand by the negotiators, because developing countries are sometimes placed at a disadvantage during negotiations, when contractual terms are not clear, and are misunderstood.

In turnkey contracts, the transferor often builds and assembles equipment at the parent company, and simply delivers it to be installed and made ready for operation. Consequently, buyers are often not given an opportunity to learn about the building, assembly and installation of equipment. The transferee has then purchased a closed technological package on "black box" without knowledge of the technical intricacies of what he has bought. The long-term consequences of such a "blind deal" can be great. First, because indigenous personnel have not had the opportunity to develop and improve their skills. Second, the country must continue to rely on their supplier's expertise and manpower to maintain and sustain the imported technology.

The United Nations Advisory Committee on Science and Technology summarised the problems of technology transfer as follows:

> "The problem of transfer as such was a minor one, and the real task was to build science and technology infrastructure without which inefficient use and costly waste would be involved in importing technology. The real bottleneck for the developing countries was not the lack of availability of technology or its costs. It was rather the domestic ability to absorb technology in an efficient manner." (United Nations, 1969).

It is in this area that Oman has the problem. To absorb technology in an efficient manner, effective and well-established information sources are needed to link all of the sectors concerned.

Oman has not wasted any time in acquiring the latest technology in order to build up its infrastructure, and foreign manpower was extensively employed, since local skilled workers were lacking. But attention must now be paid to the development of an indigenous technical and scientific capacity. The import of technology from advanced countries, and the development of a sound indigenous technological infrastructure, must be viewed by Omani decision-makers as complementary to one another.

TABLE 10.1

THE PURPOSE AND COST OF THE PROJECTS

	Purpose of the Project	Total Value OR (Omani Rials)
1	New Equipment for Water Pumps and Engines for Agricultural Sector	1,612,000
2	Manufactures & Suppliers of water heaters	700,000
3	New Production of Tubular Steel beds & other tubular furniture	500,000
4	Recondition Truck & all off-road tyres	800,000
5	Manufactures of foam and bedding products	420,000
6	To build trucks & trailer bodies of all types	900,000
7	New Production Methods for Marble	600,000
8	Computer Stationary Industry	1,775,000
9	New Equipment for steel fabrication	448,000
10	Decorations of villas, Mosques & offices	1,000,000
11	Production of High quality PVC Piping	600,000
12	Manufactures of various types of Fabrics including Polyester, cotton & nylon.	350,000
13	Garment Industry	500,000

Table 10.1 Continued

	Purpose of the Project	Total Value OR (Omani Rials)
14	Manufacturer of high quality Paint & Coating	8,000,000
15	Manufacturing of Disposable diaper & female sanitary napkins	1,150,000
16	Manufactures of Radiators & Tyres	650,000
17	Manufacturer of automotive batteries	1,100,000
18	To make Ready-made Apparels	800,000
19	Manufacturer of chainlink fencing	1,900,000
20	To manufacture Chocolates and Hard Boiled Sweets	250,000
21	Biscuit Industry	1,220,000
22	New Equipment for Packing Food Stuff	1,800,000
23	Tea Industry	3,000,000
24	Manufacture of sprays and Powders for use against household pests	280,000
25	Manufacture of both Ordinary Portland & Sulphate Resisting cement	12,490,000
26	Footwear Industry	350,000
27	Manufacturers of Air-conditioners	250,000
28	Decorative Glass Manufacturing	530,000

Table 10.1 Continued

	Purpose of the Project	Total Value OR (Omani Rials)
29	Garment Manufacture	650,000
30	Manufacturers of insect killer	800,000
31	New Equipment for Producing Leather Footwear	250,000
32	Manufacturers of Marble Slabs & tiles, etc.	900,000
33	Decorative facing stone manufacturing plant	840,000
34	New Equipment for Producing Vegetable Oils & Derivatives	208,000
35	Manufacture of Fibrecement Pipes	630,000
36	Textile Industry	692,000
37	Manufacturers of industrial & decorative paints and varnishes.	500,000
38	Manufacturers of industrial and cooking gases	650,000
39	Manufactures of extruded architectural aluminium profiles	2,300,000
40	New Equipment for modern automatic building material	8,280,000
41	Manufacturers of Detergent Powders & other Cleaning Chemicals	900,000
42	Manufacturer of Lubricants	1,500,000

Table 10.1 Continued

	Purpose of the Project	Total Value OR (Omani Rials)
43	New Production for Marketing Agricultural	850,000
44	Manufacturers of integrated ceiling systems	1,200,000
45	Garments for export	850,000
46	New Motor Spirit facilities	3,200,000
47	New Production of Water Pumps & Engine for Agricultural	750,000
48	Manufacturers of air-conditions & water heaters	3,400,000
49	New Production of Different Types of Furniture	830,000
50	Manufacturers of radiators & water heaters	750,000
51	New Motor Spirit facilities - Rheinformer units	1,400,000
52	Manufacture of Different Types of Tyres	640,000
53	New Production Methods for Different Types of Marble	930,000
54	Manufacture of Different Types of Wires and Cables	1,200,000
55	Manufacture of Different Types of wire nails & steel wires	960,000
56	Manufacturers of wire & welding slings	2,100,000

Table 10.1 Continued

	Purpose of the Project	Total Value OR (Omani Rials)
57	New salt & chlorine Industry	860,000
58	New water storage facilities	1,400,000
59	Expansions in Equipment for New Production Methods	980,000
60	New equipment for water & Salt Separation	2,500,000
61	Manufacturers of Steel Products	980,000
62	Manufacturers & Suppliers of Water Piping	1,400,000
63	New Equipment for Different Types of Wires and Cables	880,000
64	Expansion in Equipment	790,000
65	Manufacture of Different Types of Steel Wires	640,000
66	Manufacturers & Suppliers of cables & wires	630,000
67	Expansion Production of Desalinated Water	780,000
68	Manufacture of Different Types of Steel Wires	1,300,000
69	Steel Industry	2,400,000
70	New Oil Exploitation Methods	890,000
71	New Oil & gas Storage	1,100,000
72	Expansion in Equipment	860,000

Table 10.1 Continued

	Purpose of the Project	Total Value OR (Omani Rials)
73	New Production Methods for Appropriate Energy Consumption	760,000
74	Expansion in Equipment for new production Methods	1,500,000
75	New Equipments for water & salt Separation from Oil	950,000
76	New oil Storage Facilities	560,000
77	Melamine Industry	840,000
78	Installation of New equipment to Facilitate the use of	1,600,000
79	New Equipment for Oil Storage	2,200,000
80	Oil & Gas Storage facilities	3,900,000

Notes:

Project

1 - 53 Concerned Rusayl Industrial Estate (R.I.E).
54 - 68 Concerned Ministry of Electricity and Water (M. E & W).
69 - 80 Concerned Petroleum Development of Oman (P.D.O.).

OR = $2.45 approximately.

TABLE 10.2

PROJECT COST DISTRIBUTION (%)

Company No.	Feasibility Study	Import of Machines and Equipment	Installation and Commissioning	Training	Employing Experts	Maintenance	Total (OR)
1	4	55	34	2	11	8	1,612,000
2	10	60	-	-	-	-	700,000
3	3	70	14	1	3	5	11,500,000
4	2	69	-	3	-	9	800,000
5	-	66	23	-	8	-	420,000
6	3	50	14	2	-	-	900,000
7	8	60	34	1	3	4	600,000
8	5	69	20	-	-	-	1,775,000
9	3	53	13	3	-	9	448,000
10	-	60	19	1	-	-	1,000,000
11	10	67	9	2	3	-	600,000
12	4	51	14	-	-	-	350,000
13	6	60	-	-	7	4	500,000
14	5	65	34	2	-	15	8,000,000
15	4	-	-	-	5	9	1,150,000
16	-	69	-	-	-	7	650,000
17	9	69	14	3	-	6	1,100,000
18	4	-	23	1	5	10	800,000
19	-	70	-	-	7	14	1,900,000
20	8	60	34	2	-	-	250,000
21	3	55	14	1	-	-	1,220,000

Table 10.2 Continued

Company No.	Feasibility Study	Import of Machines and Equipment	Installation and Commissioning	Training	Employing Experts	Maintenance	Total (OR)
22	5	66	20	-	3	-	1,800,000
23	-	60	-	-	-	4	3,000,000
24	10	50	14	3	8	8	280,000
25	6	69	34	2	-	5	12,429,000
26	5	53	14	1	-	-	350,000
27	4	60	-	-	3	9	250,000
28	3	67	19	2	-	-	530,000
29	7	31	13	-	-	4	650,000
30	-	69	-	-	11	-	880,000
31	3	60	-	-	3	8	250,000
32	2	65	9	2	-	-	900,000
33	5	61	-	4	-	5	840,000
34	2	56	33	-	12	3	208,000
35	9	69	15	-	2	7	630,000
36	-	70	-	2	-	-	692,000
37	3	52	14	2	-	7	500,000
38	7	-	34	1	7	2	650,000
39	4	65	23	-	-	-	2,300,000
40	2	69	-	-	2	2	8,280,000
41	6	-	13	3	-	6	900,000
42	8	60	19	-	2	-	1,500,000
43	-	69	20	2	1	3	850,000

Table 10.2 Continued

Company No.	Feasibility Study	Import of Machines and Equipment	Installation and Commissioning	Training	Employing Experts	Maintenance	Total (OR)
44	5	60	34	-	2	5	1,200,000
45	7	53	-	2	1	14	850,000
46	-	67	-	-	3	-	3,200,000
47	4	51	10	-	4	10	750,000
48	5	60	13	1	4	6	3,400,000
49	7	60	15	2	10	7	830,000
50	6	69	22	1	4	13	750,000
51	4	71	33	-	6	-	1,400,000
52	9	55	21	-	3	9	640,000
53	-	60	14	3	-	5	930,000
54	4	53	-	2	-	3	1,200,000
55	2	67	10	1	3	-	960,000
56	6	51	18	-	7	4	2,100,000
57	4	65	-	-	-	6	860,000
58	2	60	14	2	4	3	1,400,000
59	4	52	22	1	-	-	980,000
60	2	69	-	2	2	5	2,500,000
61	5	68	13	1	6	-	980,000
62	3	60	17	-	-	9	1,400,000
63	7	57	-	-	4	5	880,000
64	9	69	18	3	9	7	790,000
65	8	60	9	1	8	13	640,000

Table 10.2 Continued

Company No.	Feasibility Study	Import of Machines and Equipment	Installation and Commissioning	Training	Employing Experts	Maintenance	Total (QR)
66	6	69	31	-	4	4	530,000
67	5	66	23	3	7	-	780,000
68	2	53	-	1	-	5	1,300,000
69	3	50	30	-	3	7	2,400,000
70	5	65	24	2	2	-	890,000
71	7	69	-	-	-	4	1,100,000
72	3	-	29	1	-	5	660,000
73	6	68	-	2	12	-	760,000
74	3	54	20	-	2	-	1,500,000
75	9	60	19	2	-	6	950,000
76	4	67	15	3	-	-	560,000
77	6	55	-	-	-	5	840,000
78	4	69	-	1	4	-	1,600,000
79	3	51	10	-	3	-	2,200,000
80	2	-	11	1	-	9	3,900,000
Means	4.9	61.5	19.7	1.8	4.9	6.7	2,358,400

TABLE 10.3

SOURCES OF TECHNOLOGY

	Source of Technology	Percentage of Participation (%)	
		Foreign	Local
1	Feasibility Study	100	----
2	Machines and Equipment	100	----
3	Training	85	15
4	Manpower	40	60

TABLE 10.4

SOURCES OF INFORMATION REGARDING THE PROSPECTIVE SUPPLIER OF TECHNOLOGY

Source of Information		Percentage of Firms (%)				
		1	2	3	4	5
A	Periodicals	11.2	18.1	40	22	8.7
B	Catalogues	5.2	20	19.8	55	---
C	Consultancy	48.7	12.3	13.2	5.8	20
D	Visiting Exhibitions	75.8	12.2	---	12	---

Importance Rating

1 - Very Important
2 - Important
3 - Of Moderate Importance
4 - Least Important
5 - Not Important

TABLE 10.5

LOCAL PARTICIPATION IN

THE EXECUTION OF OMANI PROJECTS

	Project Execution	Local Participation (%)		
		High	Medium	Low
a	Design	0	55	45
b	Construction	0	30	70
c	Installation	0	33	67
d	Principal Services (Electricity, Water, etc.)	70	19	11
e	Supervision on Operation	85	7	8
f	Testing and Inspection	86	30	2
g	Research and Development	5	33	62

CHAPTER 11

HIGHER EDUCATION INSTITUTIONS AND TRANSFER OF TECHNOLOGY - A FIELD SURVEY IN OMAN

CHAPTER 11

HIGHER EDUCATION INSTITUTIONS AND TRANSFER OF TECHNOLOGY - A FIELD SURVEY IN OMAN

CHAPTER 11

HIGHER EDUCATION INSTITUTIONS AND THE TRANSFER OF TECHNOLOGY - A FIELD SURVEY IN OMAN

11.1 INTRODUCTION

This chapter examines the role of the higher educational institutions in Oman. It is divided into three parts. The first looks at the role of the Higher Educational Institutions in technological transfer. The second examines the role of the Sultan Qaboos University in providing education and training, and in contributing to the technological transfer process in Oman. Part three explores the role of vocational and technical institutions in Oman. The final part draws some conclusions.

11.2 THE ROLE OF THE HIGHER EDUCATIONAL INSTITUTIONS IN THE TECHNOLOGICAL TRANSFER

General Information

Universities and other institutions of higher education have a great role to play in development, especially in Third World countries where shortage of qualified scientists, technologists, engineers, and technicians is considered as one of the most acute problems in the effective application of science and technology. (Jones, G., 1971, p. 31). Higher education should be seen on the one hand as the main vehicle through which to increase new skills and knowledge necessary to assimilate and absorb new technologies, and on the other as a means to create a more suitable environment which will lead to social changes, enhancing the potential of the individual.

Other writers have perceived education as an investment in man, and they have treated it as a form of capital. (See, for instance, Meier, G., 1976, p. 481; Harbinson, F., 1976, p. 531; Schultz, T., 1960, p. 571; and Chamberlain, N., 1967, p. 51). Hawthorne, on the other hand, has viewed education as the essential way in which technological growth can be achieved, by extending the individual's scientific and technological knowledge. He writes:

> "The expansion of scientific knowledge stems not only from extending the individual's understanding of this knowledge but from developing his capabilities and providing the means whereby he can build upon the experiences gained of its application. This is

achieved by investing in education designed to quip the individual to participate meaningfully in the development and use of technology." (Hawthorne, E., 1978, p. 49)

Carter and Williams have written that:
"The supply of people capable of using science and of adding to it by research depends on education and similarly, the supply of people capable of using technology and of adding to it by design and development work depends on education." (Carter, C. and Williams, B., 1964, p. 198).

This led them to the view that research and development grows out of education, that development grows out of research and that innovation grows out of development.

The University is considered as a means for insuring the continuity of modern civilisation by preserving and extending culture, science, and arts and by providing vocational and adult education.

11.3 SULTAN QABOOS UNIVERSITY

Historical Background

Before the establishment of Oman's own university, the Omanis had to use foreign universities. Apart from Jordan, Morocco and Egypt, students seemed to prefer Arab countries, especially Egypt, where educational system in Egypt was similar to that of Oman. This choice was preferred by social science students. Science students preferred to study in the USA, U.K. or France.

