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PROBLEMS OF MANAGEMENT OF TECHNOLOGY TRANSFER AND DIFFUSION PROCESS IN DEVELOPING COUNTRIES WITH PARTICULAR REFERENCE TO NIGERIA.

by

JIDE OLUTIMAYIN (M.Sc.)

A thesis submitted for the Degree of Ph.D. in the Business School, City University, London.

June 1984.

DEDICATION

This work is dedicated to my late father,

OLOKE

and my mother,

REBECCA OLUWEWU.

SYNOPSIS

This study is both to review the many excellent discussions of the issue of transfer of technology which has appeared in recent years, and to comment on some which are less excellent; it is also to see the extent to which these discussions lend themselves to the burning issue of effective management (i.e. acquisition and utilisation) of technology in developing countries.

For ease of application, the study examines Nigerian technology transfer practices from a perspective that is organised around the principles and practices of the government, top executives, and middle management, and the ways in which these groups of personnel can be helped to vitualise their problems in managing technological innovation.

The study also incorporates two comparative sub-studies of how some advance countries organise for innovation, and how they predict, avoid and/or tackle technological problems that are similar to those identified in developing countries.

The resultant of the study is therefore a set of recommendations comprising:-

(i) a procedural model for acquiring (foreign) technology,

(ii) how to effect better diffusion of technology and its-know-how, and

(iii) ways and means of making available technology effective.

ACKNOWLEDGEMENT

I am indebted in thanks to my two Supervisors, Professor Kenneth J. Shone and Mr. Gordon Wright. Professor Shone gave a very helpful guidance throughout this research. His criticisms were constructive and his suggestions were very valuable. Although Mr. Gordon Wright only became very involved at the later stage, his actions at ensuring a successful completion are highly appreciated. To both of them, I am grateful. I am also grateful to [redacted] for her moral support and for her hospitality at my having lunch with the family on a number of occasions.

Professor M.O. Kayode was my external supervisor during the data collection and part of the report writing (in Nigeria). He showed personal interest in the work and gave very many valuable suggestions. For these, I am grateful.

It is not possible here to list all my friends who urged me on, and gave me words of encouragement when things looked dull. But special mention must be made of [redacted], Professor [redacted] Thank you very much indeed.

I acknowledge the patience and understanding of members of my family and other loved ones who stood by me throughout the duration of this work. I kept away from you when you would have been too glad to have me around, yet you did not complain. Thank you for the endurance.

Lastly, I would want to thank [redacted] for typing the work. He was exceptionally co-operative.

Finally, I thank God for making everything possible.

DECLARATION

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J. OLUTIMAYIN.

PROBLEMS OF MANAGEMENT OF TECHNOLOGY TRANSFER AND DIFFUSION PROCESSES IN DEVELOPING COUNTRIES WITH PARTICULAR REFERENCE TO NIGERIA.

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1.1 Definitions

1.1.1 Technology.

Because it is a special category of resource and is so varied in its content and in the meaning attached to it, "technology" has been defined in many different ways. There is a range of perceptions regarding the nature of technology and the difficulty of finding an all-embracing definition. While technology is embodied in tangible products such as machinery or industrial complexes, or in legal documents such as patents, licenses or know-how contracts, it may also be expressed in the form of a skill, a practice or even a "technology culture" which finally becomes so diffuse that it is no longer noticed. However, it is on such a "culture" that the proper functioning of a given technical system ultimately depends. For example, a firm wishing to transfer a particular technology for the first time ever may have to produce a vast set of written rules and descriptions defining its management and shop-floor practices(1)

This cultural aspect of technology has led some authors to say that "technology is, in fact, the <u>use of scientific knowledge by a given society at a given moment to resolve concrete problems</u> facing its development, drawing mainly on the means at its disposal, in accordance with its culture and scale of values" (2)

Thus technology and culture are viewed as two interwoven elements. Consequently the transfer of a technology into an environment must take cognizance of the factors inside and in the surrounding environment.

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(1) OECD; "North/South Technology Transfer: The adjustments Ahead". Paris 1981.

(2) OECD/Interfutures: "The Problems of Technology Transfer between Advanced and Developing Societies", Midway Through Interfutures, Chapter XII, Paris, February 1978.

1.1.2. Technology Transfer

Seen from this framework, technology transfer is therefore defined in its broadest sense as "the aggregate of all knowledge, expertise and other resources necessary for transforming inputs, resources and other factors of production (labour, capital, materials, machines, etc) from one place into good and services in another place". Accordingly, it embraces technical, managerial, administrative and other aspects, all of which are incorporated in an organised manner into the system of production.

This definition recognises the fact that for technology transfer to be meaningful the recipient must have the knowledge and expertise or experience (or be able to gain these) to utilise machines, materials, capital and labour to produce the desired results. In addition, the exercise must take into consideration the environment within which the technology would operate.

1.2. Need for Research

1.2.1. Success (or non-success) of Innovation

Data from the interviews in Nigeria and the literature referring mainly to developed countries showed that there were major problems in developing and using new production facilites to utilise newly available technologies. Making a success of a new technology is a problem both for developing countries (Nigeria) and Western developed countries where literature was available. It appears that Western research findings referring to Western conditions could have made greater relevance to Nigeria than may be expected by anyone who was only familar with differences between the countries.

For example the major waste of inputs of human and physical resources put into the whole innovative process seems to arise at the stage of developing the new production facilites to be nationally useful, and not in the preliminary stages of developing the technology required by those production facilites. Secondly the indications are that in both developed and developing countries the difficulty of introducing the technology is less likely to be within the technology but in using, marketing and managing it. For these two reasons alone a research study on the management of innovation with new technology would seem potentially most valuable.

1.2.2. Past Efforts at Technology Transfer by the Third World

The United Nations has been actively promoting the use of science and technology in the development of Third World countries for more than two decades. UN organisations such as the Office of Science and Technology, UNESCO, UNCTAD, ILO, WHO, FAO and others have been providing a variety of services to member states in this field. These programmes have sought to heighteen awareness of the technological aspects of developmental processes including technology transfer, employment and technology, appropriate technology and technology choice, technical training, science policy, science education and a host of other topics (3). Furthermore, numerous UN resolutions have drawn attention to the importance of developing indigenous technological capabilities. However, in the rush for solutions most developing countries have gone too far or not far enough in the purchase of packaged technology.

Most of these packaged technologies however, come as turnkey types. Technology transfer from developed countries to developing countries started as far back as 1805 (4) during the reign of Mohammed Ali. Ali tried for over forty-three years to industrialise Egypt, but his efforts did not materialise. Moving to more recent times one notices that since the introduction of the Mexican Green Revolution in 1965, total agricultural production there has not risen (2); some observers even believe that there has been a slight decrease. Although Mexican agricultural output has been showing steady increases during the period from 1945 to 1965, the new superior technology not only arrested this growth but has led to further inequities. This is a classic example of possible negative effects of technology on developing countries.

Thus it is evident that developing countries had tried to industrialise through technology transfer but have had problems doing so.

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2 OECD, ibid.

3 A.B. Zahlan; Technology Transfer and Change in the Arab World (Foreword x^1).

4 A.B. Zahlan, ibid.

Reasons for Failure.

Various reasons have been advanced why technology transfer has failed in developing countries. These include:-

(i) Misconception of technology by Less Developed Countries (LDCs), i.e. failure to understand the demands of the technological process, its finance, and prices in both technical and social terms;

(ii) Restrictions by technology suppliers;

(iii) Costs in monetary, human and physical terms;

(iv) Inability to identify requirements

(v) Over pricing

(vi) Finance

(vii) Rights and Prices

(viii) Differences (in bearings of purpose) between suppliers and recipients

Making things work.

It is evident therefore that technology transfer in developing countries over the centuries has faced many difficulties, usually not foreseen. To overcome these difficulties, it is important, indeed imperative, to understand that technology transfer has three main functions, viz:

(i) Procurement of technology
- usually in a less developed country this is the concern of government and it entails the definition of objectives and policies for acquisition of technology.

(ii) Setting up the industry
- this concerns top management who execute the policies, usually determined by government; and also the concern of the government that may provide resources and infrastructure for the industry.

(iii) Making industry effective
- this concerns middle management that ensures that direction and control of resources are effective and that the systems operate.

Management - The Imperative Focus.

The above three functions more or less define (or force) management as the central point(s) around which successful technology transfer revolves. There is therefore a need to research management of technology in developing countries so that the effort put into technology transfer may be more fruitful.

1.2.3. Management - a grassroot factor

Thirdly, problems of technology transfer need to be considered from management angle because the science/art of managing is the grassroot of any organisation, and more basic to its success than possibly any other factor.

1.2.4. Aid to Managers.

Lastly, it is observed that past studies on technology transfer in developing countries had mostly been economic-oriented. Therefore a study that is management-biased would be most valuable because of the belief that if managers of technology transfer can be helped to vitualise their problems then they are likely to reduce the effects of these problems.