Following great strides taken in the creation of schools and the spread of education throughout the country, His Majesty Sultan Qaboos announced, during the 10th National Day Celebrations in 1980, that a University would be established in Oman. The University started with five colleges: education, Islamic studies, medicine, agriculture and engineering. On 20 November 1982 the foundation stone for the University was laid in Al-Khoud, 40 Kilometres from Muscat (Capital of Oman). In the academic year 1986/87, the University received its first intake of students. In November of the same year, His Majesty officially opened the University and announced the addition of an arts college to the five existing colleges. In 1989/90 the first group of students graduated from the colleges of Education, Islamic Studies and Agriculture. (Ministry of Information, 1990, pp. 117-

122).

Table 11.1 illustrates student enrolment in the University through year 1990 to 1991. It shows that students form the highest number in the field of Islamic Studies, 1152 students, followed by the field of Literature, 499 students, the Faculty of Engineering, 426 students, the Faculty of Science, 361 students, the Faculty of Agriculture, 276 students. Omani students are more interested in theoretical, rather than applied science, and the high percentage of females enrolled is significant.

The College of Science

Since its establishment in 1986 the college has offered degrees in Biology, Chemistry, Earth Sciences, Mathematics & Computing, and Physics.

The aims of the college are:

1 - To prepare students for graduation in the individual disciplines within the college.

2 - To be responsible for the basic science training of students of agriculture, medicine, engineering science and science education through the common Foundation

TABLE 11.1

الطلبة العمانيون الدارسون في جامعة السلطان قابوس

Students Studying in Sultan Qaboos University

91 / 1990

Field of Study / Sex	Total الجملة	Fifth الخامسة	Fourth الرابعة	Third الثالثة	Second الثانية	First الأولى	التخصص / الجنس
Literature	499	-	107	119	127	146	الآداب
Male	277	-	54	71	82	70	ذكور
Female	222	-	53	48	45	76	اناث
Islamic Studies	1152	-	225	277	275	375	التربية والعلوم الإسلامية
Male	402	-	103	89	85	125	ذكور
Female	750	-	122	188	190	250	اناث
Agriculture	276	-	72	73	67	64	الزراعة
Male	218	-	64	57	52	45	ذكور
Female	58	-	8	16	15	19	اناث
Medicine	307	47	51	51	75	83	الطب
Male	168	18	32	32	39	47	ذكور
Female	139	29	19	19	36	36	اناث
Science	361	44	73	70	100	74	العلوم
Male	171	24	38	33	46	30	ذكور
Female	190	20	35	37	54	44	اناث
Engineering	426	79	59	91	106	91	الهندسة
Male	373	72	58	79	87	77	ذكور
Female	53	7	1	12	19	14	اناث
Total	3021	170	587	681	750	833	الجملة
Male	1609	114	349	361	391	394	ذكور
Female	1412	56	238	320	359	439	اناث

Source : Directorate General of National Statistics, "Statistical Year Book", 1990, p. 592

Science Course.

3 - To undertake service teaching in mathematics and science for other colleges.

4 - To train student teachers from the college of Education and Islamic Sciences in mathematics and science.

5 - To undertake research projects, especially those relevant to the needs of Oman (Sultan Qaboos University 1988-1990, p. 47).

Despite an urgent need for local scientists and engineers, the number of students enrolled in sciences is not encouraging (see Table 11.2).

An attempt was made by the author to identify the main reasons why large numbers of Omanis prefer to study Humanities (including Literature, Commerce, and Economic and Political Science), in colleges and universities in Arab and Foreign Countries, rather than science subjects. Informal interviews were carried out with 70 students. The results revealed that:

(a) The low percentage of students graduating from the secondary schools with a standard of 75% and above.

TABLE 11.2

STUDENTS STUDYING IN THE COLLEGE OF SCIENCE

YEAR 1990/91

Field of Study	First Year			Second Year			Third Year			Fourth Year			Fifth Year		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
	25	50	75	2	1	3									
Biology				4	17	21	5	25	30	4	11	15	4	9	13
Chemistry				2	8	10	6	16	22	5	8	13	6	18	24
Earth Sciences				12	0	12	11	0	11	10	0	10	14	2	16
Mathematics				3	9	12	15	11	26	6	16	22	6	2	8
Physics				5	3	8	9	2	11	8	2	10	8	4	12
Total	25	50	75	28	38	66	46	54	100	33	37	70	38	35	73
Grand Total													170	214	384

Specialisation in the College of Science starts from Second Year

Source : Sultan Qaboos University.
Unpublished information in Arabic

(b) Omani females do not like to be enrolled in scientific and technical subjects, due to the inappropriateness of the jobs they will handle after graduation (i.e., long hours, and having to work with men).

(c) Scientific and technical subjects are more difficult to follow and the time required for study is long. For instance, the Faculty of Medicine requires 7 years to award a degree; and five years are needed to achieve a degree from the Faculty of Engineering.

(d) There are only marginal differences in the salaries of science and humanities graduates. Most significant, the students' choice of career is greatly influenced by the type of home in which they have been reared, and their background in science is very week due to the educational system offered, especially in the secondary school.

The College of Engineering

In 1986 the College of Engineering was established with four departments: Civil Engineering, Electrical and Electronic Engineering, Mechanical Engineering and Petroleum and Mining Engineering.

The aims of the College of Engineering may be summarised as follows:

(1) Provide a basic education in the field of applied sciences and the processing of natural resources taking into consideration the needs of Oman's society with the objective of producing competent engineering graduates who will contribute towards the development of their society.

(2) Prepare project and research topics which are related to the technological developments in Oman and provide those working in the industrial sector with the research results so that they may use these results to further the economical and sociological development of the country.

(3) Widen the horizons in the use of modern technology and its application to agriculture through a programme for Agricultural Engineering to be offered by the College in conjunction with the College of Agriculture.

(4) Co-operation with the College of Medicine and Agriculture and the Departments of Physics, Chemistry, Mathematics and Computing in the College of Science in the fields of academic teaching and scientific research (Sultan Qaboos University, 1988-1990, p. 63)

Despite all these aims of the College, the number of students enrolled in this college is low (see Table 11.3). This is due to several factors:

(a) The low percentage of students graduating from the secondary schools with a standard of 85% and above, and the acceptance conditions stipulated by the University.

(b) The high standard and hard work required for the courses.

(c) The relative unsuitability of the field work and jobs, particularly for females.

(d) The length of time required to obtain a degree (5 years) compared with other social colleges, i.e., Arts and Education (4 years).

The Mechanical Department is one of the most important in the college, and as its main objective is to provide the country with trained and qualified mechanical engineers to solve the country's shortage of such expertise.

Collaboration between the Department of Petroleum and Mining Engineering and the Oil Industries in Oman, was found to be very weak, in spite of the fact that one of the main purposes of establishing the department was

TABLE 11.3

STUDENTS STUDYING IN THE COLLEGE OF ENGINEERING

YEAR 1990/91

Field of Study	First Year			Second Year			Third Year			Fourth Year			Fifth Year		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
	110	-	110	77	14	91									
Electrical Engineering							19	11	30	14	7	21	27	1	28
Civil Engineering							20	5	25	24	3	27	14	-	14
Petroleum and Mining Engineering							18	3	21	19	2	21	6	-	6
Mechanical Engineering							27	-	27	22	-	22	11	-	11
Total	110	-	110	77	14	91	84	19	103	79	12	91	58	1	59
Grand Total													408	46	454

Specialisation in the College of Engineering starts from Third Year

Source : Sultan Qaboos University,
Unpublished information in Arabic

to provide consultancy services to those industries.

The College of Medicine

The college of Medicine was established in 1986 with its first 88 premedical students.

The aims of the College of medicine are:

(1) To meet the need of Oman for doctors who have scientific training and possess the necessary knowledge and skills to provide "health care" to the individual and groups.

(2) To support the existing health service in Oman by co-operating with the Ministry of Health in combined projects to spread "health" consciousness and improve "health care" and to participate in providing educational health services outside the University. (Sultan Qaboos University, 1980-1990, p. 35).

Despite an urgent need for local doctors, the number of students in the college is low (see Table 11.4). Admission to the college is strictly regulated, and students must have a minimum of 85% overall in their secondary school, or equivalent, examination results. Notably, there are more female than male applicants, and

TABLE 11.4

STUDENTS STUDYING IN THE COLLEGE OF MEDICINE

YEAR 1991/92

Year	Male	Female	Total
First Year	43	45	88
Second Year	36	50	86
Third Year	38	44	82
Fourth year	18	29	47
Fifth Year	14	27	41
sixth Year	21	26	47
Total	170	221	391

Source : Sultan Qaboos University.
Unpublished information in Arabic

it is here that the competition for places is fiercest. Female standards are very high; perhaps because they do not have so many opportunities for studying outside the country, they make the most of the possible facilities available at home.

The Distribution of Sultan Qaboos University Staff

Oman, like many less developed countries, suffer from a shortage of academic lecturers. As a result the government decided to hire academic lecturers from abroad, particularly from other Arab countries. The majority of the Omani staff was in the Faculty of Arts and Education. The Faculty of Health and the Faculty of Science have the lowest number of Omani staff (Informal interview with the administration office in the University).

Concerned with the shortage of Omani academic staff, the country has made every possible effort to encourage Omani Ph.D. holders to move into the academic field, by providing an adequate salary and free accommodation.

11.4 VOCATIONAL AND TECHNICAL INSTITUTIONS IN OMAN

Human capital in developing countries has received adequate treatment in the economics literature. Today, it is a widely held view that the development of the Third World economy largely depends on the development of their human capital. Harbinson and Myers both of whom have written extensively on human resource development, state that:

> "If a country is unable to develop its human resources, it cannot develop much else, whether it be a modern political and social structure, a sense of social unity, or a higher standard of material welfare." (Harbinson, F., 1962, p. 13)

According to Harbinson, 'human capital foundation' in relation to:

> "the process of acquiring and increasing the numbers of persons who have the skills, education and experience which are critical for the economic and political development of the country." ... "Modernising economies are confronted simultaneously with two persistent manpower problems: the shortage of persons with critical skills in the modernising sector and surplus labour in both the modernising and traditional sectors." ... "Thus the strategy of human resources development is concerned with the twofold objective of building skills

and providing productive employment for unutilised or underutilised manpower."

The rate of modernisation of a country is associated with both its stock and rate of accumulation of human capital, which occur through several ways:

(a) Acquired from abroad in the form of technical assistance, expatriate enterprises, hiring of consultants, etc.

(b) Enhanced, through on-the-job training programmes, in service programmes of formal training, management development seminars, etc.

(c) Developed in employment through proper organisation of work, prompting appropriate attitudes and incentives, and better management of human resources.

(d) Through formal education in universities, schools, vocational institutes, colleges, etc.

(e) Developed as a by-product of modern military training programmes. (Harbinson, F., 1962, p. 438).

Harbinson has classified the manpower shortages of modern countries into the following categories:

(a) The lack of highly educated professional manpower such as scientists, agronomists, engineers, and doctors.

(b) The lack of technicians, nurses, technical supervisors, agricultural assistants, and other sub-professional manpower.

(c) The lack of top level managerial and administrative personnel in the private and public sectors.

(d) The lack of qualified teachers.

(e) The lack of craftsmen of all kinds as well as senior clerical personnel. That would include bookkeepers, secretaries, stenographers, and business machine operators.

(f) The lack of other various categories of personnel such as: radio and television specialists, aeroplane pilots, accountants, economists, and statisticians. (Harbinson, F., 1976, pp. 531-532).

He then considered the major human resource problems in developing countries to be:

(a) Increasingly growing population

(b) Mounting unemployment in the modern sectors of the economy and widespread unemployment in the traditional agriculture.

(c) Lack of persons with the critical skills and knowledge required for effective local development.

(d) Inadequate organisations and institutional establishments for the mobilisation of human effort.

(e) Shortage of incentives for persons to engage in specific activities which are vitally important for the country's development. (Harbinson, F., 1976, pp. 534).

It is clear now that for development to be effective, human resources must be accumulated at a high rate if rapid growth is to be achieved. It is essential for politicians and planners to understand that the development of human and physical resources must be integrated carefully in any master plan for growth.

Oman is a small country, like most of the Gulf countries, suffering from a clear lack of middle level technicians, skilled, and semiskilled workers. As a result, technical-vocational education and training in Oman was initiated as an answer to the urgent needs of government and local industry for skilled workers and technical supervisors, in order to supply the country with well trained manpower and hence reduce dependence on a foreign labour force. Technical and vocational education and training is a prerequisite for the country's development.

The purpose of this part is to illustrate through description the current trends in the field of technical and vocational education and training in Oman. Oman's College of Technology was chosen as an example.

<u>Oman's College of Technology</u>

The college was established in 1985 to provide highly skilled Omani personnel. Its main objectives are:

(a) To supply the country with qualified technical class to fulfil the goals of the socio-economic development of Oman.

(b) To develop the technical-vocational skill available in Oman labour force.

(c) To provide consultancy services and conduct studies and research in the Industrial Sector.

(d) To help society in understanding and dealing with technology which might be useful in their daily life. (Ministry of Information, 1990, p. 119)

The college was established to fulfil one of the urgent needs of the country in providing various sectors with well trained technical manpower.

As expected, the College faced many difficulties in achieving its objectives. In a personal interview, the College manager revealed to the author the factors that hinder the performance of the college:

> "Surprisingly, the Public Authority for Applied Education and Training in general terms did not meet their objectives. A high percentage of our students do not work after their graduation in the same field they were trained for. The social attitude towards our graduates and the lack of government incentives are the main obstacles to our aims

in supplying the society with national technically skilled labour."

These problems manifest themselves clearly in the number of students attending the Industrial College and various vocational programmes.

The low number of students attending vocational institutions may be attributed to a number of factors,. Firstly, there are social and cultural obstacles. For example, it is often claimed in some Third World countries that manual labour is inferior to white-collar work. As a result of this, higher status is often accorded to white-collar workers. Secondly, many students like to attend university in order to achieve a higher status. Consequently, they tend to be more interested in the general education system. James Socknat has studied human resource development programmes in the Arabian Gulf states in 1975. His investigation revealed the lack of:

> "... a comprehensive career guidance programme, much less a system of career education by the Gulf government." (Socknat, J., 1975, p. 14).

Thirdly, the reputation of the scheme operated in the present secondary schools aimed at getting students ready for higher education. Many of our secondary schools lack some important subjects such as technology, science, industrial development and so on. The result is that many students who attend industrial colleges have little or no experience in, say, recording and evaluating various components of their surroundings. Some vocational and technical activities such as seminars, lectures, films, etc. are also wanting.

There is also the problem of dropout in vocational schools. Usually, most of the students who register at vocational schools are those who did not appear to have performed well in the formal school courses. Determined to achieve success, they register for courses in the vocational schools - drawing a subsistence allowance per month under the social welfare system. However, these students tend to drop out from vocational school as soon as they secure suitable employment.

However, the low number of students attending vocational institutions as mentioned earlier makes it difficult for planners to satisfy the country's need of such skills. Dependence on non-Omani skilled manpower seems to be high and desperately needed to fill the gap.

11.5 CONCLUSIONS

The contribution that education, particularly higher education, can make to the advancement of a developing country, through technology transfer from developed countries, cannot be overemphasised. The country without doubt seeks to establish through its education system well trained scientific and technical manpower in order to reduce dependence on foreign expatriates.

The University of Sultan Qaboos is perceived to be an ideal institution in which scientific industrial and technical skills can be learned. Consequently, the University is looked upon to plan, organise and formulate standard curricula for educating and training people to meet the immediate and future needs of Oman.

Emphasis should be placed on Secondary School Education as well. It should be designed to prepare students not only for work at university level but also for entry into scientific and technical colleges. More scientific subjects should be applied for rather than humanities. The government must play a vital role in providing distinguished salaries for science graduates and encouraging students to select science subjects by providing incentives during studying.

The concept of higher education among Omanis is not yet clearly understood. Higher education is intended to develop the whole person but most Omani students see higher education, perhaps, only as one of the avenues of social and economic mobility. At the same time female students should be encouraged to be involved in scientific and technical fields by, once graduated, being provided with appropriate working places with reasonable working hours.

As far as the College of medicine is concerned, the number of candidates is restricted because of the lack of teaching hospital facilities. In order to increase the quantity and quality of Omani specialists and hence reduce the dependence on foreign medical personnel, the college need to grow in an organisational structure in order to reach the objectives desired.

The relationship between the university and industry in the scientific, technical, and management fields should be promoted, and applied research must be encouraged to be mutually undertaken by two institutions.

Research is vitally important for both teachers and students. An ideal research programme would be that which is designed to develop student's practical and theoretical skills. This could be enhanced by the use of case studies and industrial projects to be supervised by the university staff.

A review of the Vocational and technical Institutions in Oman reveals a number of drawbacks. For example, the main objective of vocational schools - that of providing middle level manpower - is yet to be met. This demands urgent action by the government. New ideas should be sought not only from local experts but also from overseas experts.

This review revealed that the curricula for vocational training appear to be improperly integrated with other aspects of the Omani educational system. To this end, it is suggested that the curricula be revised to build in necessary elements to ensure the development of local capabilities. Efforts should also be made to encourage more females to enrol in technical preparation institutes and to help to develop their skills. There is a need to link vocational and technical schools with the industry, and research and development centres. In this way, their practical and analytical skills, all things being equal, will be fully developed to meet the much needed skills.

CHAPTER 12

THE ROLE OF GOVERNMENT IN THE TRANSFER OF TECHNOLOGY

CHAPTER 12

THE ROLE OF GOVERNMENT IN THE TRANSFER OF TECHNOLOGY

CHAPTER 12

THE ROLE OF GOVERNMENT IN THE TRANSFER OF TECHNOLOGY

12.1 INTRODUCTION

This chapter explores the role of government in developing countries in the transfer of technology from industrialised nations. There are five parts. The first gives some general information on the role of the governments, and the second examines the Omani government regulations on the transfer of foreign technology. Legislations and regulations on technology transfer in some selected developing countries are discussed in part three. Among the countries examined are Indonesia, India, Nigeria, Thailand and Brazil. Finally, some conclusions are drawn.

12.2 GOVERNMENTS AND THE TRANSFER OF TECHNOLOGY

> "Successful technological development and, in the long term, technological transformation, depend crucially on the existence of an appropriate legal framework which will promote a favourable and beneficial environment for the transfer, application and development of

needed technology." (UNCTAD, 1985, p. 14).

As well as the prospective contribution of technology to their economic development, Third World countries have specific reasons to formulate policies dealing with the transfer of technology.

Firstly, the technology transferred to developing countries is often inappropriate to their conditions. It has been frequently realised that imported technology from industrialised countries, which is complex and used a large amount of capital per unit of labour, is not suitable for developing countries, where capital and skills are scarce and labour is underemployed.

Secondly, developing countries have on many occasions entered into arrangements where they are often at a disadvantage due to economic reasons, when dealing with the suppliers of technology. This is due, to some extent, to oligopoly/monopoly where technology is supplied by only a few or in some cases only one outlet and often at inflated prices. Another problem of the "buyers" is their lack of technical and commercial expertise needed in such a field. Because of these problems and also because of conditions such as licensing agreements and other legislation, the maximum benefits are often not obtained in transfers of technology.

Thirdly, technology tends to be sold to developing countries in the form of a "package" and the countries usually try to obtain all, or most elements in the "package". However, several "side effects" are encountered. Firstly, there is increased dependency on foreign contractors and technology suppliers to the detriment of local contractors. Local skills and technology are often ignored and go into decline. Whilst in the short run these arrangements look profitable, there are, in the long run, many disadvantages and economic problems.

Last but not least, several governments have been encouraged to take action, often spurred on by the balance of payments situation in cases where there was concern usually for economic and technical reasons, to increase local technological output often by reducing legislation and by encouraging the unpackaging of imported technology; in doing so they have increased the recipients bargaining position (UNCTAD, 1980 p. 1)

Lall notes that:

> "The need to 'unpackage' foreign investment is ... well argued. The development of local technological, managerial and other capabilities requires a strong stimulus from

the government, and part of this stimulus involves cutting off too easy an access to foreign technology and skills." (Lall, S., 1980, p. 703).

The role of government in the transfer of technology is an important one. the government usually draws up policies aimed at guiding through the transfer process.

UNCTAD suggests the following guidelines for the transfer of technology:

a - The creation of institutions and provision of finance to help develop national technology.

b - The formulation of a science and technology policy which should be understandable to potential suppliers and recipients.

c - Supporting the activities designed to adapt and improve upon the acquired technology (UNCTAD, 1975, p. 37).

On the other hand, Bradbury recommends ways in which the government could assist in the transfer of technology:

a - By creating a favourable climate for investment.

b - By recognising the fact that technology transfer is an expensive and complex process.

c - By recognising the fact that the technology transferred should pay its way. Consequently, there should be no discrimination against royalty payments from parent to affiliate firms.

d - By encouraging the exchange of staff between the transferring company and the transferee company.

e - By devising a means of facilitating customs clearance of equipment, samples, etc., through the construction period.

f - By creating confidence in supplier companies to assure them that once agreements are made, they will not be changed or amended to their advantage.

g - By the equitable grant of patents and import licences or quotas, where they exist, and by the operation of equitable methods for appeal and arbitration.

h - By ensuring free and continuing access to raw materials and parts.

i - By equal and clearly understood arrangements for the resolution of labour disputes and by the creation of good relationships between management and manpower.

j - By encouraging long term participation in and understanding of plans for coherent development of related technologies in recipient countries, or for increase in the local economic strength.

k - By equal and consistent application of Laws covering commercial conditions, business activities, etc. Third World countries often insist on monopoly situations for plants to realise economies of scale. (Bradbury, F., 1987, p. 304).

12.3 OMAN GOVERNMENT REGULATIONS

Most of the Laws governing business operations in Oman contain special regulations concerning the participation of non-Omanis in the capital structure and in the labour force. Generally, non-Omanis may only participate in business with government permission and then only hold a minority interest, of up to 35%. In Oman, the Industrial Law Royal Decree No. 1/79 of 1978 provides an opportunity for the screening technology licence agreements.

If an individual project is considered to be a feasible venture compatible with the economic and social needs of Oman it will be approved, and a licence will be issued by the Ministry of Commerce and Industry. Licences are again only granted to Omani nationals (although the company may be up to 50% foreign owned). All government purchases and contracts go through the Central Tenders Committee. Tenders are advertised in the local government magazine. Pre-qualification is required to show evidence that the company is capable of undertaking the size and type of project envisaged. All contracts entered into between Omani and foreign firms are subject to Omani Law unless parties agree otherwise.

No special regulation exist in Oman that governs the control of the importation of foreign technology, despite the large volume of foreign technology imported. This law is considered to be the principal law controlling the establishment of industries in the country. However, the government, through the enactment of Industrial Law in 1978, did recognise the importance of the development, protection and promotion of local industries. This clearly manifests itself in the following articles:

Art. (19)

"The Minister of Commerce and Industry may do the following at the recommendations of the Industrial Development Committee:

(1) Exempt, wholly or partially, industrial installations registered or licensed from all the currently imposed taxes including income tax or any other taxes that may be applicable in future and that for a renewable period of five years starting from the date of permission of registration or production commencement.

(2) Exempt, wholly or partially, from the payment of customs duties on the following materials:

a. Equipment required by the industrial installation during the period of setting up the expansion.

b. Raw materials and partly manufactured goods required by the installation for production purposes.

(3) Exempt the export of product manufactured by local industries from any dues or taxes imposed on them.

(4) Impose or increase custom tariffs on imported goods identical to local products according to Royal Decree 1978 or to prevent or restrict their import, provided that they maintain the suitability of local products in terms of quantity, quality, excellence and the interest of the customer.

(5) Agree with the bodies concerned to reduce electricity, water and fuel charges for industrial installations to which apply the provisions of this law, and that within the resources available in Oman."

<u>Art. (20)</u>

"Give preference, while granting government plot, to industrial installations according to the law and regulations issued in this respect. The bodies with such plots of land will arrange for their allocation and contracting out at the recommendation of the Ministry of Commerce and Industry and within the limits of the area and location determined by permission granted to the installation."

Art. (21)

"Give preference, when purchasing for the government, to local products which conform with the provisions of this law, provided that such local products satisfy the standard specifications in terms of excellence and quality, also including a price preference in the region of 10% at the most"

Art. (22)

"All the government bodies concerned shall, within the limits of their resources, facilitate and simplify the arrangements necessary to expedite the establishment of new industries, particularly the following:

- To provide facilities and services necessary for such industries.

- Arrangements for contracting out and handling over government plots of land to such industries.

- Immigration arrangements such as entry visas and residence and work permits."

Art. (23)

"According to the recommendation of the Industrial Development Committee, the Ministry of Commerce and Industry may advise banks and government bodies available in the country to participate in all or part of the costs of carrying out economical and technical feasibility studies of industries of importance to national economy."

Art. (24)

"The Ministry of Commerce and Industry shall work in co-operation with industrial installations in setting up of displays of Omani industry both within and outside the country, also taking part in international industrial fairs for the purpose of encouraging and promoting the products of national industries."

(Oman Chamber of Commerce & Industry, p. 31)

As an essential step in this study, the author visited the Ministry of Commerce and Industry and met with official employees, particularly in the Rusayl Industrial Estate, Department of Industrial Services, whose main functions are:

a - Setting plans and programmes concerning the development and protection of local industry.

b - Conducting feasibility studies for those who have an interest in establishing industry in the country.

c - Supervising and promoting local industry.

d - Providing other services such as import licences, registration of firms, allocation of industrial land, etc.

e - Strengthening local and international relations with industrial countries and other organisational entities.

An expert official who works in the field of evaluation of local and foreign projects confirmed to the author, in a personal interview, the willingness of the Department to establish regulations towards the flow of technology to Oman, despite the urgent need for such regulations. He then explained some of the difficulties in the Department which affect its efficiency. A shortage of qualified manpower seems to be the main obstacle the

Department has faced since its establishment. Some projects are given to new graduate employees who do not have adequate experience, and yet have to make decisions without proper supervision. As a result, applications to this Department take a considerable. The accuracy and quality of the decisions made by the Department's employees when evaluating projects also suffer.

12.4 LEGISLATION ON TECHNOLOGY TRANSFER IN SELECTED DEVELOPING COUNTRIES

Some developing countries have implemented policies which deal with the process of transfer of technology as a whole. Such policies differ greatly from one country to another, and they tend to cover a varying number of issues relative to the need of the country. In most cases there is no one specific law regulating the development and transfer of technology, and it is possible to find regulation in several different areas, such as laws concerning foreign investment, antitrust, industrial property (trade market, patents), and the regulations and screening procedures dealing with foreign technology. The advantages of implementing regulations have had noticeable effects:

a - A reduction in the cost of imported technology, through several types of transfer agreement;

b - the elimination of restrictive clauses for the transfer of technology agreements;

c - A shortening of the terms of validity of contracts. (UNCTAD, 1985, p. 14)

Indonesia

There are no specific rules in Indonesia governing technology transaction; there is already the power to vet agreements in the foreign and domestic investment laws. Within the regulations currently in use, it is still possible for the board of investment (recognised in 1973) to scrutinise and if necessary take action to place restrictions on technology imports. There are also some restrictions, including royalties and similar payments (UNIDO, 1977, p. 51).

India

The country with the largest experience of technology transfer is India who first put controls into practice in 1947. It is possible to see three distinct stages in the time since the initiation of the controls. The first stage was from 1947 until 1968, when a Foreign Agreement Committee was organised to deal with foreign collaboration within the general industrial policy. The second stage, 1969-1978, saw the introduction of the Foreign Collaboration Agreement (1969) and the Foreign Exchange Regulation Act (1973), and thus the improvement of systems of control (UNCTAD, August 1980, p. 2). A more reasonable policy was recognised as beginning in 1978, and a number of the most significant of the official guidelines are quoted below.

> 1 - "Permission to import foreign technology will be denied in those field where indigenous technology is sufficiently developed. As a result, no foreign collaboration will be permitted, only technical collaboration will be permitted and financial, as well as technical, collaboration will be permitted.
>
> 2 - The maximum duration of the licence agreement is not normally to exceed five years.
>
> 3 - Extensions of technology agreements are not encouraged, only for those products in respect of which the applicants have not sufficient time to absorb the imported technology.
>
> 4 - Foreign trademarks should not be used for

sales in India.

5 - Clauses that provide for minimum royalty payments will not be permitted.

6 - Royalty payments will be computed on the basis of value of production ex-works, minus value of imported components, and will be subject to tax.

7 - Clause in the licence agreement that prohibit exports will not be permitted except for export to countries where the foreign party has a similar manufacturing licence agreement.

8 - Provision should be made for sublicensing know-how to other Indian enterprise on terms that are mutually acceptable to all parties concerned, including the foreign collaborators and the government.

9 - Exemptions are available for proposals envisaging substantial exports.

10 - The government will consider favourably proposals of foreign collaboration in which a suitable 'favoured licensee' clause is

incorporated in the draft agreement.

11 - Approved/registered Indian engineering design and consultancy organisations must be the prime consultants and the government will consider permitting the purchase of only such design and consultancy services from abroad as are not available within the country.

12 - Proposal for the purchase of overseas technology must be accompanied by proposals regarding the programme of further development and improvement technology in this field.

13 - It is desirable that an approved/ registered Indian engineering design and consultancy organisation should be associated right from the start in any evaluation, selection and negotiation conducted for the purchase of overseas technology.

14 - It is desirable that enquiries to overseas parties should be made on the basis of separate quotations for technology if such technology is not available in India." (UNIDO, 1977, pp. 47-49).

It is quite clear that since the implementation of the guidelines, far from encountering difficulties, the position and power of recipients has been greatly increased. Their bargaining position is much stronger, and many restrictive and unwanted clauses have been avoided. In addition, having put a time limit on agreements means that those involved must absorb foreign technology rapidly. The technology policy of 1983 sets out the basic aims of India's Technology policy. (UNIDO, 1977, p. 49).

Thailand

In Thailand, transactions are considered private between the parties involved, and there are no specific rules on technology transfer. However, there is a Promotion of Industrial Investment Law which, if necessary, can be used to monitor technology licence agreements. This Law, introduced in 1962, is also concerned with issues related to the promotion and regulation of industrial activity. (UNIDO, 1977, p. 53).

Nigeria

The Nigerian government's consultation with the United Nations Industrial Development Organisation (UNIDO), the United Nations Conference on Trade and Development (UNCTAD) and other government agencies, established regulations for the importation of foreign technology. This was enforced in September 1977 by the promulgation of Decree no. 70, code-named National Office of Industrial Property (N.O.I.P), (UNCTAD, 1985, p. 1).