1.3. Purpose of Research.

It is generally recognised that the acceleration of the rate of economic growth of the developing countries and the rapid improvement in their social structure through the eradication of mass poverty and of inequlity of income require inter alia a large-scale transfer from the vast pool of technology accumulated mainly in the developed countries.

There is also the belief that the process of the transfer of technology, if left to the prevailing market forces, would accentuate rather than alleviate some aspects of under-development: it would aggraviate the inequality of social and economic relations and increase external dependence. For instance, the direct annual foreign exchange payments by the developing countries for imported technology are high - $1,500 million in or around 1968 (5).

In order to change the commonly observed pattern of technological dependence and to achieve an increasing degree of technological efficiency, it is necessary to make a conscious effort to build up the required technical infrastructures. In order to master the process of technological transfer a country must acquire the capacity to choose between alternative technologies, to adapt imported technologies to local conditions, and ultimately to participate in the creation of new technology. This means that the problem of the transfer of technology, although tackled in isolation in this study, is infact closely related to scientific policies and to the Social and Political pre-requisition of economic development(6).

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(5) UNCTAD (Geneva), Guidelines for the Study of the transfer of technology to developing countries. United Nations, New York, 1972 p.1.

(6) UNCTAD (Geneva) ibid p.6.

The purpose of the research therefore is to help managers understand the process of innovation so that they will be more successful in it. The resultant of this success is a corollary to the "Need for Research", and the realisation of the above benefits.

The research therefore seeks to identify the problems involved in the management of technological innovation (i.e. acquiring and utilising technologies in developing countries) such that (in addition to other benefits) will enable developing countries to utilise foreign technology more effectively in the world industrial trading system that has contributed so much to the prosperity of the developed countries over the last 25 years.

1.4. Scope and Limits of Research.

The scope and complexity of the subject matter has made it necessary to impose some limits on the study as follows:

(i) the study will not involve itself deeply in economic considerations of technology transfer because earlier researches on problems of technology transfer in developing countries (particularly, Nigeria) were mostly economic oriented (Accounts and the rest of it), e.g.

> "Technology Transfer and Capital Accumulation (A study of the Nigerian Manufacturing Industries); Thomas, D. Babatunde: Ph.D. Thesis, Indiana University (1973)"

(ii) the study will steer clear, as much as possible, from issues of Restrictions by Technology Suppliers i.e. Packaging; Costs and/or Pricing of Technology; Financing Technology; Rights and Prices attracted by, and attached to Technology; and from issues of Legislative and Legal Difficulties involved in Acquisition of Technology, mainly because there had been some sporadic work/comments on the legal implications of the process in Nigeria.

(iii) rather, the study will concentrate on the implementation phase of Technology Transfer, in other words, on the management of innovation, where innovation is to introduce and make effective a 'new' technology which may have been purchased from abroad or acquired from local sources, i.e. acquisition and utilisation of technology (See Fig. 1.5.1)

More recent work gives rise to optimism that this was a realistic choice and likely to be beneficial to developing countries who are expected to use the research results.

The model in Fig. 1.5.1. is segregated into two elements; 'Acquisition' and 'Utilisation'. Acquisition, in general, is further divided into 3 broad operations: Research, Development and Production. It is recognised that depending on the type of technology or the method of transfer, acquisition can terminate at research or at development or at production. Therefore, operations which are constituent parts of 'an acquisition' for one method are constituent parts of utilisation for another method.

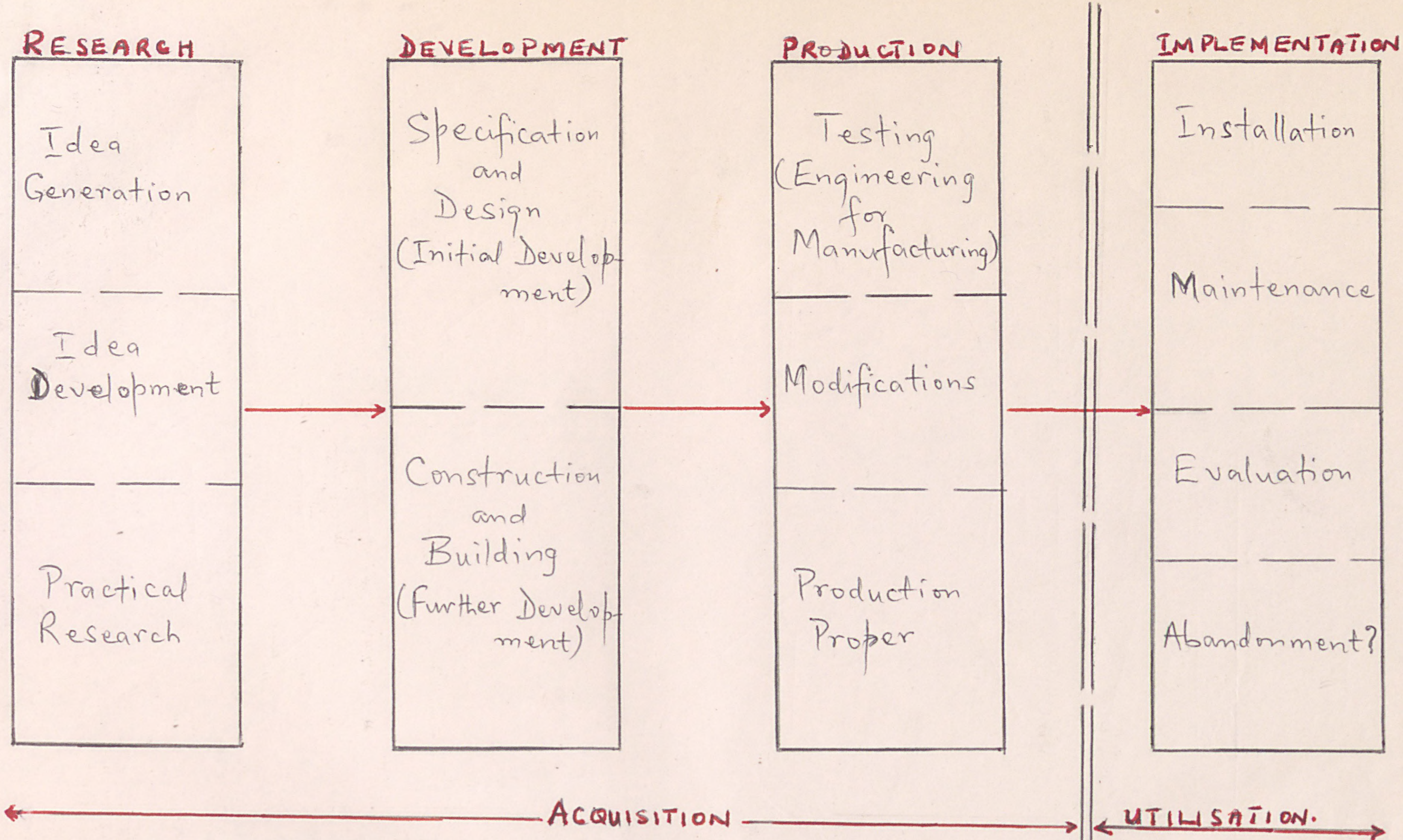

Fig. 1.5.1: A (Linear) Model of the Relationship between Acquisition and Utilisation of Technology

1.5. Premise of the Research Data.

Management by Problem Solving.

The research draws its interest from the strong belief that if managers of technology transfer can be helped to vitualise the problems involved, then they are likely to reduce the effects of these problems on technology transfer.

This belief is borne out of the principle of 'Management by Problem solving' which involves management's ability to 'foresee' problems and plan to avoid them, or to recognise problems when they arise and take actions to solve them. The level of management success in these tasks would depend very much on its perception of - and hence its attitude to - the organisation (or the system). See Figure 1.5.2.

In other words, the function of managing an organisation (or a system) successfully draws heavily on the attitude(s) of the manager(s). Therefore, an analysis of management problems in a system is, in the main, a study of how management perceives the system and its attitude to the system. These two variables are behavioural in nature and can not be comfortably represented by 'hard data'.

'Soft' Data

Some of the research data are therefore recognised, collected and treated as 'gently' as reasonably possible in terms of how they relate to attitudes and opinions. In this sense, the analyses are interpreted with 'very great care' as the data do not lend themselves to rigorous statistical treatments. However, this 'soft' approach should not, in any sense, impair the validity of the research findings.

It has become a common practice for research findings to be 'stuffed' with all sorts of statistical analyses, in an attempt to sophisticate the validity of the findings. It is the contention of the author that the nature of a research determines the type of analysis required and that the degree of validity of research-findings does not depend on any sophisticated presentation per se.

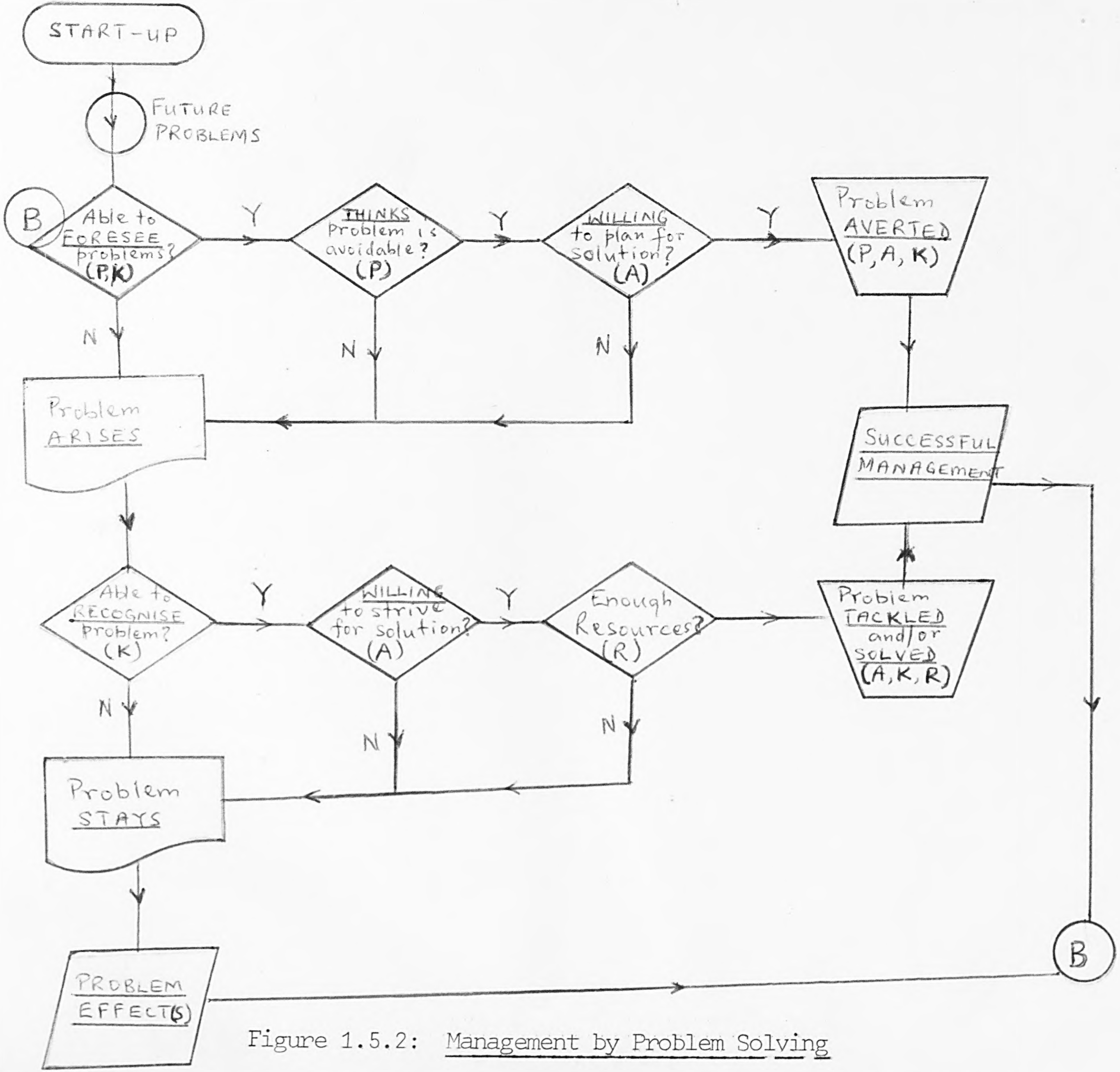

Figure 1.5.2: Management by Problem Solving

Key: The resources utilised for the operations are indicated within the boxes as follows:

A.- attitude

K - know-how

P - perception (judgement)

R - resources

Rather, the findings should be presented in a form that would be most suitable for readers to understand/interprete and use.

The research has therefore not involved itself in any rigorous statistical analysis because of the foregoing and also because of the soft nature of the data.

1.6. Research Methodology (See Fig. 1.6.1.)

Problems of management is broadly a two-type affair, viz: defining a body of rules, principles and objectives; and secondly direction and control of people and effective control of resources.

The first affair is the direct responsibility of the government and top-management (i.e. executive policy-makers), while effective control (or management of resources) is the responsibility of middle management (i.e. managers that are charged with operational activities of the organisation). Thus, these three levels of management (i.e. Government, Top-Management and Middle Management) form the 'centres' around which the problems of technological innovation revolve for solutions.

Very broadly, problems of acquisition of technology relate to the government and top-management since these two tiers of management make policies that govern or direct the procedures for making technology available for use. The middle-management is responsible for utilising available technologies to achieve the objectives defined by the government and top-management, mainly by directing and controlling the people and the resources within the rules defined by the top tiers of management. However, there are instances when the (nonchalant) attitude of both the government and top management could be a major factor affecting the effective utilisation of acquired technology by middle management, particularly when such attitudes run against the advice or information supplied by middle management to the government and/or top management.

For a start, therefore, the methodology is to scan through the literature to find out what sort of people - oriented problems had been encountered in the processes of managing innovation, and the measures management had taken in solving these problems. To validate these findings, one organisation in Nigeria (the Post and Telegraphs) was examined to determine its people-oriented problems in its effort at technology transfer (or technological innovation). This effort was by interviewing the people involved in the exercise, covering as wide a spectrum of employees as possible.

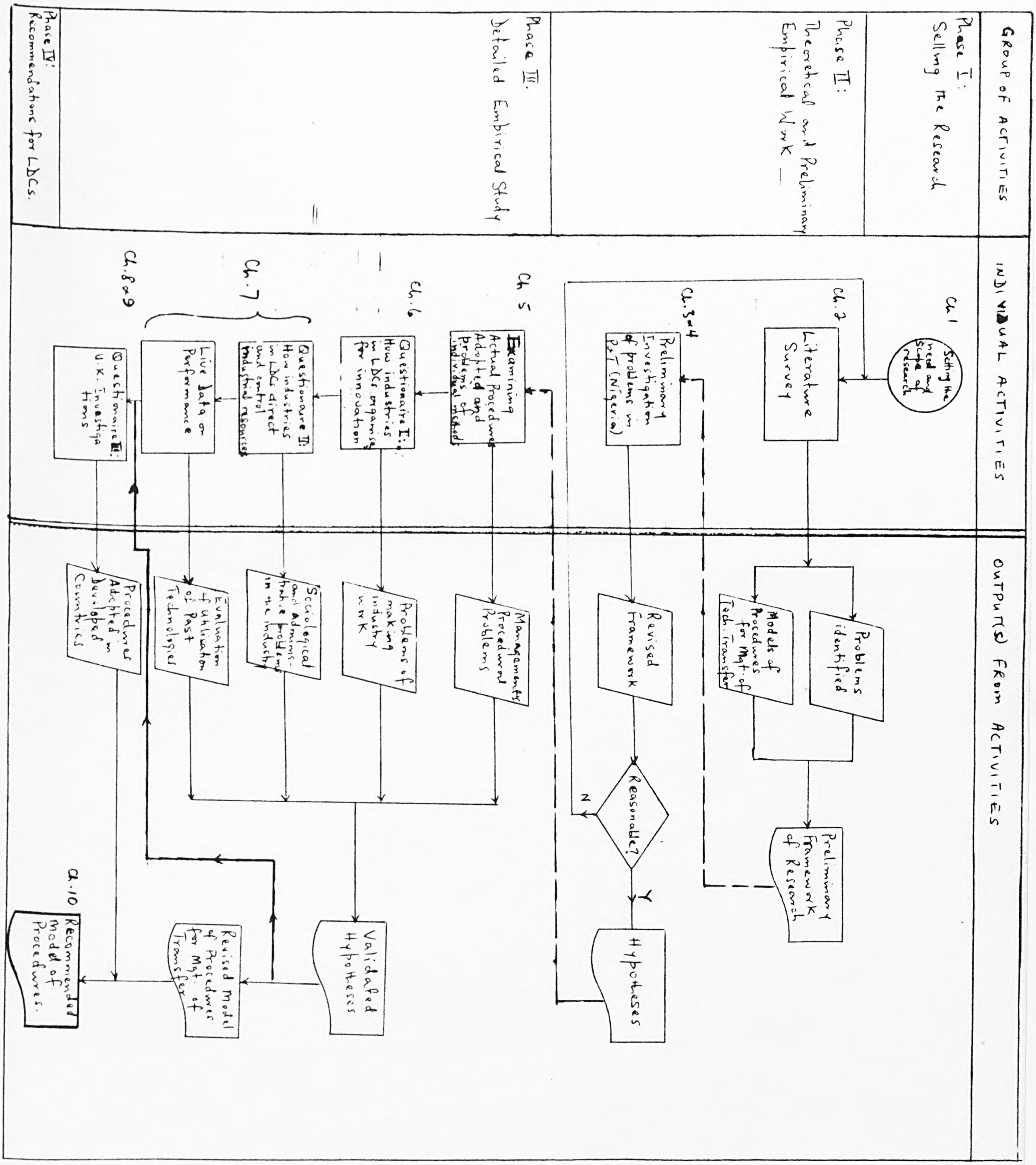

FIGURE 1.6.1. RESEARCH PLAN.