(A) The main objectives of the National Office of Industrial Property include the following:

1. To encourage the flow of technology to Nigeria in order to strengthen national industrial development.

2. To promote national enterprises to acquire the appropriate technologies that suit local needs.

3. To give assistance to enterprises in obtaining technology from abroad.

4. To strengthen the negotiating capability of Nigerian personnel in order to obtain the appropriate technology needed with the suitable terms and conditions.

5. To acquire a more efficient process for a speedy absorption and assimilation of foreign technology by local technicians.

6. To be able to adapt imported technology to meet national market requirements.

7. To promote the development of local technologies.

8. To encourage future exporting of domestic developed technologies to various locally developed neighbouring countries. (UNCTAD, 1985, pp. 1-2).

(B) The major functions of N.O.I.P.

Under Decree No. 70, the major functions of N.O.I.P. were to evaluate and screen technology transfer agreements based on cost-benefit analysis, to determine whether the commercial transactions contained within a contract match with the goals of Nigerian technology policy, and to examine such agreements from the technical, legal and economic view. (UNCTAD, 1985, pp. 3-4).

(C) The criteria used for cost-benefit analysis

The criteria used by the Nigerian government's agent (i.e., N.O.I.P.) to do cost-benefit analysis include:

1 - "The type of technology to be transferred with special attention to:

(a) The age of the technology;

(b) The industrial sector in which it is going to be applied;

(c) The degree of complexity it involves;

(d) The types of items to be produced;

(e) Its contribution to the creation of new jobs;

2 - The payments required with special attention to:

(a) - Total amount of payments during the term of agreements;

(b) - Its impact on the national balance of payments;

(c) - The rate of royalties with respect to other sources of technology available;

(d) - The impact on the profits of the recipient enterprise;

3 - The way in which the agreements contribute to the improvement of local technological capabilities;

4 - The existing relationship between the supplier and recipient of technology, parent-subsidiary relations;

5 - The advantages and disadvantages of the agreement that will contribute to the overall domestic interest." (UNCTAD, 1985, p. 5).

(D) Technical Evaluation

It is important to insure that the terms and objectives of each contract are made clear by the supplier of the technology, For example, the type or form of licence, the rights of both the recipient and supplier, and the type of technical assistance to be offered must be made known at the outset. The technical evaluation also focuses on the following points:

1 - The age of the technology to be transferred, in order to determine if the imported technology requires changes or adaptations to function on a profitable basis and in accordance with domestic resources.

2 - Training programmes directed at the assimilation of the acquired technology by the recipient's operating personnel.

3 - The ability of the recipient to adapt the supplier's innovation or new products developed during the term of the agreement.

4 - The advantages of the acquired technology in comparison with other similar technologies.

5 - Information relating to the experience of the supplier either from research and development programmes or from its subsidiaries. (UNCTAD, 1985, pp. 5-6).

(E) Economic Evaluation

The economic evaluation of the transfer of technology agreement is principally based on Decree No. 70 (Section 6 (2) (6)). The main objectives are:

1 - To ensure that the price or vital point in the contract compensate for the technology acquired.

2 - To ensure that the governments technology policy does not suffer at the expense of acquisition of foreign technology by indigenous firms. (UNCTAD, 1985, p. 6).

Consequently, N.O.I.P. is often meticulous when it comes to the evaluation of the royalties and other payments involved in the contract. It also seems to be rigid in the examination of the legal terms and conditions stipulated in the contracts.

(F) According to UNCTAD Report (1985, p. 10) the N.O.I.P. has evaluated 231 technology transfer applications since it was formed. Of this number, 180 of the contracts were renewable as shown below.

<u>Number of Old and New Agreements by Sectors</u>

Industrial Sectors	New Applications	Old Applications
Agro-based	47	26
Mineral-based	46	2
Engineering	68	21
Services	19	2
Total	180	51

Initially there was the problem of a suitable infrastructure, but this has since been overcome.

<u>Brazil</u>

The National Institute of Industrial Property (INPI) was set up in 1970 under the auspices of the Brazilian Ministry of Industry and trade. (Oliveira, L., 1982, p.

167).

A - Major Functions

INPI was charged with the following functions:

1 - To provide appropriate law relating to the economic, social technical and legal activities of the industrial property.

2 - To accelerate and regulate the transfer of technology.

3 - To improve conditions for the negotiation and use of patents. (Oliveira, L., 1982, p. 167).

B - Classification of Agreements for Registration

All technology transfer agreements meant for registration at the National Institute of Industrial Property's office were categorised into five major groups:

> 1 - "Licensing agreements for the exploitation of patent. Refers to agreements involving technology for the design of products, manufacturing processes, formulae, etc.

2 - Licensing agreements for the use of a trademark. Refers to agreements pertaining to trademarks, marketing or publicity slogans.

3 - Licensing agreements for the supply of industrial technology. Refers to agreements concerning the supply of technology, such as knowledge, special skills, and know-how for the production of consumer and intermediary goods.

4 - Agreements for technical-industrial co-operation. Refers to long-term agreements providing technology, knowledge, know-how and other special skills and services for the manufacture of capital goods such as complete industrial units, machines, equipment, and components.

5 - Agreements for the supply of specialised technical services. refers to the short-term supply of technology, such as managerial and engineering supervising industrial projects." (Oliveira, L., 1982, pp. 182-183).

It is important to note that this method of categorisation adopted by INPI, derives from an attempt to ensure that each transaction in the process of technology transfer receives adequate attention. As a result of this, registration, evaluation and monitoring are often treated separately.

According to Law No. 5772 of December 1971, under which INPI was formed:

> "All acts or contracts which involve the transfer of technology are hereby subject to legalisation by the National Institute of Industrial Property." (Oliveira, L., 1982, p. 168).

C - Normative Acts

Since the inception of INPI, there have been a number of Normative Acts aimed at reinforcing INPI's control on technology transfer from industrialised countries to Brazil as well as encouraging the development of local capabilities. In 1982, for example, the rules governing contracts for specialised technical services were amended by Normative Act No. 60. This was a replacement of Item 6 of the Normative Act No. 15. With the above amendment it was possible to incorporate the following:

1 - The elaboration and use of computer systems or data processing programmes affecting any of the services mentioned.

2 - The listing of more engineering and/or consulting services falling within the law.

3 - A general prohibition against restrictions on business activities or technological development by the recipient.

4 - A general prohibition on restrictions against the national interest.

Consequently, INPI always insists under Normative Act No. 65183 that companies importing foreign technologies must justify the need for doing so. They must also justify the selection of the supplier by providing the National Institute of Industrial Property with comparative data for similar or identical technology on file with its patent data bank. (UNCTAD, 17 August 1984, pp. 6-7).

12.5 CONCLUSIONS

This overall view shows that government play an important role in the transfer of technology from developed to developing countries. However, this role varies from one country to another, depending on bargaining power, as well as on economic, technical and legal circumstances in the individual country. Central to the successful transfer of technology, is the ability of both parties to formulate and agree on an effective legal framework which will ensure that each party gets a fair deal. It is essential to ensure that no party is cheated.

Brazil, through Normative Acts, has amended the law relating to technology transfer in order to strengthen its control on imported foreign technology. In sharp contrast, Oman has not yet revised its law related to the transfer of technology from industrialised countries. This can damage its economy, as well as weaken its bargaining position.

There is a need for the governments of developing countries to formulate effective rules and regulations, designed to direct and control the implementation of foreign technologies for the benefit of individual countries. In addition, technological policy should be designed to:

a - Foster the development of local technology.

b - Assist local companies in negotiations and acquisition of appropriate technology.

c - assist in the technical and economical evaluation of the agreement for the transfer of technology.

d - Help in the classification and registration of technology transfer agreements.

To summarise, the roles and regulations guiding the transfer of technology from developed to developing countries should be designed to strengthen the hands of negotiators in commercial technology transfer deals, maximise gains from the transfer, and last but not least, enhance the development and successful adaptation and diffusion of the imported technologies.

CHAPTER 13

CONCLUSIONS

CHAPTER 13

CONCLUSIONS

CHAPTER 13

CONCLUSIONS

13.1 INTRODUCTION

This chapter draws conclusions from the information and arguments presented in this work, and discusses the various hypotheses upon which the work is based. The chapter also discusses the implications of the findings for the future transfer of technology to Oman. Any study has its limitations, and those of this study are discussed briefly.

13.2 THE RESEARCH METHODOLOGY

The Sources of the Data

The empirical research conducted in the present thesis has been designed to test a number of hypotheses, and followed a number of stages (see chapter 9 for further discussion). The first was to identify the recipients firms which were importing technology from developing countries. The selection of these firms was based upon the types of technology they imported, and their relationship with the local sector (see section

9.5). A pilot sample of 10 firms was selected in the Rusayl Industrial Estate in order to test the questionnaire.

It will be observed that some data presented in Table 10.2 is not exhaustive, i.e., some percentages do not add up to 100%. This is due to the fact that Omani management systems, in common with those of many other developing countries, are not always "tight" and data can often be missed as a consequence. It will be recognised that such a state of affairs is an unavoidable but nevertheless irritating fact of life for starters involved in field in the Third World.

A final sample of 120 firms was ultimately identified. Eighty firms responded, from which a detailed study was obtained (see Table 10.1). These eighty firms come from three major industries. These are the Rusayl Industrial Estate (R.I.E), the Petroleum Development of Oman (P.D.O), and the Ministry of Electricity and Water (M. E & W). The author also studied Sultan Qaboos University and the Vocational and Technical Institutions, to examine their contribution to the transfer of technology, and the development of local capabilities (see section 11.3 and 11.4 for more discussion).

It is important to mention that I have concentrated on the Rusayl Industrial Estate (R.I.E) in my empirical findings, because most of the firms which responded to the questionnaire were from the R.I.E. Out of the 80 firms that responded, 53 were from the R.I.E. Therefore, in my study of the research findings, I did not put much emphasis on the Petroleum Development of Oman (P.D.O) and the Ministry of Electricity and Water (M. E & W). Out of the 80 firms that responded only 15 were from M. E & W and 12 from P.D.O.

Nevertheless, from discussions with Omani managers and during the design and pilot stages of the study, and from my knowledge of Omani industry in general, it is possible to be confident of the representative nature of both the sample and the stated findings. In short, the findings of this study, together with my conclusions and recommendations, can be generalised to other sectors of the Omani economy, including Petroleum and Electricity and Water.

Finally, the role of government regulations for directing and controlling the flow of foreign technologies and the encouragements of local technologies was studied (see sections 12.2 and 12.3 for more discussion).

Precautions Against Error

In any social science research, sampling errors are inevitable, to some extent. However, the success of research of this type depends upon several factors, among which are:

1 - The sensitivity of the research topic under investigation.

2 - The availability of information on that particular topic.

3 - The extent of co-operation from respondents in revealing information.

4 - The personality (ability) of the researcher himself, in persuading and stimulating respondents to reveal information.

5 - The quality of the method selected for gathering information.

In this study several obstacles were experienced and depending upon the type of obstacles, a solution was eventually provided. Steps were taken to facilitate the process of gathering data on the topic under study (see Chapter 9). These steps helped a lot in persuading respondents, usually the directors of firms, to provide accurate answers to the questionnaire, and to the questions asked during personal interview.

Other Limitations of the Study

This study, like any, has its limitations. First, the war between Iraq and Kuwait has had its effect, not only on the economy of Oman, but also by imposing some restrictions in Omani organisations on the disclosure of information about essential industries, particularly the oil companies. The author experienced several obstacles when gathering information, and when encouraging individuals to complete questionnaires.

Some of the information required in the questionnaire was classified by firms as confidential. These firms were unable to divulge certain information, for fear that it might get into the hands of competitors. This lack of information must affect the robustness of these findings, but would be very unlikely to alter the general conclusions which have been drawn.

13.3 THEORETICAL CONSIDERATIONS

The Concept of Technology Transfer

Over the years, there has been an increasing interest in the process of technology transfer from industrialised to developing countries. Technology is an important factor in the industrialisation process, particularly for developing countries. The transfer of technology has an important contribution to make towards development, and it is an important tool used by multinational corporations, even though the local development may not be their main objective.

The term technology has been variously defined. One of the simplest definitions is attributable to Root (1968) and is "The body of knowledge that is applicable to the production of goods and the creation of new goods" (see chapter 2). It is often seen not only as a factor contributing to greater production but also as an asset which improves the quality of a product, reduces its cost and constantly leads to the creation of new, and often sophisticated, products.

Another way to look at technology is to distinguish between product technology and process technology. OCDE (1982, p. 11) and Siggel (1983, p. 86). The former consists of the specifications and characteristics of the product, and the latter comprises all the know-how necessary to produce a product. (Fig. 2.1 in chapter 2 may clarify these definitions).

There is no universally accepted definition of the term "Technology Transfer", Which incorporates several meanings. Some authors limit the use of the term simply to the transfer of technology between developed and developing countries. Others give it a wider definition, by including within its scope all possible aspects of transfer such as the entire transfer of technological knowledge throughout society (see chapter 2 for more discussion).

The transfer of technology is broadly distinguished into two types, which Brooks (1966) calls vertical and horizontal. Vertical transfer is a process by which scientific knowledge becomes part of a technological system, by making a technology out of unrelated and different techniques, and horizontal transfer is the adaptation of a technique from one use to another, or from one country to another. The transfer of technology to developing countries is mainly related to the second type of transfer; it could be defined as any group of measures used to set up and extend production facilities by improving machinery and elements of technical knowledge from abroad.

The definitions above (see chapter 2) open the way to many questions as to whether such a transplantation does occur in reality, whether knowledge is transferable or whether it is tied to a particular locality. Some authors, particularly those representing the dependency school of thought, such as Dos Santos (1970) and Amin (1973), argued that technology transfers necessarily lead to ever-increasing economic and technological dependence. Siggel (1983) notes, however, that these statements of dependence depend on the nature and completeness of technology transfer. If that transfer is merely viewed as transplanting modern technologies into developing countries without generating learning effect, then it could be said that it obviously leads to economic dependence, whereas if technology transfer focuses on acquiring technological capacity through learning, it can contribute successfully to economic dependence.

The most important part of technology transfer is the transmission of know-how through education and training combined with practical experience. There exist several means for the transmission of know-how, formal local training programmes, training programmes abroad, in-plant courses, on-the-job training, education abroad, and circulation of books and periodicals, etc. (see chapters 2, 3 and 10 for more discussion). Vaizey (1969) suggests that job-oriented training programmes and on-the-job training are the most efficient means. Education abroad has often been criticised as impractical to the actual needs of developing nations, Young (1966).

In general, failure to transfer satisfactorily the knowledge required for the absorption of technology has led to the failure of technological transfer; a relevant study by Peterlongo (1977) is worth mentioning at this point; it consists of co-ordinating the transfer of educational systems with the transfer of technology. The usual path followed to accomplished both transfers can be described as: economic study-choice of the technology-transfer of the technology then transfer of organisational and training systems. This simple uncoordinated pattern has created serious difficulties to the recipient country. Improvement of this pattern is suggested by Peterlongo is presented in Fig. 2.2 in chapter 2.

The concept of redesigning the organisational as well as the educational and training systems corresponding to the redesign of technology allows the receiving country to take into account the requirements and the general situation of the country and, therefore, of being able to assimilate and adapt the technology. The two activities of redesign should be performed contemporaneously and not, as often happens at present, sequentially. The aim is to obtain reciprocal influences in order to benefit from both aspects of the transfer.

The phases of redesign in order to modify the technologies and education transferred will direct the training and educational systems towards the proper use of technology. Although the costs involved for these operations are high, this approach will not only compensate, in the long run, the allocated resources but also it will ensure a well-planned, and successful technological transfer.

Peterlongo (1977, p. 178) concludes his paper with the following original idea, which may be related to technological transfer, to some extent; he says: "The suggestion here proposed could perhaps improve the present situation. They are based on resources, such as creativity and reflection, which by their nature are much more evenly distributed among the nations, the capitals and raw materials."

The modernisation theorists, (see Rostow, 1960), will certainly not agree with the above statement. They stipulate that third world countries are "backward", "late-starters" and lack the attributes of modernity as Fitzgerald (1981) reports. One should therefore not restrict one's views when looking at developed and developing nations and at their technological differences, as knowledge exists everywhere; what is lacking is enhancement and encouragement for the use of knowledge to profitable ends.

One may be tempted to conclude, based on overall review, that Oman should have acquired sufficient foreign technologies over the years to enable it to develop its local capabilities aimed at sustaining and maintaining some elements of technological independence.

Elements and Stages of Transfer

Hoffman, L. (1985, p. 77) finds that there are many elements of technology incorporated in transfer agreements. He cites many factors as typical examples of elements of technology (see chapter 2 for more discussion). Specifically, however, I propose to concentrate on those elements of technology imported to Oman from industrialised countries. They include:

a - Provision of maintenance facilities by the exporter of technology.

b - Provision of technical support.

c - Provision of technical research and development facilities.

d - Provision of marketing know-how.

e - Provision of management techniques.

f - Design and construction production techniques.

The above elements are particularly important to Oman in enhancing its local capabilities.

First, the provision of maintenance facilities will enable Oman to carry out routine maintenance and repair of the imported technology. This will also help to minimise costs while maximising efficiency of local labour. Second, the provision of research and development facilities will enable Oman to conduct research, particularly in the oil and petrochemical industries. This would include research into the use of the by-products of petroleum. Through this new scientific knowledge, ideas and innovations may evolve, which, in turn, will help to improve the local capabilities of Oman. Last, the provision of marketing know-how will enable Oman to sell its products in competitive markets as well as plan, organise, co-ordinate and control, and manage the marketing strategies.

Figure 2.1 summarises the major elements of technology which are mainly comprised of product and process technologies. This figure may usefully be used to differentiate between proprietary technology and non-proprietary technology, as first distinguished by Quinn (1969). The former category comprises technologies owned by the technology supplying firm, most often transferred through private foreign investment, usually the ownership is guaranteed by patents in the case of product technologies. Non-proprietary technologies are generally bought in a freely available market, and do not involve any proprietary right to the seller; in transfer agreement for non-proprietary technologies, the product and process technology play a major role compared to management and training, which in this case constitute the main elements (see chapter 2 for more details).

The fulfilment of project implementation requires foreign technological expertise at more than one of the stages of transfer. Okita and Tamura (1975, p. 72) and UNIDO (1973, p. 4) discuss these stages as follows.

The first stage of the transfer usually takes place when a country imports the machines along with the flow of technological know-how, and starts to learn to operate them. The second stage requires the maintenance and repair technology; sometimes the machines may be complex and automatically controlled which requires specialised tools and parts. The third stage is the establishment of engineering technology which requires a great accumulation of specific material and skilled workers.

The planning and design technology constitute the final stage. It includes the research and development activities for new products, and the design of actual products. It is this stage which permits the developing country to develop its own technology. The local expertise for most of these stages is practically non-existent in the receiving country and often, even the plants and equipment are installed by the transferor.

Effectiveness of technology transfer can be achieved when the last stage of transfer is attained, that is, when the receiving firms have mastered the technologies. There are, according to Siggel (1983, p. 99), three factors responsible for the effectiveness of transfer. Firstly, technologies must be transferred in all their required parts, an incomplete technology transfer may be acquiring a turnkey plant without training the personnel. On the other hand, a pure training arrangement is an incomplete technology transfer if the receiving firm does not obtain the documentation and managerial know-how it needs for operating the training. Secondly, the effectiveness depends on how the transfer mechanism is organised. There is particularly a high risk that the transfer may be incomplete when it is in an "unpackaged" form with independent dealers, as preliminary studies, the delivery of equipment as well as the training of personnel and management are not sufficiently co-ordinated. Thirdly, it depends on the receptivity of the receiving firm, that is, management capacities and technical absorption.

This method, nevertheless, has its problems. For example, although the supplier may provide training and maintenance, the local staff are often not involved in the design, construction and installation stages of the project. Another disadvantage is that the supplier often insists upon supplying the whole package for the project.

One can agree that a transferor of technology who has a monopoly of the package is likely to deny the recipient firm the ability to develop its local capability, thus perpetuating the dependence on foreign technology (see chapter 3 for further discussion).

The Cost of Technology transfer

Most of the literature has focused on the cost aspect of technology transfers as an imperfect market, Vaitsos (1974) and Stewart (1979) among others (see chapter 2). Moreover, since the market for technology, protected by patents, trademarks, commercial secrets and by semi-monopolistic control is largely imperfect, it is difficult to assess the cost of a particular technology. The price and the conditions for the transfer of technology from one enterprise to another may differ from case to case, and depends greatly on the value the recipient attaches to it. The licensee is usually unaware of the complexities of negotiating a licenses agreement and, therefore, he is in a particularly weak position vis-a-vis the licenser, whose bargaining strength is much bigger. (UNIDO, 1973, chapter 3).

Stewart (1979) divides the cost of technology into actual or direct costs and indirect costs. The former constitute the payment of technology royalties, profits, and transfer pricing mechanism. The indirect costs, on the other hand, which may account for over-pricing, etc., represent the largest part of the transfer cost; in doing so the activities of the recipient enterprises are greatly restricted. These operations have often been called manipulations of the transfer pricing by the multinationals; see Lall (1978 a, p. 209) and chapter 3 for more discussion.

The major element weighing most heavily is the cost of knowledge. Siggel (1983, p. 107) reports that foreign supervisors and managers which represent only three to five percent of employment often account for a larger proportion of the production cost than ordinary labour.

In Oman, the situation is different. The cost of importing technology, be it direct or indirect, is a less critical factor. Oil resources have provided the necessary capital required for the socio-economic development of Oman within a very short period of time (see section 5.3 for more discussion). However, such rapid development appears not to have brought with it the means as well as essential skills, i.e., appropriate indigenous managerial and manpower capabilities (see chapter 5 for more discussion). The required labour force has become much greater than the local workforce could provide, hence the need for importation of foreign manpower and expertise (see chapter 10, Research Findings and Discussion of Results).

As we have seen in the empirical finding in this study, the types of technology imported into Oman are sophisticated. Consequently, the low educational standard (see Table 6.2) of the local people often makes the comprehension of such technologies difficult. In turn, this perpetuates dependence on both foreign technology and foreign manpower (see section 10.2, Evaluation of Hypotheses). It was found that the programmes arranged with equipment firms were ill-planned. The training was not carried out in sufficient depth to provide the necessary skills required to cope with the technical complexities of the imported machines. the technology purchased ought to fit Oman's national resources and needs, and should be capital-intensive. Appropriate technology ought to be selected, and should be in line with the environmental setting of Oman.

13.4 CHANNELS OF TECHNOLOGY TRANSFER

There are many channels by which technological know-how is transferred from advanced to developing countries. They cover a wide range, from joint ventures, licensing, and turnkey agreements, to the supply of engineering, parts, and management. Depending on the exact circumstances of each individual case, and the nature of the technology involved, a developing country will adopt these methods either singly, or jointly (see chapter 4 for more details). The most predominant form, which can be divided into two, is a direct foreign investment by a multinational firm in a wholly-owned subsidiary or a joint venture with majority or minority participation by the foreign firm. The second form is basically a transfer agreement between independent enterprises, either private, semi-public or public (United Nations, 1974, p. 25).

Many projects may involve a combination of two or more of these methods, the majority owned direct investment may be subject to a contractual plan or be of indefinite duration. Each of these methods has its advantages and disadvantages to the importing country, Siggel (1983, p. 95).

In fact, it is often true that direct foreign investment remains a substantial source of capital and is sometimes the only source of specific technology. The United States as well as other major capital exporting countries prefer, for economic as well as ideological reasons, to transfer their capital outflows through private investment, and it is most probable, as Root and Ahmed (1979) put it, that developing countries will continue to rely on foreign direct investment to carry out their development programs. There are, however, certain conditions in developing countries that could either be attractive or unattractive to foreign direct investments; the above study found that substantial urbanisation, a relatively advanced infrastructure, a comparatively higher growth of per capita G.D.P. and political stability were major factors in attracting foreign investment.

For the second form of transfer which is a transfer agreement between enterprises, and which do not involve proprietary rights to the transfer, the decision of transfer may be left to local private enterprises, although governments are increasingly intervening in such decisions, either in local or public firms.

There is a growing concern of host countries to increase joint venture types of transfer. It seems, according to Stopford and Wells (1972) that certain multinatinality oriented firms are favouring such joint venture agreements. This is due to their lack of financial resources and to the tendency to increase their vertically integrated organisation so as to ensure that supply of a product over which they have quasi-monopolistic control.

According to Vaitsos (1974), the increasing shift from fully-owned subsidiaries by multinational companies towards joint venture agreement may be due to the enhanced knowledge and increasing concern of government authorities in developing countries over the nature of multinational enterprise activities. This method is often viewed as an important advantage to the recipient firms. When operating in joint ventures, the multinationals provide the machinery and equipment, the know-how and patents, and the recipient firm supplies the capital funds. The know-how supplied by the foreign participant may be related to the construction phases, to the production process and may involve brand-names and marketing skills, which involve a licensing agreement.

The licensing agreement contract includes, according to UNCTAD (1975), certain restrictive clauses related to the acquisition of technology, to its use in the production process and to the distribution of the commodities produced. Through these clauses, the licenser can exert control over a series of operations of the licensee, in particular those concerning the production; the clauses often refer to the quality of the product, the choice of the process technologies, and possible technical innovations, improvements and modifications that would be carried out by the licensee (see section 4.3 under licence agreement).

The licensing agreement may provide a good arrangement for the recipient firm in that it enhances their competitive position in the local market and often secures profitable operation because of the use of brand-name etc. However, and most often, because of the restrictive clauses it may restrict the growth prospects of the firm.

Another form of technological transfer is the turnkey contract. Turnkey agreements are made particularly at an early stage of industrialisation, when the country lacks local skills and when the operations involved are technologically complex. This form of contract implies a completely packaged transfer, that is, a supply of technical and managerial operations required to run the enterprise for the allocated period of time. Depending on the nature of the plant and the technology involved, the turnkey contractor may be either the owner of the technology or the main supplier of machinery or a consulting engineering organisation. When the project is large, many foreign organisations may combine to take up turnkey operations, UNIDO (1973, p. 9).

One of the disadvantages of such an arrangement is represented by the delivery of a plant together with instructions for operating it under the conditions assumed in its design, but failing to provide the recipient with an understanding of the full details of how and why the plant works to obtain maximum productivity or how it could be adapted for even better results (see chapter 4 for more discussion).

Despite the variety of forms and channels mentioned earlier, it is the combination of the desire of the supplier of technology to supply the technology and know-how in a particular form, and the ability of the purchaser to acquire it in a particular form that determines the mechanism of transfer in a particular case. Generally speaking, the most important issue of transfer lies in the case where suppliers play an active role of providing information in an immediately operational form such as foreign direct investment, licensing, turnkey agreements and technical service contracts. These (indirect forms) tend to predominate were a country lacks the capacity to undertake direct acquisition or the ability to negotiate or to put the package together. However, modes where foreigners play a passive role, which means locals have to acquire the knowledge and later translate it into technology (By consulting foreign technical staff, training, and copying foreign operations), appear to be channels of technology transfer of as much significance (see chapter 10).

In both of these cases, three types of capability should be distinguished in the transfer; the manufacturing ability that is necessary to operate the technology; the investment that is needed, either to expand existing capacity or to establish new capacity; and the innovation required to tailor the new methods of working in the new social circumstances.

In the technology transfer cases examined here, the last component was missing. The innovation needed to adapt processes and products to new ways of doing things, was lacking. One major reason for this problem is that technology transfer has been considered as a goal in itself, rather than as a way to enhance local technologies and capabilities, and so eventually lead to technological independence.

13.5 THE ECONOMY OF OMAN

Despite new discoveries, announced by the government, in oil and gas reserves which are now expected to last well into the twenty-first century, the strategy in Oman has been to diversify the national reserve sources on the basis of long-term plans. Government efforts have concentrated on agriculture, fisheries and light industries, with the aim of underpinning the country's development and creating more wealth (see chapter 5 for more details).

Before the discovery of oil in the 1960s, Oman has a largely subsistence economy based on farming and fishing. Now the economy is 90 percent based on the production of oil and gas (see Table 5.2). During the 1970s, when the infrastructure of the country was being developed at great intensity, there was a drift from the land to the urban areas, where high wages were attractive (Oman, 1990, pp. 97-105)

The shift of the national labour force from the traditional industries (fishing, boat-building, agriculture, etc.) to the oil sector resulted in that these traditional industries appear not to have enough workforce to maintain and sustain them. Consequently, some of the traditional industries seem to be gradually collapsing.

In the early years of development Oman was heavily dependent on expatriate skilled and semiskilled labour because of the lack of Omani workforce (see section 10.2). The distribution of the Omani and non-Omani population by economic activity (see Table 5.4) has been uneven, and has shown a tendency for concentration in the 'production' sector. Despite the fact that the professional, technical and managerial workers are the backbone of the economy, the number of Omani workers employed in this sector remain extremely low.

A review of the past and present portrays Oman as a young country with ambitious plans to develop its socio-economic structure. The imbalance in the distribution of manpower between the indigenous Omanis and the foreign expatriates is damaging the realisation of this objective (see section 5.5 for more discussion). Migrant workers outnumber native Omanis, and this is impeding the development of the local capabilities of Oman, and promoting dependence on foreign technologies.

Nevertheless, if no adequate action is taken now, to depend entirely on foreign labour may delay or even impede the Omani government's plan to achieve and sustain its local capabilities and thus reducing, to a large extent, its dependence on foreign technology.

13.6 OBSTACLES TO TECHNOLOGY TRANSFER

Despite the effort being made by the Government of Oman to tackle illiteracy, which effort is well expressed by the total commitment to expand and improve local education, the situation still poses a barrier to economic and social development. In almost all sectors of the economy a shortage of manpower constitutes a major constraint in the application of science and technology (see chapter 6 for more discussion).

There are many reasons why Omanis form a low percentage of the country's workforce. First of all, women are generally not encouraged to work to avoid mixing with men. The reasons for this are related to the religious background and the social structure of the country. Second, a large proportion of the population is under 15 years of age. Third, there is an excessive supply of social science graduates from university and high school level (see Table 6.1) compared with the actual need of the country. Fourth. in spite of the fact that the rate of illiteracy is falling, there still is a large number of Omani population who can neither read nor write (see Table 6.2)

Other reasons for the low percentage of Omani manpower include: (1) The poor level of proficiency among graduates of vocational schools (see table 6.2). (2) The import of labour-saving or capital-intensive methods of production being hindered by the shortage of the highly skilled manpower normally required to operate such technology-intensive equipment (3) The slow rate of economic development in the non-oil sector, due in part to an inadequate infrastructure (see Evaluation of Hypotheses in chapter 10).