This was followed by a questionaire designed to validate the problems identified within the P & T through interviews. The questionaire covered a very wide range of the Nigerian economy - from manufacturing through distribution to consultancy and educational services. The questionaire paid particular attention to the problems of acquisition of technology and the effects technology produces on the organisations. For the aspect of utilisation of technology, another questionaire was designed and tested on the Sister company of P & T (i.e. the Nigerian External Telecommunication) to determine what problems exist(ed) in the management of that phase of technology transfer.

The literature survey also observed the various procedures available for managing innovation (or transferring technology). A study was then made of the actual model of the procedures adopted in transferring technology into Nigeria (as representing developing countries). The tool for this exercise was "Procedure Analysis Charts" which record routines very vividly, showing who does what and the sequence of events.

The result of these exercises was that they provided details and framework for a suggested model of managing innovation in developing countries; they also strengthened some hypotheses of the study.

For the second affair (i.e. effective control of resources) live data were collected about performances of some firms in Nigeria from the appropriate ministries of the Federal government, ensuring a wide spread, based on economic-sectoral and geographical considerations.

The empirical work thus far allowed the earlier hypotheses to be tested. A final questionaire was then designed to find out the practices of the management of innovation in developed countries. The questionaire was tested on U.K. companies, by directly talking to to people concerned across the table. Some were, however completed by me through Case-studies where it was felt that they provided the necessary and required information.

This final bit of work, coupled with the earlier ones, provided good information for a final model of the suggested procedures that developing countries should adopt in their management of technology transfer.

The Chemistry of the Research: Synthesising the Chapters.

<table>
<tr><th>Chapter</th><th>Task</th><th colspan="2">Out put</th></tr>
<tr><td>2.</td><td>Literature Survey</td><td colspan="2">(i) Perceptions of innovation by managers of technology (world-wide).
(ii) Problems of technological innovation (in advance countries)
(iii) Basic ingredients of successful innovation (in developed countries)</td></tr>
<tr><td></td><td colspan="3">These items provided a preliminary framework for the research</td></tr>
<tr><td rowspan="5">3.</td><td rowspan="5"><u>Preliminary Investigations</u>:
To know the problems encountered in Nigeria (generally) in the course of managing technology by:
(a) Assessing performances on past national plans.
(b) Gathering data through interviews with technical personnel in the P & T</td><td colspan="2">Problems of technological innovation encountered in Nigeria in general and the P & T in particular. (Classification is according to their natures).</td></tr>
<tr><td>Type of Problem</td><td>Related to the functions and duties of</td></tr>
<tr><td>(i) Administrative</td><td>Top-Management</td></tr>
<tr><td>(ii) Technical</td><td>Middle (Operative) Management</td></tr>
<tr><td>(iii) Personnel/ Societal</td><td>Government, Top & Middle Managements.</td></tr>
</table>

Chapter	Task	Output.
3 (cont.)	Study (a) shows that problems of technology stem more from the actions (or inactions) of the government and top-management than from middle management, while Study (b) suggests a different order, i.e. that problems of technology are related more to middle management, than top-management and the government, in that order.	
4.	To arrest the stalement thus produced, a nation-wide investigation involving different types of industries is believed to be a good 'umpire'. Hence this chapter.	
	Investigating problems of technological innovation in different industries in Nigeria covering different segments of operation.	The findings support the classifications of technological problems suggested by the two studies in Chapter 3. However, the 'verdict' here is that problems of management of technology are more related to middle-management than top-management or the government, in that order.

Remarks:

Chapters 3 & 4 have helped to revise the initial framework of the research and have thus laid the foundation for (focussing) detailed studies, i.e. how to help the 3 (three) tiers of management to vitualise their respective problems in order to achieve an efficient management of technological innovation.

Chapter	Task	Output
5.	The investigations here are aimed at helping the government and top-management to appreciate their problems that are <u>administrative</u> in nature (i.e. problems inherent in their operational procedures).	
	Investigating procedures adapted in the transfer (acquisition, mainly) of technology.	Procedural errors that create procedural problems in the transfer (acquisition) of foreign technology.
6.	This is directed at helping the government and top-management in their policies over the methods of transfer.	
	Investigating the implications (i.e. the merits and demerits) of the various methods of transfer, and how industries in developing countries organise for innovation.	Problems of making industries work, i.e. factors that cause decision-making problems on the parts of the government and top-management.
7.	The aim is to help middle management to understand its <u>operative</u> (i.e. technical) problems within the industry such that it will be able to direct, control and utilise industrial resources including, and particularly, acquired (or available) technology.	
	(a) Evaluating the utilisation (or application) of past technologies. (b) Analysing the economic performance of some selected industries in Nigeria.	Sociological, administrative and technical problems in the industries.

Chapter	Task	Output
Remarks. Chapters 5,6 and 7 validated some of the hypotheses initially formulated in chapter 2 (and which were strengthened by the findings in chapters 3 and 4).		
8	A comparative study of how industries in some advanced countries organise, direct, control and utilise industrial resources. This is aimed at helping middle (operative) managers in developing countries to overcome their operative problems that are internal to the industry.	
9.	Another comparative study of two (specific) industries in the U.K. involved in advance technologies. The study is specific on: (i) the procedures adapted in acquiring foreign technology - this would help top-management in its procedural policies. (ii) how these industries organise for effective utilisation of foreign technologies - this would enable middle management to utilise available technologies effectively.	
Remarks: Findings of Chapters 8 and 9 enabled the development of a revised model of procedures for the management (i.e. acquisition and utilisation) of technologies.		
10.	Putting things together, i.e. recommendations for - procedures for the acquisition of technologies - diffusion of technologies - making available technologies effective.	

CHAPTER 2 - Technology and Innovation:
A Literature Survey

2.0. Definitions

Because the survey makes references to the various methods of technology transfer, the following brief definitions/ explanations of these methods are given:

(a) Direct Method - a turnkey type of transfer which physically transports an operational system from one country to the other.

(b) Indirect Method - the method transports the technological knowledge in the form of the technician and not the operational system.

(c) Alternative (or Mixed) Method - an attempt to effect a compromise between Direct and Indirect Methods; it transfers the concepts of technology, to be developed locally by the transferee under the supervision of the transferer.

(d) Try-It-Yourself Method - the method allows the transferee to develop a 'burrowed' idea by himself.

(e) Joint-Ventures Method - the method by which project is jointly sponsored by the transferee and the transferer.

(f) Patents and Licensing Method - technological know-how is obtained under Special contract and/or legislative arrangements.

(g) Own Research & Development Method - 'transfer' involves starting from basic fundamental sciences, and progressing to final products.

2.1. Introduction: This research is concerned with the problems of management of Technology Transfer with reference to Post and Telegraphs (Nigeria) and to developing countries. Preliminary work in Nigeria and U.K. confirmed that the research would be useful.

Examination of the whole process of Technology Transfer from "Identification of need" for a technology to "Obtaining the benefits" of a technology suggested that the research should concentrate on the implementation phase of technology transfer and leave the selection and purchase of technology transfer for investigation by others or to a later date (this point was discussed earlier under 'Limits of study'). This choice of focus is influenced by two major factors:

(a) that no research had been done on the specific aspect of management problems involved in technology transfer in Nigeria, and

(b) that as specific as this aspect of technology transfer may appear to be, it will invariably touch on other aspects (even if only briefly) like appropriate technology and methods of transfer, purchasing procedures, etc.

Preliminary literature survey indicated some of the problems particularly in developed countries, and demonstrated the lack of a generally acceptable and useful "model" of the innovative process being discussed. We all have some intuitive feelings about technological innovation, and yet, when we try to specify how we might organise or carry out the process of innovation, the creation of new devices or new industries, we become rapidly confused. A wide variety of models are available but they seem to relate to the "instinct" of different writers rather than to the reality of the process observed. Wiesner (1) applied the story of the blind men and the elephant to technical innovation: "What each man has experienced and where he has touched the animal determine his ideas about what it is. And each man has very different ideas".

It would seem that the "best" model of the innovative process and hence most successful way of understanding the innovative process is itself an open question and is a potentially valuable research project.

The objectives of the literature survey are directed on four issues:

(i) To study the different managerial perceptions of technological innovation so as to get an understanding of what technology transfer is and to see if any generally-accepted model exists to assist the research.

(ii) To look at the activities involved (including their arrangements), and the kind of focal points, in technological innovation. At the end, a comprehensive model is expected to emerge to form the framework of the research.

(iii) To survey specific factors causing problems in technological innovation (in the West), and

(iv) To identify the conditions that make for successful management of transfer.

2.2.1. What is Innovation?

The divergence of opinions on processes of innovation starts right from the definition and usage. The term innovation is usually employed in three different contexts (see Tilton, 1971. pp.4-6) (1).

In one context, it is synonymous with invention; that is, it refers to a creative process whereby two or more existing concepts or entities are combined in some novel way to produce a configuration not previously known by the person involved. A person or organisation performing this type of activity is usually said to be innovative. Most of the literature on creativity treats the term innovation in this fashion e.g. Steiner, 1965 (2); National Academy of Sciences, 1969 (3); Myers and Marquis 1969 (4), with an emphasis upon technological development.

In another context, innovation is used to describe only the process whereby an existing innovation becomes a part of an adopter's cognitive state and behavioural repertoire. This is a process of adoption and internalisation. For example, Knight (1967, p.478) offers the following definition: "An innovation is the adoption of change which is new to an organisation and to the relevant environment " (5). Mohr (1969) (6) follows a similar approach in defining the term innovation as "the successful introduction into an applied situation of means or ends that are new to that situation". Knight considers the process of innovation "as a special case of the process of change in an organisation". The two differ only in the novelty of the outcome" (p.479)

In the first usage of innovation the individual or organisation can be innovative without adopting; whereas in the second case he can be innovative without being inventive. It is acknowledged, however, that one could argue that the adoption or internalisation of an innovation might be viewed as an inventive activity because two previously unconnected constructs, the individual or organisation and the innovation, are combined in some novel way.

The third use of the term is to refer to that idea, practice, or material that has been invented or that is regarded as novel independent of its adoption or nonadoption. The emphasis here is on description of why something is novel, whereas invention and adoption involve processes. Barnett (7) and Hagen (8) belong to this school of thought. Morton (9) agrees with this concept of innovation when he says "Innovation means renewal. It means the improvement of the old and the development of new capabilities of people and their organisations. Innovation is not the anarchistic destruction of the old - rather, it is the adaptive change and improvement of existing systems." This position is very similar to the stance taken by Rogers and Shoemaker (10):

> "An innovation is an idea, practice, or object perceived as new by the individual or organisation. It matters little, as far as human behaviour is concerned, whether or not an idea is 'objectively' new as measured by the lapse of time since its first use or discovery .... If the idea seems new and different to the individual or organisation, it is an innovation".

It is the perception of a social unit that decides its newness. Summarising, there are three ways of thinking about innovation:

(a) a process of new creation or invention

(b) a process of adoption and internalisation, i.e. a renewal or an improvement of, and the development of new capabilities from, existing systems.

(c) an idea or practice or material that is considered novel or new, if its application results in objectively qualitative differences.

The first two ways involve practical discoveries, while the third implies only the usage of an already-developed practice.

2.2.2. Theories governing the processes of technological development

2.2.2.1. Theory 1.

The pace and direction of scientific and technical research

Schiavo-Campo and Singer (1) said "... Technology was developed in line with economic requirements and resources. The economic problems of the day shaped the course of technological research, and the training and adjustment of people to modern technology proceeded more or less simultaneously with the development of technology itself.....".

Economists in earlier days believed that as the stock of knowledge accumulated over time, it was progressively easier for new countries to join the ranks of the developed countries at increasingly faster rates, rapidly catching up with those countries which started their development earlier when the stock of knowledge to draw upon was smaller (the so-called leap-frog pattern of international economic advance). This theory presupposes that technological innovation can only be gained through knowledge from those who started their development earlier, i.e. innovation by adoption; up to a point in time, this proved to be correct because the new-comers tended to develop faster and possibly better than the pioneers. The theory would have guided management decisions in developing countries, then. But because of aboundant capital and highly skilled labour, modern technology has become capital intensive and labour-saving in developed countries.

These conditions are the reverse in LDCs, i.e. labour is surplus and capital is scarce. What LDCs would appear to need is a technology which is capital-saving and labour intensive.

Comments.

If this theory were accepted, it is likely to influence management decision in a direction where the product of technological innovation creates unemployment, and therefore social unrest. Tentative conclusions would therefore be that managers of technological innovation in developing countries should not be guided solely by this theory; rather their decisions on "from where" should be guided by the objective of making products that are compatible with the demands of their environment.

2.2.2.2. Theory 2

Requirements of developing Countries

Arising from the first theory is the suggestion that developing countries would need a technology which is capital-saving rather than capital-using; which is labour-using rather than labour-saving; which requires a lower degree of skills to operate, control, repair and maintain; and particularly a technology on the basis of which plants can be efficiently operated on a small scale of operations, corresponding to the small markets, often purely local markets, of developing countries, and a technology providing plants which can with a minimum of time and cost, be changed over from one output-mix to another, and be easily and cheaply installed(2). Unfortunately this technology does not exist.

It does not exist mainly because those engaged in technological progress and research simply do not have such problems put before them. 'If the problems were put before them with proper priority' argued Zahlan (4), 'we can have confidence that they would be solved'. All these point to the fact that managers (*) in developing countries lack the knowledge of their technological requirements.

(*) 'Managers', in this sense, refers to Top-Management (Executive Policy makers)

At its mini-world conference in Jamaica in Jan. 1979, the International Institute for Environment and Development started/off with one absolutely key point: "The first question is not 'what technology?' but 'technology for what?'. People-oriented development policies clearly require people-oriented technological strategies".

They need to be able to determine what technology is appropriate for them, and present these problems with proper priorities in their search for solutions.

2.2.2.3. Theory 3

Another school of thought sees technology primarily as an instrument for job creation at a low cost (i.e. by using locally-produced tools). This group would rather not import foreign technology at all.

Young (5) described intermediate (appropriate) technology for developing countries as

> "oriented to problem solving to meet local technological needs. The design, manufacturing and application of various useful products using available materials and equipment is the key to this type of technology. Trainees are required to use their local creative ability in constructing practical systems that can be readily utilised for a profit ....".

In his own contribution, Harford Thomas (6) wrote:

> "The most pressing problem, therefore is to find ways of making poor peasants more productive, and getting income circulating in the villages. You cannot do that with tractors and chemical-intensive agriculture the peasants cannot afford. That is the most simple illustration of the point that Western-style 'modernisation'with large industrial plants and mechanised agriculture is not, properly speaking, development". They continued, "In developing countries (and increasingly in developed countries, for that matter) the test of an appropriate technology is whether it creates jobs and incomes for people in the place where they live".

Comments.

This school of thought appears to be very narrow in its perception of technology. The true argument is not exactly whether technologies locally designed and tools locally made out of available local materials are suitable, and produce jobs for the local nationals. The argument should focus on wider factors. 'Are these locally produced technologies more practicable and more productive than those imported from abroad?'. 'Do these local technologies produce sound solutions to the local problems?'.

Of course, there are sporadic instances where locally produced technologies are cheaper than foreign ones and where they are sufficiently capable of solving the problems rather than the very sophisticated western-style technologies. But the question is, how often is this the case?

One would have thought that a setting which fuses the two approaches together is more beneficial to developing countries. While the first approach (i.e. foreign technology) produces a wider shpere of applications the second approach would take better cognizance of the local culture. George McRobie, Director of Intermediate Technology Development Group has said,

> "The choice of technology is the most important collective decision confronting any country. Technology carries its own culture with it".

This type of fused setting recognises the fact that developing countries have a vast store of traditional knowledge and can build their modern technology on that foundation, borrowing ideas from other imported technologies.

Summarising, the first theory concerns itself with how (or from where) should technology be developed; while the second theory considers what type of technology should be developed: it presupposes that technology should be developed by whoever is going to use the technology.

To one's mind, the first theory would result in perpetual dependency of LDCs on developed countries (assuming the products of technological innovation ever obey the demands of the LDCs' internal environments), but the period of development will probably be shorter than when the third theory solely guides decisions on technological development. The third theory advocates belief in self-ability and is ambitious in that it is expected to result in self-reliance; but it may be costly on the long-run because of the time and the numerous mistakes that would be made before perfection is achieved. Management therefore needs to balance between time and cost on the one hand, and personal satisfaction through self-development on the other. The detailed demands of these thecries are left for other researchers, or for a later date.

2.3. Models of Technology Transfer

Various models of technological innovation indicate a wide variety of understandings of the subject, based on different focal points. Each group defines its own focal point depending on the circumstances sorrounding its operations .....

> Some see innovation in terms of marketing strategies, others focus on organisational arrangements; some think of innovation process in terms of the arrangement of activities, while others conceive it, in its entity, as an invention which affects its environment; yet others see innovation owing its success strictly to top-managerial control and ability to draw scientific and technological knowledge from external environment.

This set of understandings (*) indicates the problem of communication between different 'managers' of technological innovation.

Similarly, there is a wide variety of managerial perception of technology transfer: Innovation as discussed earlier, presupposes development of technology within the industry, whereas transfer involves the movement of any of the following - Knowledge, Know-how, Machinery, System and men - from one place to another. The different pattern of activities in these movements give rise to various models of technology transfer.

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* From the variety of concepts of the innovative process is developed a comprehensive model which, not only breaks the process into its basic structures, but also identifies a focal point for each stage of the process, thus making the process easier to understand and, therefore to manage. It also allows those involved with managing technological innovation to discuss from a common view point, and therefore understand one another, i.e. it removes communication barrier.

2.3.1. The Black-Box Model

Technology transfer had been, much earlier than now, considered merely as a black box, without adequate consideration for possible segmentations into inputs, processings, outputs and other complementary phases. This model, represented in Figure 2.3.1, only recognises technology transfer with respect to:

(i) the two main 'actors' of the system (that is the transferee and the transferer of technology

(ii) the technicians on both sides

(iii) some sort of legislations or contract conditions e.g. licensing agreements, patents agreements, etc.