Other problems in this area are: the lack of local participation in recipient organisations in the carrying out of the feasibility studies. Table 10.2 indicates that the cost of feasibility studies ranged from 2% to 10% of the actual cost of the projects. It was also discovered that the education institutions in Oman were not involved in any of the stages of execution of the projects. The recipient organisations were found to be heavily reliant on foreign firms for the conduct of the feasibility studies, rather than consulting indigenous firms. This will hinder the development of local capabilities and thus accelerate the degree of dependence on foreign sources (see chapter 10).

The cost of the imported machinery and equipment was very high, and accounted for between 50% and 71 % (see Table 10.2) of the actual total cost of the projects. The abundance of capital and lack of skilled Omani manpower place Oman in a special socio-economic status that is different from other developing nations. Where labour-intensive technology is appropriate for certain developing countries, e.g., India, Egypt, etc. (see chapter 8 for more discussion), it is indeed not suitable for Oman. As a result, Oman seeks technology with high capital intensity that is highly priced. The cost of acquiring technology is not as critical issue for Oman as it is in most other developing countries. In fact, Oman's aim in acquiring technology was found to be mainly directed towards sustaining its economy. Little attention was paid to the development of indigenous technical and managerial capabilities.

The cost of installation and commissioning was also found to be high (see Table 10.2). This fact reflects the lack of indigenous qualified scientists, engineers, middle-level technicians, and skilled workers, able to unpackage the imported technology. Even though Sultan Qaboos University has a college of Science, and a college of Engineering, they do not participate in the selection, unpackaging and adaptation of the technology. In fact, their role in supplying the country with trained skilled manpower in not very effective.

In terms of training and the collaboration of funds, only 43 projects out of 60 considered providing training programmes for their employees, and allocated only between 1% and 3% of the total cost for training (see Table 10.2). Despite the sophisticated nature of the technology involved, the recipient decision-makers ignored the importance of training in enhancing the individual's knowledge and ability in mastering the technology.

As Table 10.2 indicates, employing foreign experts was also considered by recipients. The employment of foreign experts is an essential mechanism of technology transfer. Their effectiveness in building and developing local manpower depends on whether they are left to work alone, or whether they work with local manpower.

Due to the shortage of skilled manpower and the sophistication of the technology, recipients always allocate a certain amount to cover maintenance. It was found (see Table 10.2) that firms in Oman depend mostly on suppliers for providing maintenance for the technology whenever requested.

Another obstacle has been the inadequate management of the natural resources, which has led to the inability to formulate an effective management programme for natural resources, or to utilise scientific techniques to develop a co-ordinated and comprehensive plan to effectively deal with problem areas (see chapter 6 for further discussion). The inadequate dissemination of technological information is another obstacle. An effective information system is essential in the technology transfer process. It is needed for the appropriate selection of new techniques, which depends on timely information.

Other external obstacles are cultural and social problems. Oman lacks indigenous skilled manpower. Consequently, the majority of the skilled scientific and technical personnel in most of the sectors are immigrant workers. These workers subscribe to different cultures, customs and living habits. The problem of co-ordinating such an assortment of ethnic groups, to achieve a common goal, is indeed a difficult job (see chapter 10). In such an environment, productivity and efficiency are bound to suffer. This assortment of ethnic groups of technical personnel is not stable. Because of the fast turnover, a high rate of recruitment is necessary to balance the high rate of resignation.

The second external obstacle is the environmental differences. Technological transfer, like other forms of international relations, involves countries with different political and socio-economic settings. However, the countries which provide most of the technology for developing countries, often seek to push them alongside their own way of development. For example, it is often claimed by developed countries that for developing countries to be able to use the imported foreign technologies effectively, they must have the same social and technical conditions as those of the supplier countries (see Al-Hassan, I., 1977). In most cases, this causes problems in developing countries because of the environmental differences.

13.7 OMAN AND SIMILAR DEVELOPING COUNTRIES

To provide a basis for the comparison and generalisation of the results of this study, the transfer of foreign technology to Oman has been compared with the situation in the other developing countries of Egypt, Nigeria, Brazil and India (see chapter 8 for more discussion). It was discovered that there are differences in the methods, processes and mechanisms of technology transfer from the industrialised countries to these recipients. Comparing these four countries with Oman, both similarities and dissimilarities can be explained by the differences in the economic strengths of the individual countries.

The similarities were that all of the countries discussed (including Oman) import both established and sophisticated technologies with similar elements of the technologies involved. The methods of transfer were also similar in that all of the countries received equipment and engaged in the training of the recipient personnel.

On the other hand, there were dissimilarities between Egypt, Brazil, Nigeria and India, on one side, and Oman on the other. Oman does not have problems with regard to financing of technology transfer projects. Oman is also more stable politically than the other countries, and is therefore able to attract more foreign investment, on more profitable terms. Oman does not have as large a skilled and able workforce as the other four countries do, which has meant that it is more difficult to develop local capabilities. This has increased dependence on foreign technologies, rather than reduced it (see chapter 10).

There is little or no local participation in the execution of projects in Oman, while there is significant local participation in such projects in say India, or Brazil (see sections 8.4 and 8.5 for further details). Unlike these other countries, Oman does not insist that foreign suppliers of technology must make maximum use of all local materials and services (see under Restrictions on the Omani Firm's Activities in chapter 10, page 225).

13.8 THE RECIPIENTS OF TECHNOLOGY

An analysis was carried out of a sample of the contractual agreements which had been signed with foreign firms which have provided technology to Oman. All contractual agreements, for the transfer of technology to Oman take place within the framework of Omani Law No. 26 of 1977. All government purchases and contracts pass through the Central Tenders Committee where relevant pre-qualification is required to show evidence that the supplier company is capable of undertaking the execution of the project.

Among the issues examined were: the source of the technology, the types of technology transferred, the training programmes carried out in the recipient organisations, the extent of the restrictions imposed upon the Omani firms' activities, the extent of the local participation in the execution of the projects, the availability of adequate scientific and technological information, and the methods used by the Omani firms to acquire the foreign technology, and their impact on the development of local capabilities (see Chapter 10).

The duration of the contractual agreement is a significant element in the process of technology transfer in the sense that the recipient firm might receive outdated and antiquated technology if the duration is too long. (see under the Period of the Contractual Agreement in Chapter 10).

It has been found from the results of the questionnaire that the time between the negotiation for the purchase of the technology (e.g. a turnkey project), and the commissioning of the project itself, takes around 45 months on average. In the best case, only 32 months are likely to have elapsed. Fifty percent of the cases are commissioned within three years and nine months (45 months) from start to finish (see in chapter 10). However, one can argue that in the worst 25% of instances there is a chance that some technologies may be obsolete by the time they are commissioned for use more than five years later.

It was also discovered that the recipients in Oman ignored the participation of local consultancy services in the feasibility studies, and relied totally on foreign firms (see under Source of Technology in Chapter 10). There was no involvement of indigenous institutions, such as Sultan Qaboos University. It is through local participation in the process of technology transfer that indigenous capabilities can be strengthened. The greater the local involvement in the design, the more rapid is the enhancement of local manpower. On the other hand, the less the participation of local manpower in the conduct and implementation of projects, the less likely is the development of indigenous personnel. The consequence is that the country will remain dependent on foreign manpower for the management of the acquired technology. In a similar vein, all of the machinery and equipment required for the projects was also imported (see Evaluation of Hypothesis in chapter 10).

Turnkey projects and the supply of machinery were found to be the most common methods used to transfer technology to Oman (see under The Criteria Used for the Selection of the Technology, page 216, in chapter 10). Omani firms try to acquire the latest available technology in the market which at the same time is proven to be economic in use. Surprisingly, only 30% of the selected projects considered the technological complexity as a "very important" factor in the selection of the technology. The point that arises here is that recipient firms depend upon acquiring technology through turnkey projects, under which a supplier of equipment undertakes to provide the full range of technical and managerial operations required to establish a certain firm. Thus, whether the technology is complex or not affects them little. In any case, foreign firms would provide short training programmes concerning operation and maintenance, even though they would ignore participation during the early stages of design and construction. It can be seen, however, that expenditure on training is typically a very small part of the value of turnkey projects.

It has been found from the results of the questionnaire (see chapter 10) that the recipient firms depended entirely on suppliers to execute the whole project, from the early stages through to the end. Local involvement was found to be minimal, in the design, construction, and installation of the projects. This clearly illustrates the extent to which the recipients had then to depend upon the foreign suppliers to operate, maintain, and adapt the technology. As a result, the recipient then sought skilled manpower from abroad.

Training as one means of successful transfer of technology was also neglected by recipient personnel (see under Training in chapter 10). In general, the training agreements between the recipient firms and the suppliers were too vague. Clauses did not specify in detail the period of training, the number of candidates, the qualification requirements, or the time scale required for the replacement of foreign expertise by the indigenous manpower.

13.9 THE ROLE OF HIGHER EDUCATION INSTITUTIONS

Universities and other institutions of higher education have a great role to play in development, especially in Third World countries where shortage of qualified scientists, technologists, engineers, and technicians is considered as one of the most acute problems in the effective application of science and technology. (Jones, G., 1971, p. 31). Higher education should be seen on the one hand as the main vehicle through which to increase new skills and knowledge necessary to assimilate and absorb new technologies, and on the other as a means to create a more suitable environment which will lead to social changes, enhancing the potential of the individual.

Other writers have perceived education as an investment in man, and they have treated it as a form of capital. (See for instance Meir, G., 1976, p. 481; Harbinson, F., 1976, p. 531; Schultz, T., 1960, p. 571; and Chamberlain, N., 1967, p. 51). Hawthorne, on the other hand, has viewed education as the essential way in which technological growth can be achieved, by extending the individual's scientific and technological knowledge (Hawthorne, E., 1978, p. 49).

Carter and Williams have written that: "The supply of people capable of using science and of adding to it by research depends on education and similarly, the supply of people capable of using technology and of adding to it by design and development work depends on education." (Carter, C. and Williams, B., 1964, p. 198).

This led them to the view that research and development grow out of education, that development grows out of research and that innovation grows out of development.

No nation can possibly grow industrially or economically, without drawing on the contribution of its higher education, the university is considered as means for ensuring the continuity of modern civilisation by preserving and extending culture, science and arts and by providing vocational and adult education (see chapter 11 for more discussion). Among those examined in this study were Sultan Qaboos University and Oman's College of Technology.

Despite an urgent need for local scientists and engineers, the number of students enrolled in sciences is not encouraging (see Table 11.2). It has been found that the majority of Omanis prefer to study Humanities (including Literature, Commerce, and Economic and Political Science). This situation has resulted from several reasons, among which are:

(a) The low percentage of students graduating from the secondary schools with a standard of 75% and above.

(b) Omani females do not like to be enrolled in scientific and technical subjects, due to the inappropriateness of the jobs they will get after graduation, i.e., long hours, and having to work with men (see chapter 6 for more discussion).

(c) Scientific and technical subjects are more difficult to follow and the time required for study is long; for instance the Faculty of Medicine requires seven years to award a degree, and five years are needed to achieve a degree from the Faculty of Engineering.

(d) There are only marginal differences in the salaries of science and humanities graduates. Most significant, the students' choice of career is greatly influenced by the type of home in which they have been reared, and their background in science is very week due to the educational system offered, especially in the secondary school (see section 11.3).

Oman is a small country, like most of the Gulf Countries, suffering from a clear lack of middle level technicians, skilled, and semiskilled workers. As a result, technical-vocational education and training in Oman was initiated as an answer to the urgent needs of governments and local industry for skilled workers and technical supervisors in order to supply the country with well-trained manpower and hence reduce dependence on a foreign labour force. Technical and vocational education and training is a prerequisite for the country's development (see Evaluation of Hypotheses in chapter 10).

Oman's College of Technology was established to provide highly skilled Omani personnel, and to fulfil the urgent need of the country in providing various sectors with well-trained technical manpower (see section 11.4).

As expected, the College and the Vocational and Technical Institutions encountered the same difficulties in achieving their objectives. These problems manifests themselves clearly in the number of students attending the College and various vocational programmes.

The low number of students attending vocational institutions may be attributed to a number of factors. Firstly, there are social and cultural obstacles. For example, it is often claimed in some Third World countries that manual labour is inferior to white-collar work. As a result of this, higher status is often accorded to white-collar workers. Secondly, many students like to attend university in order to achieve a higher status. Consequently, they tend to be more interested in the general education system. James Socknat has studied human resource development programmes in the Arabian Gulf states in 1975. His investigation revealed the lack of: "... a comprehensive career guidance programme, much less a system of career education by the Gulf governments." (Socknat, J., 1975, p. 14).

Thirdly, the reputation of the scheme operated in the present secondary schools aimed at getting students ready for higher education. Many of our secondary schools lack some important subjects such as technology, science, industrial development and so on. The result is that many students who attend industrial colleges have little or no experience in, say, recording and evaluating various components of their surroundings. Some vocational and technical activities such as seminars, lectures, films, etc. are also wanting.

There is also the problem of dropout in vocational schools. Usually, most of the students who register at vocational schools are those who did not appear to have performed well in the formal school courses. Determined to achieve success, they enrol for courses in the vocational schools, drawing a monthly subsistence allowance under the social welfare system. However, these students tend to drop out from vocational schools as soon as they secure suitable employment (see chapter 11 for more discussion).

However, the low number of students attending vocational institutions as mentioned earlier makes it difficult for planners to satisfy the country's need of such skills. Dependence on non-Omani skilled manpower seems to be high and desperately needed to fill the gap.

13.10 THE ROLE OF GOVERNMENT

Perhaps the most important organ in the transfer of technology is government. Without the consent of government the transfer of technology to a country would be almost impossible. It usually draws up policies aimed at guiding the transfer process (see chapter 12 for more discussion). UNCTAD suggests guidelines for the transfer of technology. First, the creation of institutions and provision of finance to help develop national technology. Second, the formulation of a science and technology policy which should be understandable to potential suppliers and recipients. Third, supporting the activities designed to adapt and improve upon the acquired technology (UNCTAD, 1975, p. 37).

On the other hand Bradbury (1987) recommends ways in which the government could assist in the transfer of technology (see section 12.2 for more discussion).

As well as the prospective contribution of technology to their economic development, Third World countries have specific reasons to formulate policies dealing with the transfer of technology.

Firstly, the technology transferred to developing countries is often inappropriate to their conditions. It has been frequently realised that imported technology from industrialised countries, which is complex and uses a large amount of capital per unit of labour, is not suitable for developing countries, where capital and skills are scarce and labour is underemployed (see under The Choice of Technology in Chapter 3).

Secondly, developing countries have on many occasions entered into arrangements where they are often at a disadvantage due to economic reasons, when dealing with the suppliers of technology. This is due, to some extent, to oligopoly/monopoly where technology is supplied by only few or in some cases only one outlet and often at inflated prices. Another problem of the "buyers" is their lack of technical and commercial expertise needed in such a field. Because of these problems and also because of conditions such as licensing agreements and other legislation, the maximum benefits are often not obtained in the transfer of technology (see chapter 3 for more discussion).

Thirdly, technology tend to be sold to developing countries in the form of a "package" and the countries usually try to obtain all or most elements in the "package". However, several "side effects" are encountered. Firstly, there is increased dependency on foreign contractors and technology suppliers to the detriment of local contractors. Local skills and technology are often ignored and go into decline. Whilst in the short run these arrangements look profitable, there are, in the long run, many disadvantages and economic problems (see section 3.3 for more discussion).

Last but not least, several governments have been encouraged to take action, often spurred on by the balance of payments situation in cases where there was concern usually for economic and technical reasons, to increase local technological output often by reducing legislation and by encouraging the unpackaging of imported technology; in doing so they have increased the recipients bargaining position (UNCTAD, 1980, p. 1).