In Figure 2.3.1

A - represents the developed country (that transfers the technology) and its operations (research and development, etc.)

B - represents the developing country (to whom technology is being transferred) and its operations.

Box 1- represents the channel through which the 'parcel' is sent, e.g. the technicians, the licensing agreements, etc.

Box 2- represents the physical operation of installing the system, and training.

Box 3- represents the channel through which the 'parcel' is received, e.g. the local technicians, the patents agreements, etc.

Drawbacks of the Black-Box Model

The model has failed to consider some other important parties like the financiers and the public, etc. It has also failed to give a meaningful breakdown of Box 2, i.e. the constituents of the system installation, e.g. testing, modifications, training, etc. The model is silent on the details of the environment of the recipient neither has it suggested any necessary infrastructures for the technology.

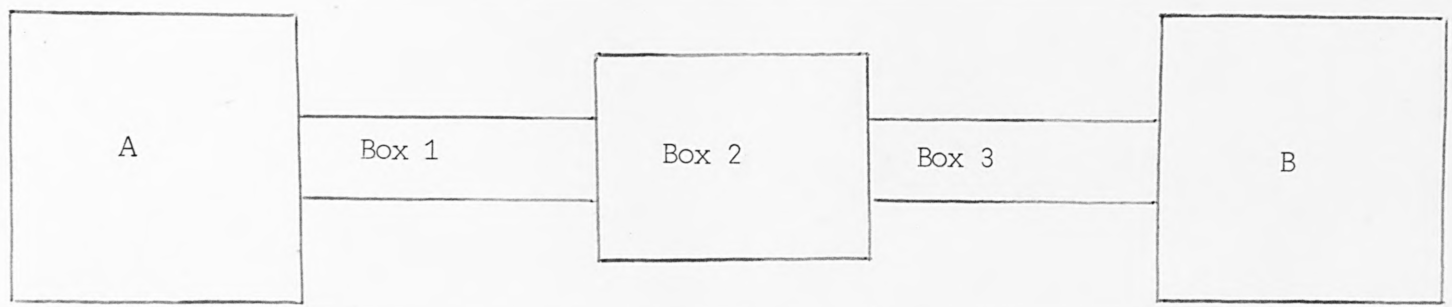


Figure 2.3.1. The Black-Box Model of Technology Transfer.

In short, on its own, the model is not of much use for proper management of technology transfer because there are vast areas of the process that it does not cover - it is too concise. A revised version of the model is suggested in Fig. 2.3.2

The Parties Concerned with Technology Transfer.

Figure 2.3.2. identifies the different parties involved in transferring technology. It also highlights the interactions between these parties (or elements). The parties identified are:

i. Government or Policy Makers

ii. Government Institutions/Research & Development

iii. Environment/Public

iv. Technology (that is, technological know-how or concepts of technology)

v. Technology (that is Products of technology)

vi. Funds

vii. External Forces

The splitting of technology into the two composites is an attempt to show the processes of generating and developing ideas into technology concepts or systems as distinct from the outputs from the application of these concepts or systems to solve particular problems. For instance a technology might have produced a type of product or service, while more recent technologies (or methods), as a result of further research and development, might be available to produce the same service of better quality; the advantages of the latter over the former might be of economic, safety or social nature.

It would perhaps be legitimate, and certainly would be prudent, to say that no generalisations can be made about those to be involved in the process of technology transfer, nor their respective roles. But equally certain is the fact that some parties have paramount roles to play in the process, hence those mentioned above.

An analysis of this nature should help managers of technology transfer in their task of "division of labour"; more importantly, an understanding of the interactions between the parties would help to create the right atmosphere (or conditions) for the acceptance of scientific developments resulting from technology transfer; the correct atmosphere so created will also actively work and financially subscribe to such advances(7).

Participants Involved in Transfer of Technology and their Interactions

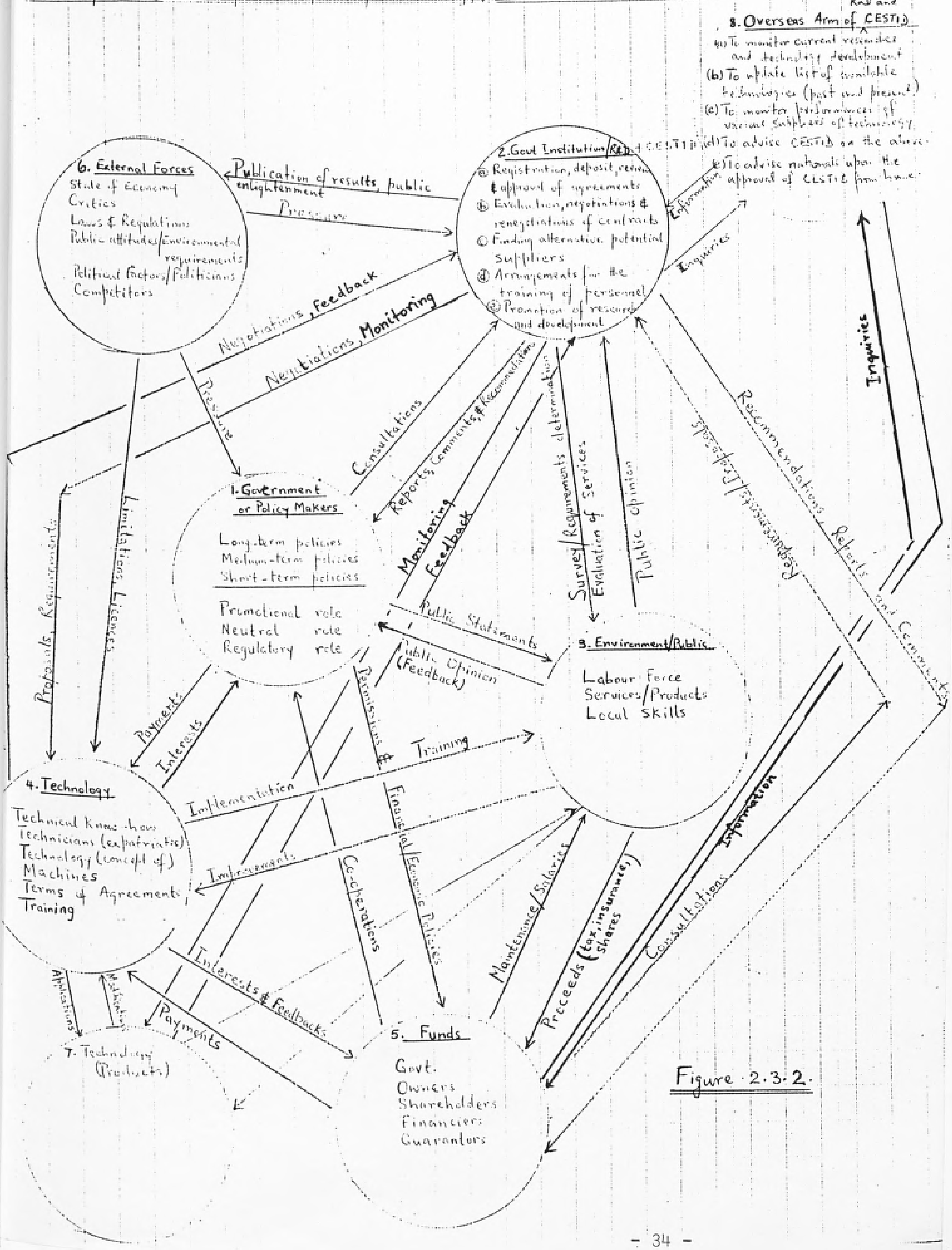


Figure 2.3.2.

2.3.2. The Linear Model.

The model, shown in Figure 2.3.3. looks at the subject of technology transfer, not from the point of view of participants or parties involved, but from a consideration of the important stages necessary in the process. These 'stages' relate to the activities of the transferee of technology, rather than those of the transferer.

The model incorporates a feed-back system via a measurement phase called "Evaluation". Comparing the evaluation data with the desired objectives provides a control system that would initiate decisions and "corrective" actions to be taken.

The major limitation of the linear model is that it considers all the different methods of transferring technology as being governed by the same set of activities at the implementation stage: it does not consider the possible variations of factors governing this stage for the different methods of transfer; it merely concerns itself with the "end-point and not the routes via which the end-point is to be reached.

Stages of Transfer Process

There are various methods of transferring technology, but whichever methodology is employed, the following stages, as shown in Fig. 2.3.4. are considered to be important:-

(i) Actual Problem - This is the perception of the problems plagueing the society for which solutions are required. The problems are ranked in some order of priority.

(ii) Defining Objectives - Based on problems identified in stage (i) and the ranking order, this stage is usually a policy matter by the government in power. It is the pivot about which the success or failure of the transfer rotates in that it affects the type of technology being sought to produce some solutions to the problems earlier identified. Since the people in government are not usually very knowledged in technology, the normal practice is for them to rely on the advice given to them by their technical advisers; this is probably more pronounced in developing countries.