While government plays an important role in the transfer of technology, this role varied significantly from one country to another, depending on bargaining power, and economic, technical, and legal circumstances (see section 12.4 for further details). One issue of importance was the role of Omani Government regulations. These were compared with the legislation and regulations which exist for the transfer of technology to Indonesia, India, Nigeria, Thailand and Brazil.

In Oman, there were no special regulations for the direction or control of the flow of technology into the country, despite the large volume of foreign technology imported (see section 12.3). In addition, the use of the patent system for the development of innovation was not effective. There is no national reporting system for the review of the activities of the patent office.

Brazil, through Normative Acts, has amended the law relating to technology transfer in order to strengthen its control on imported foreign technology (see under Brazil in section 12.4). In sharp contrast, Oman has not revised its law related to the transfer of technology from industrialised countries. This can damage its economy, as well as weaken its bargaining position.

There is a need for the governments of developing countries to formulate effective rules and regulations, designed to direct and control the implementation of foreign technologies for the benefit of individual countries.

To summarise, the rules and regulations guiding the transfer of technology from developed to developing countries should be designed to strengthen the hands of negotiators in commercial technology transfer deals, maximise gains from the transfer, and, last but not least, enhance the development and successful adaptation and diffusion of the imported technologies.

13.11 THE LACK OF LINKS BETWEEN HIGHER EDUCATION AND INDUSTRY

The contribution that education, particularly higher education can make to the advancement of a developing country, through technology transfer from developed countries, cannot be overemphasised. The country without doubt seeks to establish through its education system well-trained scientific and technical manpower in order to reduce dependence on foreign expatriates (see chapter 11 for more details).

The University of sultan Qaboos is perceived to be an ideal institution in which scientific industrial and technical skills can be learned. Consequently, the University is looked upon to plan, organise and formulate standard curricula for educating and training people to meet the immediate and future needs of Oman.

The relationship between the University and industry in the scientific, technical, and management fields should be promoted, and applied research must be encouraged to be mutually undertaken by two institutions. Research is vitally important for both teachers and students. An ideal research programme would be that which is designed to develop students' practical and theoretical skills. This could be enhanced by the use of case studies and industrial projects to be supervised by the University staff (see chapter 11 for more discussion).

The absence of R and D activities in a developing country (see Jones, G., 1971, p. 27) tends to perpetuate dependence on supplier companies for technical know-how and manpower. This does not encourage the development of local capabilities, which is what Oman (particularly) badly needs (see Evaluation of Hypotheses in chapter 10).

The most important aspect is to encourage and promote the establishment of R and D centres in Omani industry, especially in those sectors vital to oil. In the questionnaire respondents were asked to indicate if any relations existed between their R and D and that of other local and foreign R and D establishments. The results show no existence of any collaboration (see chapter 10).

An attempt was made for this study to identify the role of local educational institutions, such as Sultan Qaboos University, and the Vocational and Technical Institutions, in the selection and transfer of technology. None of the educational institutions in Oman had helped in the selection or in providing consultancy. Network links between those sectors and the higher educational institutions seems to be lacking (see chapter 10). The dependency in those sectors on foreign experts to solve urgent problems, and to provide advice when needed, widens the gap between those sectors and the higher educational institutions.

Government policies on matters such as education, industrial, training, technology transfer and population need to be revised to permit the successful transfer, adoption and diffusion of technology. The government needs to create the circumstances which will involve local engineers, scientists, technicians, and managers in the technology. It needs to formulate guidelines and mechanisms for the development of appropriate technology, to improve educational and training systems, and arrange for them to be linked to the manpower needs of the country (see section 11.2 for more discussion).

13.12 OBJECTIVES OF THE STUDY

From the literature review, the empirical findings and the results of the questionnaire, we identified the objectives of this study. First we examined the issue of technology transfer and highlighted the salient factors in this process analysing their impact on Oman as a developing country. Then we identified the obstacles facing the firms which include shortage of manpower and management capabilities that influence technology transfer, as well as the social, cultural, and environmental differences.

We have then investigated the contribution of the institutions of higher education and the government in the transfer of technology to Oman, and looked at the transfer of technology to some selected developing countries to make relevant comparisons with that of Oman. We also examined the extent to which the adaptation of technology by Oman requires the consideration of some fundamental aspects, such as developing local skills and making the appropriate choice of technology. Finally we assessed how far Omani technological independence is a function of the development of local capabilities.

This study concludes that Oman should develop a plan to create and develop local capabilities, to generate technological know-how, and to use indigenous manpower for the benefit of the country. Therefore, the import of technology from advanced countries and the development of indigenous technological infrastructure must be viewed by Omani decision-makers as complementary to one another.

CHAPTER 14

RECOMMENDATIONS

CHAPTER 14

RECOMMENDATIONS

CHAPTER 14

RECOMMENDATIONS

14.1 INTRODUCTION

In what follows, recommendations are formulated in order to make it possible for Oman to improve the process of technology transfer. And since, in this context, the adaptation of technology requires the participation of both parties, namely the firms and the government, these recommendations are derived from the factors described in chapters 9 (Research Methodology) and 10 (Research Findings and Discussion of Results), and their analysis, it is recommended that Oman should take the following steps to achieve a more beneficial and constructive technological transfer process.

It is important to realise that the various recommendations made should by no means be regarded as appropriate and suitable to all the recipients firms in Oman. This seems important as most of the recommendations are based primarily on the results of the analysis of the various selected firms for the study.

14.2 A PLAN FOR MANPOWER

Oman should develop a plan to create and develop local capabilities, to generate technological know-how, and to use indigenous manpower for the benefit of the country. It is necessary to create educational and professional training schemes that will enable the indigenous workforce. As we have seen in our empirical findings, there is the urgent need to develop the local capabilities aimed at reducing dependence on foreign technologies. It should also establish effective training and development programmes for the Omanis to be trained for technical and managerial jobs.

14.3 THE CO-ORDINATION OF RESEARCH AND DEVELOPMENT

Oman should establish a centre to co-ordinate the research and development activities of the Sultan Qaboos University and other institutions for higher education. No significant links were found to exist between the Omani higher educational institutions, and the sector investigated. The study here revealed that industry in Oman depends mainly on foreign experts, both for urgent problems and for long-term advice. The Sultan Qaboos University and other institutions of higher education should be encouraged to link their research activities with industrial projects. This would enhance and facilitate the development of local capabilities.

14.4 THE REGULATION OF TECHNOLOGY TRANSFER

State regulations governing transfer of technology should be revised to ensure that local consultancy and engineering design offices are closely involved in the technology transfer process through design, construction and maintenance. As we have seen in this study, in Oman there were no special regulations for the direction or control of the flow of technology. There is a need for the Omani governments to formulate effective rules and regulations designed to direct and control the implementation of foreign technologies for the benefit of the country. In addition, technological policy should be designed to:

a - Foster the development of the local technology.

b - Assist local companies in negotiations and acquisition of appropriate technology.

c - Assist in the technical and economical evaluation of the agreement for the transfer of technology.

d - Help in the classification and registration of technology transfer agreements.

To summarise, there is an urgent need for the creation of proper regulations to control the transfer of technology to Oman.

14.5 TECHNOLOGY TRANSFER AGREEMENTS AND TRAINING

Technology transfer agreements should be amended to include a clause that makes it imperative that local manpower is trained on the job by the supplier company so that local manpower can eventually handle and manage the new technology. This can be achieved by ensuring that training requirements are clearly stipulated in an agreement. An agreement should make it categorically clear whether personnel will be trained on the job in Oman, or in the transferor's overseas depot. Training in the areas of design and engineering services, construction and safety, and standards should also be included.

In order to build up and strengthen existing local capacity, recipients firms should pay the attention required to such activities while negotiating the conditions of the agreements. The supplier company should be asked, where relevant, to supply a prototype of the technology being transferred to Oman, to ensure its performance in the Omani environment, and to aid the training of the local workforce.

14.6 THE NEED FOR A COMMITTEE AND A CENTRE FOR TECHNOLOGY TRANSFER

A committee for the transfer of foreign technology to Oman should be commissioned and charged with responsibility to: establish criteria for the selection of appropriate technology; evaluate imported technology; classify and document available technology as a data bank for prospective firms; and establish a well-equipped centre for the dissemination of technological information.

A centre should be established for the training of personnel in the specialised areas of technology transfer, technology evaluation, forecasting, and patent activities. The centre should be charged with the responsibility of improving the mechanism for the successful adoption, adaptation and diffusion of acquired technology. This will speed up the development of local technology.

As we have seen in our empirical findings, there is an urgent need to develop the local capabilities aimed at reducing dependence on foreign technologies. To make the appropriate choice of technology, attention should be paid to the following factors:

1 - Develop local skills to exploit the imported technology successfully

2 - devise a mechanism for making the appropriate choice of technology. This must be enshrined in the national plan.

3 - Ensure that available local raw materials are fully used to reduce dependence on foreign resources.

4 - The government should hold the technology momentum by making money available for research and development aimed at application, adaptation and absorption of imported technologies.

14.7 LOCAL PARTICIPATION

Recipient organisations should be given the opportunity for local participation in the various stages of the execution of the projects because it is through local participation in the process of technology transfer that indigenous capabilities can be strengthened. The greater the local involvement in the design, planning, construction, and implementation of projects, the more rapid is the enhancement of local manpower. On the other hand, the less the participation of local manpower in the conduct and implementation of the projects, the less likely is the development of indigenous personnel.

For example, in our study the recipients depend entirely upon foreign firms in the execution of the projects, from the early stages to completion. The recipient personnel must recognise the importance of participation in every stage of the project. As participation in the construction of the plant, and its commissioning, provides the optional condition for learning how to use the technology, it is at these stages that local scientific and technological capabilities will be strengthened most effectively. Hence, dependence on foreign technology and manpower will be most easily reduced.

14.8 HIGHER EDUCATION'S MEETING MANPOWER REQUIREMENTS

The University of Sultan Qaboos and the Vocational and Technical Institutions should play a great role in Oman's development, especially in manpower requirements. The country without doubt seeks to establish through its education system well-trained scientific and technical manpower in order to reduce dependence on foreign expatriates. The University should be seen as a vehicle for providing the new skills and knowledge that is necessary to assimilate and absorb new technologies imported into the country. It should also be considered responsible for the supply of the scientists, engineers, technologists, and technicians that the country urgently needs.

It is also suggested that the University should attempt to improve its image by developing the school of postgraduate studies and by encouraging students to undertake research which serve the interests of the country.

The University of Sultan Qaboos and the Vocational and Technical Institutions should be involved in manpower planning so that they can prioritise the training and education of the students into those areas of the economy where the local workforce is most needed. It will help the educational institutions to equate the intake of students of faculties to national manpower needs.

14.9 SUGGESTIONS FOR FURTHER RESEARCH

It is hoped that what has been done and documented in the present thesis will provide knowledge regarding the kinds of transfer of technology and adaptation needed in a Third World country like Oman, and the problems and obstacles that are required to be bridged in order to make the technology prominent and meaningful in adapting technology transfer.

Further research seems necessary on the type of technology transfer from other developed countries to Oman. It was evident in the study that local service and consultancy organisations were not involved in important areas of technology transferred to Oman. Without local involvement it is difficult for local capabilities (e.g., technical) to be developed to the level required for Oman to create its own technology, or even to maintain and sustain any of the existing high technology of foreign companies. It would be of interest to study the Omani government's plans for eradicating or minimising dependence on foreign technology. Research undertaken in this area would help both existing and prospective new technology recipients to formulate their future strategies with more confidence.

It would also prove interesting to study and analyse ways in which the process of modernisation through technology could be achieved without affecting certain preserved identities, inherited cultures etc. On the other hand, as to whether certain culture or beliefs are barriers to modernisation, economic development and success in international competition needs to be determined.

The method of starting with examples of firms and then selecting a specific project seems to have been successful and has revealed interesting examples of problems in transfer of technology from foreign companies to local firms. This is a useful start. Future research could use more sophisticated forms of analysis with carefully-structured samples and comparisons of success with failure etc. of technology transfer. Concentration on specific aspects is also possible in that there could be studies of management decision making, production techniques, the role of marketing etc. The crucial problem of the synthesis of different aspects remains and the author hopes that this thesis has been able to demonstrate how technology transfer could help Oman to develop its local capabilities aimed at sustaining and maintaining some elements of technological independence.

REFERENCES

REFERENCES

Note : References indicated by an asterisk are in Arabic.

ADIKIBI, O.
"The Multinational Company and Technology Transfer to Nigeria: Case Study of the Type Industry", 1981.

AL-HASSAN, I.
"The Transfer of Technology as a Socio-Economic Problem", Baghdad Observer, 1977.

AL-MUSA, A.
"Seminar on Human Resources Development in the Gulf States", Bahrain, 15-18 February 1975.

AMIN, S.
"Neo-Colonialism in West Africa", Harmondsworth, Penguin, 1973.

APO
"APO Sem: Product Design", V1/83, Hong Kong, 1983.

BAER, W.
"Technology, Employment and Development: Empirical Findings", in World Development, Vol. 4, No .2, 1976.

BAMAKHRAMAH, A.
"Policies for Transfer of Technology to Developing Countries: The Case of Middle Eastern Oil-Exporting Countries", Ph.D. Thesis, University of Miami, 1981.

BARANSON, J.
"Technology and the Multinationals", Lexington Books, Massachusetts, 1979.

BARNET, R. J. and MULLER, R. E.
"Global Reach: The Power of the Multinational Corporations", New York, Simon & Schuster, 1974.

BAYNES, K.
"Industrial Design and the Community", London, Lund. Hampshires, 1967, p. 10.

BONSIEPE, G.
"Precariousness and Ambiguity: Industrial Design in Dependent Countries", The Social Contribution of Design, Julian Bicknell and Liza Quiston, Editors, Oxford, Pergamon Press, 1977, p. 13.

BOURRIERES
Discussion Paper on "Appropriate Technologies for Third World Development", Edited by Austin, B., Proceeding of Conference held by the Economic Association at Tehran, Iran, St. Martin Press, New York, 1979.

BRADBURY, F. R.
"Technology Transfer Practice of International Firms", The Netherland, Sijthoff & Noordoff BV, 1978, p. 51.

BROOKS, H.
"National Science Policy and Technology Transfer", Conference on Technology Transfer and Innovation, National Science Foundation, NSF 67-5. mimeo 1966.

BROOKS, H.
"The Government of Science", Cambridge Massachusetts, The MIT Press, 1968.

BURKHARDT, F. and FRANKSEN, I.
"Design Dieter Rams", 1984, p. 14.

CARTER, C. and WILLIAMS, B.
"Government Scientific Policy and Growth of British Economy", The Manchester School of Economic and Social Studies, Vol. xxxii, 1964.

CHAMBERLAIN, N.
"Training and Human Capital", in Spencer, D. and Woroniak, A. "The Transfer of Technology to Developing Countries", New York, Fredrick A. Praeger Publishers, 1967.

CHISNALL, P.
"Marketing Research: Analysis and Measurement". McGraw-Hill Book Company (U.K.) Ltd., 1981.

CHUDSON, W.
"The International Transfer of Commercial Technology to Developing Countries", International Advisor on Foreign Investment, Development of Economic and Social Affairs, United Nations, 1977.

CNAA
"Managing Design", Report of a Project Jointly Sponsored by CNAA, Department of Trade Industry and the Design Council, 1984, p. 5.