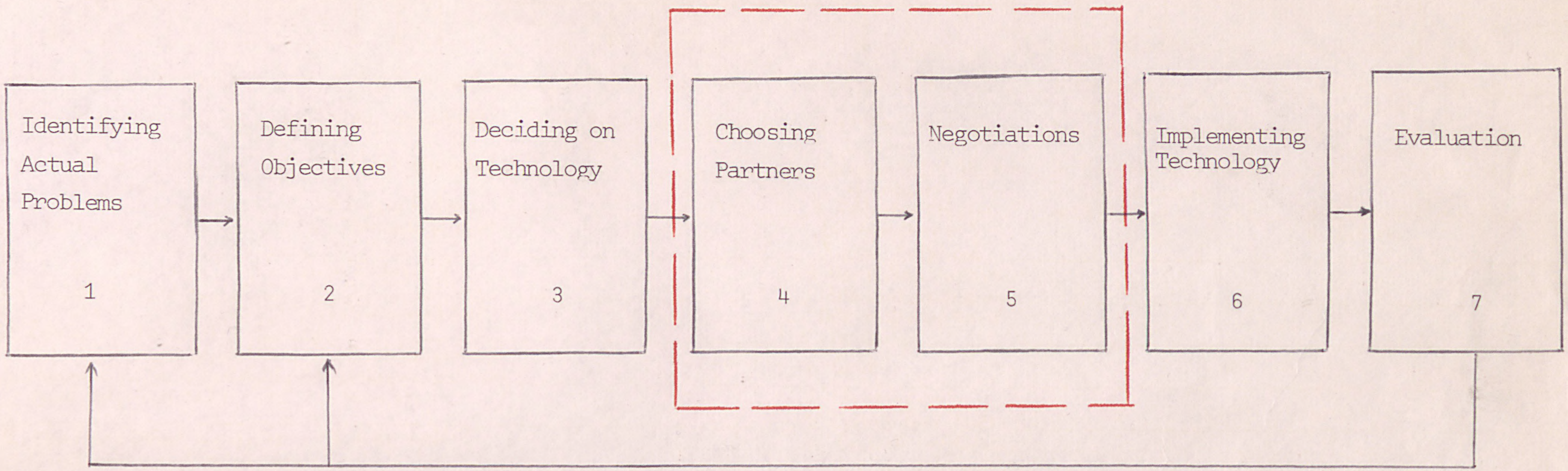


Figure 2.3.3. The Linear Model of Technology Transfer.

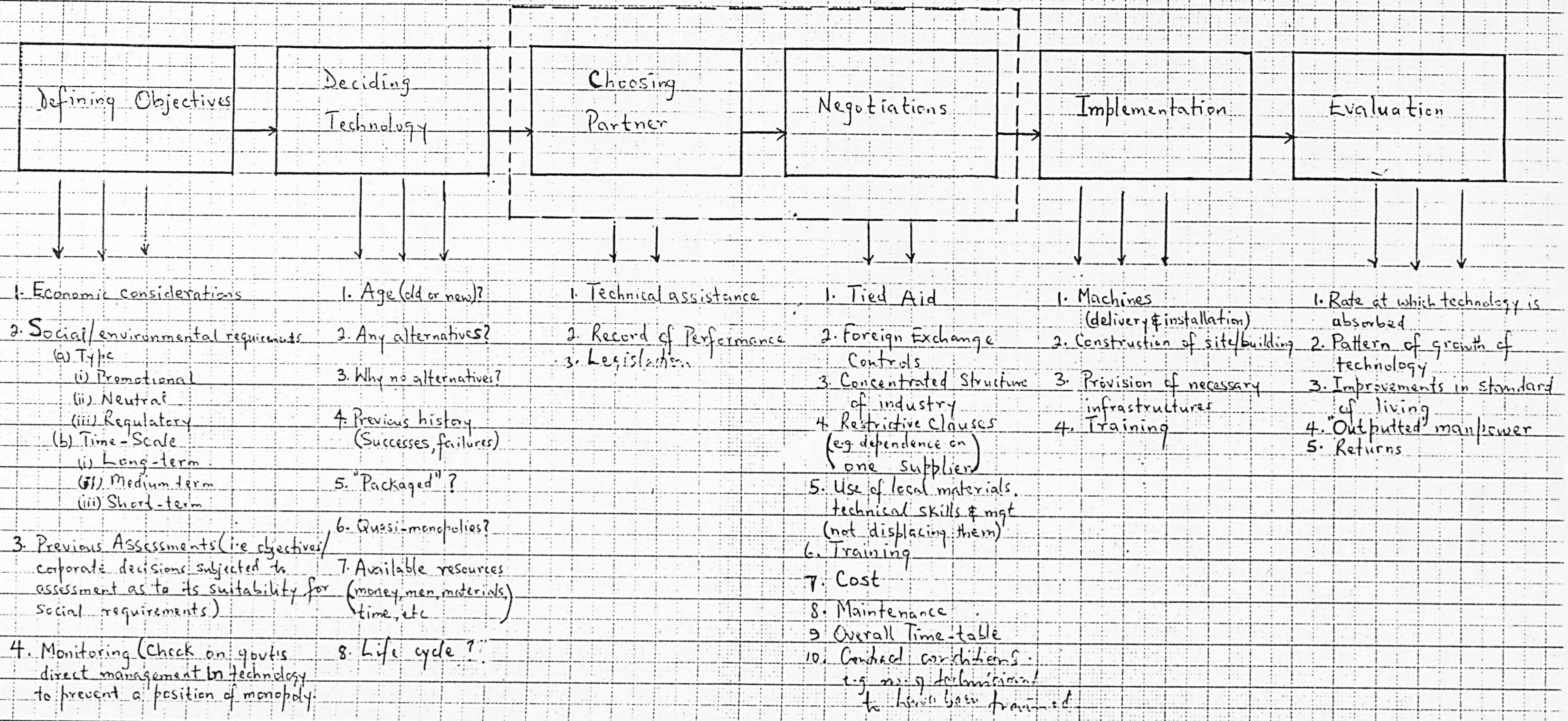

Defining Objectives
Deciding Technology
Choosing Partner
Negotiations
Implementation
Evaluation
1. Economic considerations
2. Social/environmental requirements
(a) Type
(i) Promotional
(ii) Neutral
(iii) Regulatory
(b) Time-Scale
(i) Long-term
(ii) Medium term
(iii) Short-term
3. Previous Assessments (i.e objectives/corporate decisions subjected to assessment as to its suitability for social requirements)
4. Monitoring (Check on govt's direct management in technology to prevent a position of monopoly.
1. Age (old or new)?
2. Any alternatives?
3. Why no alternatives?
4. Previous history (Successes, failures)
5. "Packaged"?
6. Quasi-monopolies?
7. Available resources (money, men, materials, time, etc)
8. Life cycle?
1. Technical assistance
2. Record of Performance
3. Legislation
1. Tied Aid
2. Foreign Exchange Controls
3. Concentrated Structure of industry
4. Restrictive Clauses (e.g. dependence on one supplier)
5. Use of local materials, technical skills & mgt (not displacing them)
6. Training
7. Cost
8. Maintenance
9 Overall Time-table
10. Contract conditions.
1. Machines (delivery & installation)
2. Construction of site/building
3. Provision of necessary infrastructures
4. Training
1. Rate at which technology is absorbed
2. Pattern of growth of technology
3. Improvements in standard of living
4. "Outputted" manpower
5. Returns

FIG 2.3.4.

(iii) Deciding on appropriate technology

Once the broad policies have been made, they are examined by the 'technical experts' and a number of technology alternatives are identified to match the policies. If the R & D Team were 'involved' in the policy making process it is believed that choosing the appropriate technology has a greater chance of success.

(iv) Choosing a Partner

The chances are that the technology chosen is available with a number of suppliers. It is at this 'stage' that a 'Partner' or Supplier is picked out of the lot. Several factors are taken into consideration in choosing a partner; they include the following (not in order of importance):

(i) Previous transactions? and if any

(ii) Successful or was it a failure?

(iii) Political considerations

(iv) Credit facilities (or easy terms) available?

The next step within this stage is for the supplier and the home country to understand the environmental requirements of each other. This is of prime importance because:

(a) Basically the supplier is unaware of the need for this understanding and often assumes that the cultural goals of his own country universally apply to all others(3) (e.g. profitability, infrastructures to support the technology).

(b) The specifications during this process is based on an agreement between the supplier and the user about what the end product will look like(3); (the end product may be some kind of services).

(c) The organisational structure of the societies may be different and the same facilities may not be available (e.g. data base as an integral part of the system)(3).

(d) Some technologies may require a 24-hour operation each day and may require continuous operational support. In a culture where working on the Sabbath is a serious offence, the system will not be "manned" as intended and serious malfunctions may occur(3).