CONTRERAS, C.
"Technology Transfer: A Survey and Some Policy Prospects", Lima, 1975.

COOPER, C. and SERCOVITCH, F.
"The Channels and Mechanisms for the Transfer of Technology from Developed to Developing Countries", Geneva, UNCTAD, 1971.

DAHLMAN, C. and WESTPHAL, L.
"The Transfer of Technology: Issues in the Acquisition of Technological capability by Developing Countries", In Finance and Development, Vol. 20, December 1983.

DAVIDSON, H., CETRAN, M. and GOLDHAR, J.
"Technology Transfer", Noordhoff-Leiden Press, 1974.

DELORME, J.
"The Changing Legal Framework for Technology Transfer, Some Implications", in OCDE, 1982.

DEVAVS, D. A.
"Surveys in Social Research", George Allen and Unwin Press, 1986.

Directorate General of National Statistics,
Sultanate of Oman
"Statistical Year Book", 1990, p. 377.

DOS SANTOS, T.
The Structure of Dependence in C. D. Wilber: The Political Economy of Development and Underdevelopment, New York, 1970.

DRS CONFERENCE
"The Role of Designers", Bath University, 1984.

DRUCKER, P.
"India and Appropriate Technology", Wall Street Journal, March 1, 1979, p. 22. Cited in Khera, 1, "A Two Tire Technology Choice Model for Developing Countries", Asia, Pacific Dimensions of International Business, University of Hawaii, December 18-20, 1979. p. 280.

DUNNING, J. H.
"Towards a Taxonomy of Technology Transfer and Possible Impact on OECD Countries", in OCDE, 1982.

Egypt-British Chamber of Commerce
"The Economy of Egypt", Journal of Egypt-British Chamber of Commerce, December 1984.

FITZGERALD, F. T.
"Sociologies of Development", Journal of Contemporary Asia, Vol. 11, No. 1, 1981, pp. 5-19.

FORSYTH, D., MCBAIN, N. and SOLOMON, R.
"Technical Rigidity and Appropriate Technology in Less Developed Countries", in World Development, Vol. 8, 1980.

FRISENDAHL
"Lecture Note on Manpower Planning", Social Policy in the Middle East, April, 1970, p. 2; Quoted from Al-Essa, S., 1981.

GEE, S.
"Technology Transfer, Innovation, and International Competitiveness", John Wiley & Sons, New York, 1981.

GENEVIENCE, C. D.
"Science and Technology in the Development of Modern China", London, Mansell, 1976.

GOLDEN, D. A.
"Technology Transfer from Developed to Less Developed Countries", Information Technology, North-Holland Pub., 1978.

GRAHAM, E. M.
"The Terms of Transfer of Technology to the Developing Nations: a Survey of the Major Issues", 1979.

HARBINSON, F.
"Human Resources Development Policy in Modernising Economies", International Labour Review, No. 85, May 1962.

HARBINSON, F.
"Approaches to Human Resources Development", Cited in Meier, G., 1976.

HAWTHORNE, E.
"The Management of Technology", Mcgraw-Hill Book Company (U.K.) Ltd., 1978.

HAYES, C.
"The Industrial Design Requirements of Industry", London, The Design Council, 1983.

HELLEINER, G. K.
"The Role of the Multinational Corporations in the less Developed Countries", Trade in Technology, in Kojima & Wionczek, op-cit, 1975.

HETMAN, F.
"Science and the Assessment of Technology", Premises, Concepts, Methodology, Experiments, Areas of Application, OECD, 1973.

HOFFMAN, L.
"The Transfer of Technology to Developing Countries", Intereconomics, Vol. 20, March/April 1985.

HAYES, C.
"The Industrial Design Requirements of Industry", London, The Design Council, 1983.

JASINSKI, B.
"Appropriate Technology for Developing Countries", in Studies on the Developing Countries, Polish Institute for International Affairs. Vol. 10, 1979.

JONES, G.
"The Role of Science and Technology in Developing Countries", Oxford University Press, 1971.

LALL, S.
"Transactions, Domestic Enterprises and Industrial Structure in Host LDC's: A Survey", Oxford Economic Papers, Vol. 30, 1978, pp. 217-247.

LALL, S.
"Transactional Corporation Investment and the Sharing of Technology", Third World Quarterly. Vol. 11, No. 4., October 1980.

LALL, S.
"Developing Countries in the International Economy", Oxford University, Institute of Economics and Statistics, the MacMillan Press Ltd., 1981.

LANGRISH, J.
"Technology Transfer: Adaption not Adoption", Gloria, 1975.

LLOYDS BANK
"Brazil Economic Report", November 1988.

LLOYDS BANK
"Egypt Economic Report", November 1986.

LLOYDS BANK
"India Economic Report", November 1987.

LLOYDS BANK
"Nigeria Economic Report", November 1987.

MACDONALD, S. and LAMBERTON, D.
"The Trouble with Technology: Exploration in the Process of Technological Change, Thomas Mandeville Pub., 1983.

MEHROTRA, S.
"India and the Soviet Union: Trade and Technology Transfer", 1985.

MEIER, G.
"Leading Issues in Economic Development", Oxford University Press, New York, 1976.

Ministry of Agriculture and Fisheries
"Economic Development", 1990, pp. 66-72.

* Ministry of Commerce and Industry
"The Economy of Oman", 1989, pp. 77-92

Ministry of Commerce and Industry
"Commerce and Industry", 1990, pp. 81-87.

Ministry of Commerce and Industry
"The Economy of Oman", 1980, pp. 92-98.

* Ministry of Education
"Education in Oman", 1990, pp. 143-149.

* Ministry of Health
"Health Services", 1991, pp. 156-162.

Ministry of Information
"Oman", 1984, pp. 26-28.

Ministry of Information
"Oman", 1985.

Ministry of Information
"Oman", 1988, p. 17.

Ministry of Information
"Oman", 1990, pp. 19-22.

Ministry of Information
"The Promise & The Fulfilment", Oman, 1990, pp. 117-122.

Ibid, pp. 149-152.

* Ministry of Social Affairs
"Social Affairs", 1990, pp. 130-139.

MORAWETZ, D.
"Employment Implications of Industrialization in Developing Countries: A Survey", pp. 491-542, Cited in Santikarn, M., 1981, p. 17.

MURPHY, J. W.
"A Modern View of the Transfer of Technology - Third World Development", Science and Public Policy, Vol. 12, No. 3, Beech Tree Publishing, Surrey, England, 1985.

MYINT, H.
"The Economic of the Developing Countries", Hutchinson, London, 1967.

OCDE
"North/South Technology Transfer: The Adjustments Ahead", Analytical Studies, Paris, 1982.

OKADA, Y.
"The Dilemma of Indonesian Dependency on Foreign Direct Investments, Development and Change, Vol. 14, No. 1, 1983, pp. 115-131.

OKITA, S. and TAMURA, S.
"Transfer of Technology and Japanese Experience, in Kojima and Wionczek", 1975.

OLIVEIRA, L.
"The International Transfer of technology on an Enterprise to enterprise basis: A Conceptual Model and an Application - A Brazilian Experience in Computers", Ph.D. Thesis, University of Bath, 1982.

* OMAN
"Agriculture in Oman", 1990, pp. 97-105.

* OMAN
"Electricity & Water", 1991, p. 123.

* OMAN
"Justice, Awqaf, and Islamic Affairs", 1985, pp. 187-190.

Oman Chamber of Commerce and Industry
"The Law for the Organisation and Encouragement of Industry", 1985, p. 31.

OZAWA, T.
"The Role of Technology from Japan to Developing Countries", UNITAR, 1971, p. 27.

PACK, H.
"The Substitution of Labour for Capital in Kenyan Manufacturing", United States Agency for International Development, 1972.
PAPANEK, V.
"Design for the Real World", London, 1974, p. 33.

PETERLONGO, G.
"Two Models for the Development of Transnational Education Systems: Redesigned Transfer and Controlled Multiplication", in A.M.R. Ghonaimy, 1977.

QUINN, B.
"Technology Transfer by MNC's", Harvard Business Review, November/December 1969.

QUINN, D.
"Scientific and Technical Strategies at the National and Major Enterprises Level", Paper for UNESCO Symposium on the Role of Science and Technology in Economic Development, Paris, 1969.

ROOT, F. R.
"The Role of International Business in the Diffusion of Technological Innovation", Economics and Business Bulletin, Summer, 1968.

ROOT, D. R. and AHMED, A. A.
"Empirical Determinants of Manufacturing Direct Foreign Investment in Developing Countries", Development and Cultural Change, Vol. 27, 1979, pp. 751-767.

ROTHWELL, R. and ROBERTSON, A.
"The Role of Communications in Technological Innovation", in Research Policy 2, 1973.

ROSTOW, W. W.
"The Stages of Economic Growth", Cambridge University Press, 1960.

RUBENSTEIN, A. H.
"Technical Information, Technical Assistance and Technology Transfer, the Need for Synthesis", in Research and Development Management, Vol. 6, 1976.

RUBENSTEIN, A. H., SCHLIE, T. W. and JEDLICKA, A. D.
"Some Current Field Research on Appropriate Technologies for the Less Developed Countries", Science Technology and Development - Essays in Honour of Prof. A. Rahman, Sherma, K. D., Qureshi, M. A., Sterling Pub., ovt. Ltd., New Delhi, 1978.

SAGASI, F.
"Knowledge is Power", Mazingira, No. 2, 1979, p. 28: Cited in UNIDO, 1981, p. 7.

SANTIKARN, M.
"Technology Transfer: A Case Study", Singapore University Press, 1981.

SCHLIE, T. W.
"Appropriate Technology: Some Concepts, Some Ideas, and Some recent Experiences in Africa", East Africa Journal of Rural Development, 1974.

SCHULTZ, T.
"Capital Formation by Education", The Journal of Political Economy, Vol. lxiii, The University of Chicago Press, February-December, 1960.

SERCOVITCH, F.
"Foreign Technology and control in the Argentinian Industry", D. Phil. Thesis, Sussex University, England, 1974.

SHUMACHER, E.
"Small is Beautiful", a Study of Economics as if People Mattered, Abacus, London, 1979.

SIGGEL, E.
"The Mechanisms, Efficiency and Cost of Technology Transfers in the Industrial Sector of Zaire", Development and Change, Vol. 14, 1983, pp. 83-114.

SINGH, K. D.
"Import of Capital Goods", in Kojima and Wionzek, op-cit. 1975.

SOCKNAT, J.
"An Inventory and Assessment of Employment Oriented Human Resources Development Programmes in the Gulf Area", Bahrain, 1975.

SOLO, R. A.
"The Capacity to Assimilate and Advanced Technology", The American Economic Review, LV1, No. 2, 1966, p. 91.

STEWART, F.
"Technology and Employment in Less Developed Countries", in World Development, Vol. 2, No. 3, March 1974.

STEWART, F.
"International Technology Transfer: Issues and Policy Options", World Bank Staff Working Paper, Washington, 1979.

STEWART, T. and FRANCIS, D.
"Choice of Technique in Developing Countries", Journal of Development Studies, October 1972, pp. 100-126.

STEPANEK, J. E.
"Technologies Appropriate for Industry in the Developing Countries", UNCID, STD/5/R PCA/IND/2, 1979, p. 3.

STOPFORD, J. and WELLS, L.
"Managing the Multinational Enterprise", Longman, London, 1972.

STREETEN, P.
"The Frontiers of Developed Studies", MacMillan, London, 1972, p. 391.

SUNKEL, D.
"National Development Policy and External Dependence in Latin America", Journal of Development Studies, Vol. 6, No. 1, 1969.

Sultan Qaboos University, Sultanate of Oman
"Academic Year-book", 1988-1990.

SUMMER REPORT
"Industrialization in Developing Nations", Engineering Foundation Research Conference, University School, Milwaukee, 1969.

TOMLINSON
"A Model of the Joint Venture Process in International Business", 1978.

UN
"The Acquisition of Technology from Multinational Corporations by Developing Countries", New York, 1974.

UNCTAD
"Guidelines for the Study of the Transfer of Technology to Developing Countries", December, 1972.

UNCTAD
"Major Issues Arising from the Transfer of Technology to Developing Countries", United Nations, New York, 1975.

UNCTAD
"Handbook on the Acquisition of Technology by Developing Countries", United Nations, New York, 1978.

UNCTAD
"Transfer of Technology: its Implication for Development/Environment", New York, UN, 1978.

UNCTAD
"Legislation and Regulations on Transfer of Technology: Empirical Analysis of their Effects in Selected Countries", Report by the UNCTAD Secretariat, 28th August 1980.

UNCTAD
"Planning the Technological Transformation of Developing Countries", Study by UNCTAD Secretariat, United Nations, 1981.

UNCTAD
"Problems and Issues Concerning the Transfer, Application and Development of Technology in the Energy Sector", Study by the UNCTAD Secretariat, 19 August 1982.

UNCTAD
"Restructuring the Legal Environment: National Laws and Regulations on the Transfer, Acquisition and Development of Technology", Report by the UNCTAD Secretariat, 17 August 1984.

UNCTAD
"The Implementation of Law and Regulations on Transfer of Technology: The Experience of Nigeria", United Nations, 1985.

UNCTAD
"A Strategy for the Technological Transformation of Developing Countries" United Nations, 1985.

UNCTAD
"Transfer and Development of Technology in Egypt", Report by UNCTAD Mission, United Nations, 8th January 1986.

UNIDO
"Guidelines for the Acquisition of Foreign Technology in Developing Countries", New York, 1973.

UNIDO
"National Approaches to the Acquisition of Technology", United Nations, New York, 1977.

UNIDO
"Technological Self-Reliance of the Developing Countries: Towards Operational Strategies", Development and Transfer of Technology Series, No. 15, Vienna, United Nations 1981.

US Congress House
"Select Committee on Small Business (Subcommittee on Science and Technology), Policy Planning for Technology Transfer, A Report Prepared by the Science Policy Research Division, Legislation Services, Library of Congress, 90th Congress, First Session, Washington, D.C., Government Policy Office, 1967.

VAITSOS, C.
"Intercountry Income Distribution and Transnational Enterprises", Clarendon, Oxford, 1974.

VAIZEY, J.
"Technology and Skills, Planning for Advanced Skills and Technologies in UNIDO", Industrial Planning and Programming Series No. 3, 1969.

VERNON, R.
"Sovereignty at Bay", Basic Books, New York, 1971.

WAHBA, W.
"Acquisition of Foreign Technology in Egypt: A New Approach", UNIDO, 1982.

WALLENDER, W. and HOLLAND, S.
"Analysis of an UNCTAD Draft Outline of an International Code of Conduct on Transfer of Technology", New York, 1976, p. 66.

WILKINS, M.
"The Role of Private Business in the International Diffusion of Technology", Journal of Economic History, March, 1974.

WIPO
"Licensing Guide for Developing Countries", Geneva, 1977.

YEOMAN, W. A.
"Selection of Production Process for Manufacturing Subsidiaries of U.S. Based Multinational Corporation", Boston, Mass., 1968.

YOUNG, A. J.
"Methodological Aspects of Management Education at University Level in Developing Countries", Management International Review, Vol. 4, 1966, pp. 95–102.

YOUNG, S.
"Appropriate Technology for the Developing Countries", in Manser, W. and Webley, S. "Technology Transfer to Developing Countries", The Royal Institute of International Affairs, 1979.

YOSHIOKA, M.
"Report of Seminar on Product Design", Asian Productivity Organisation, Hong Kong, 1983.