(v) Negotiating the type and terms of transfer

A good understanding of one another's environmental requirements will help in deciding the type of technology (if there's to be a change from the user's initial choice), and/or facilitate decisions if changes are necessary. These in turn would help decide the type of transfer that is appropriate. There are a few techniques of transfer (See Section 2.0). It is at this stage that the 'terms of contract' or terms of transfer are decided. The considerations include:

(i) Cost, including discounts or trade-in

(ii) Time of transfer (particularly latest time, or stages and times of implementation)

(iii) Training of local 'materials'.

(iv) Implementation procedures

(v) Maintenance agreements
- for how long after implementation (sort of guarantee)
- spare parts.

(vi) Shares of responsibilities or liabilities in event of partial or total failure of project.

(vii) Consultancy charges (after expiration of guarantee)

(vi) Implementation

This is the stage when the project is actually executed, according to the agreed phases at the negotiation stage. These may include, amongst other things,

(a) bringing in the physical machinery

(b) construction of site and/or building

(c) providing the necessary facilities to support the project (e.g. good roads, electricity generators, water (may be) etc.)

(d) installing the machines.

Training of local 'materials' may come just before implementation or it may be alongside implementation (that is on-the-job training) or it may be after implementation (particularly with a view of maintenance). Mostly the type of transfer will dictate the type of training.

(vii) Evaluation

This is the step that many/most developing countries miss out of technology transfer processes. The step provides information as to whether the initial objectives have been met and, if not, why? It also provides data on the performance of 'past suppliers' as well as reviews the whole project in terms of cost and time, and objectives. The detailed treatment of the functions of the stages are omitted in this section to ensure brevity.

However, the steps or stages may not be as distinct or discrete as they appear in the figure. A stage, by concept, must be identified with the following characteristics:

a. clear objectives
b. identifiable start-time
c. necessity (objective-wise)
d. necessity (time - wise)
e. identifiable result
f. recognisable finish time
g. available resources

These properties suggest that each stage should be as autonomous as possible. Within these constraints therefore, it is more conceivable to 'merge' choosing partner and negotiations into one stage.

Shortcomings of the Linear Model

Summarising, while the model shows the 'necessary' stages that technology transfer demands (including determination of societal problems) it only provides a general view of what is to be involved at the implementation stage. Even at the other stages common to all methods it merely provides an overview of what the transferee does, but silent on the local parties concerned; conspicuosly, it is silent on what participations the transferer has.

For the management of a project, the model aids general scheduling time-wise, but is not of much use in decisions about "division of labour" and subsequently in planning of resources, particularly for purposes of implementing the technology, which is the main focus of this research.

2.3.3. The Spiral Model

This model of technology transfer, in the main, contains the same constituent parts as the linear model, but its presentation is different: even though the linear model provides for a control system loop, it does not stress the ideal and practical concept that the completion of one stage may (and does) require going back to an already-completed stage before the next stage is embarked upon in the light of the facts that have emerged from the present stage (Fig. 2.3.5)

Some authors consider this spiral model as an extension of the linear model, but actually the spiral model identifies in very clear terms, the concept of iterative processes; it recognises the fact that these iterative processes are inevitable (and probably the order of the day) in a process like technology transfer.

It must be stressed that the iterations identified on the model may not represent the true processes in practice but are only for purposes of illustrations. Furthermore, the relative positioning of the stages (i.e. the distances at which they lie to one another) on the model is not a true representation of the periods between the adjoining stages so identified.

Because the model is mindful of the participations of both the transferee and the transferer, its considerations are borrowed to develop the model in Figure 2.3.6. which has pulled together the positive applications of both the Black-box model and the Linear Model. And even then, it has only amplified the implementation stage - it has failed to show how the activities at the stage relate to individual methods adopted. The Implementation Stage of the model is amplified below it.

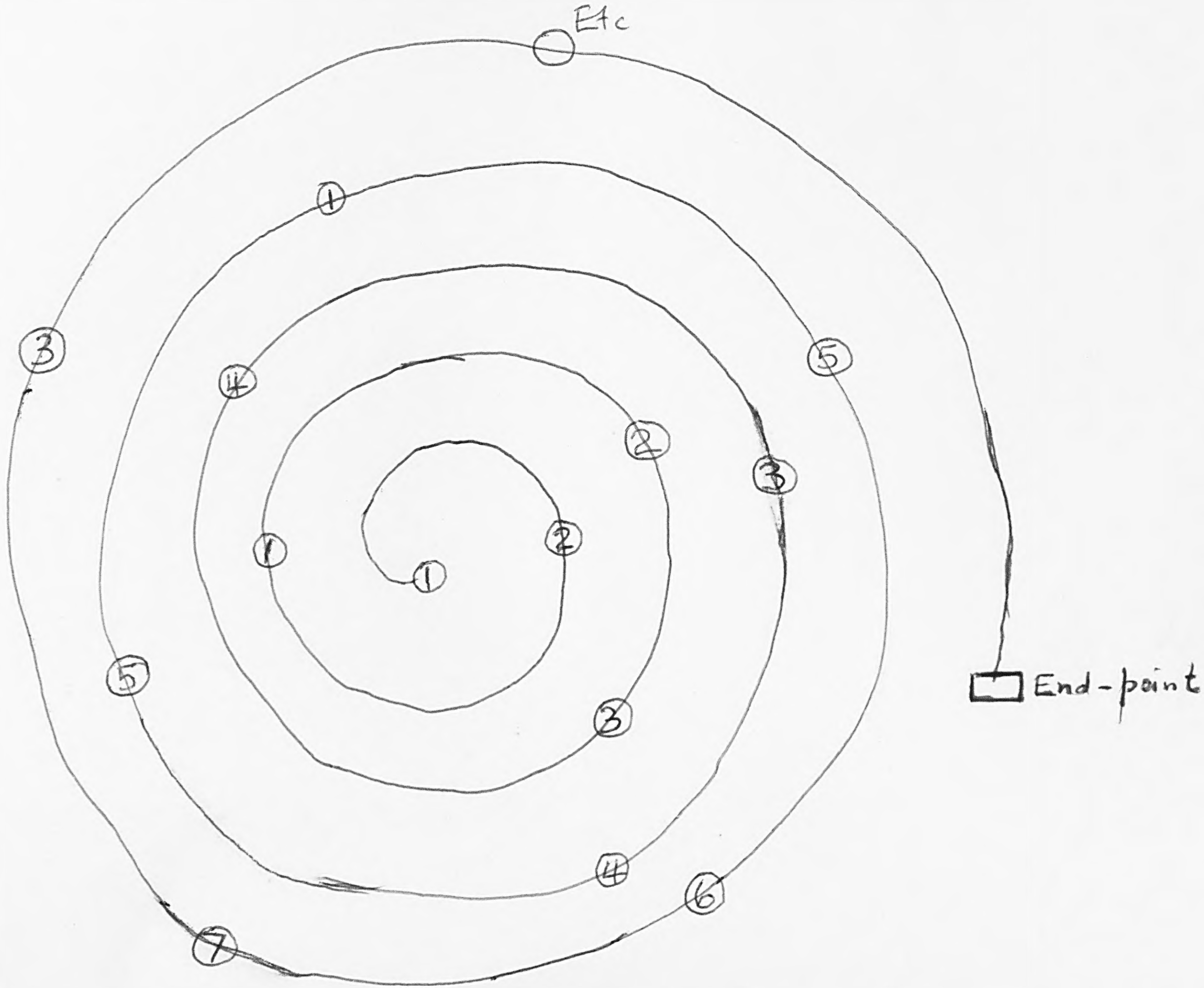


Figure 2.3.5. The Spiral Model of Technology Transfer.

Implementation Stage - amplification of

As mentioned earlier the research looks at the activities that arise from idea generation, through research and development but focusses mainly on full implementation of the technology. For this purpose Figure 2.3.6 presents the various activities (and the parties concerned with each activity of the implementation stage. One notices that the public and its need feature at almost every activity. This is not surprising as the main aim of transferring technology is to produce service for the public, or to produce an output of some sort. But as the main focus of the research is how an already-acquired technology is utilised, if step (1) is omitted from the figure, it becomes a detailed version of the Implementation Stage of Figure 2.3.3. The full lines indicate two-way interactions (communications) between the parties while the dotted lines show a uni-directional activity. The activities may not be as distinct as they appear, therefore Fig. 2.3.7. indicates that some iterative processes are involved. However for clarity sake, the "many" iterations are omitted. To support the earlier contention that the type of transfer will largely determine the parties concerned, Figure 2.3.8. presents various activities encountered for the various methods. The diagram also illustrates the environment in which the activities are carried out i.e. transferer's environment or transferee's environment, or both. For all methods it is noted that research and development is always done in the suppliers environment. This is possibly one major reason why technology transfer seems to be very successful in developed countries. Admitted that some research might be involved in the Do-it-yourself method in developing countries, but this is not to any appreciable level at he present time.

Strength of the Spiral Model.

Summarising, the spiral model has pulled together the various highlights of the black-Box Model and the Linear Model. This way, it

(i) makes "division of labour" easier for management of technology.

(ii) provides a framework for scheduling activities (time-wise) into the stages of transfer.

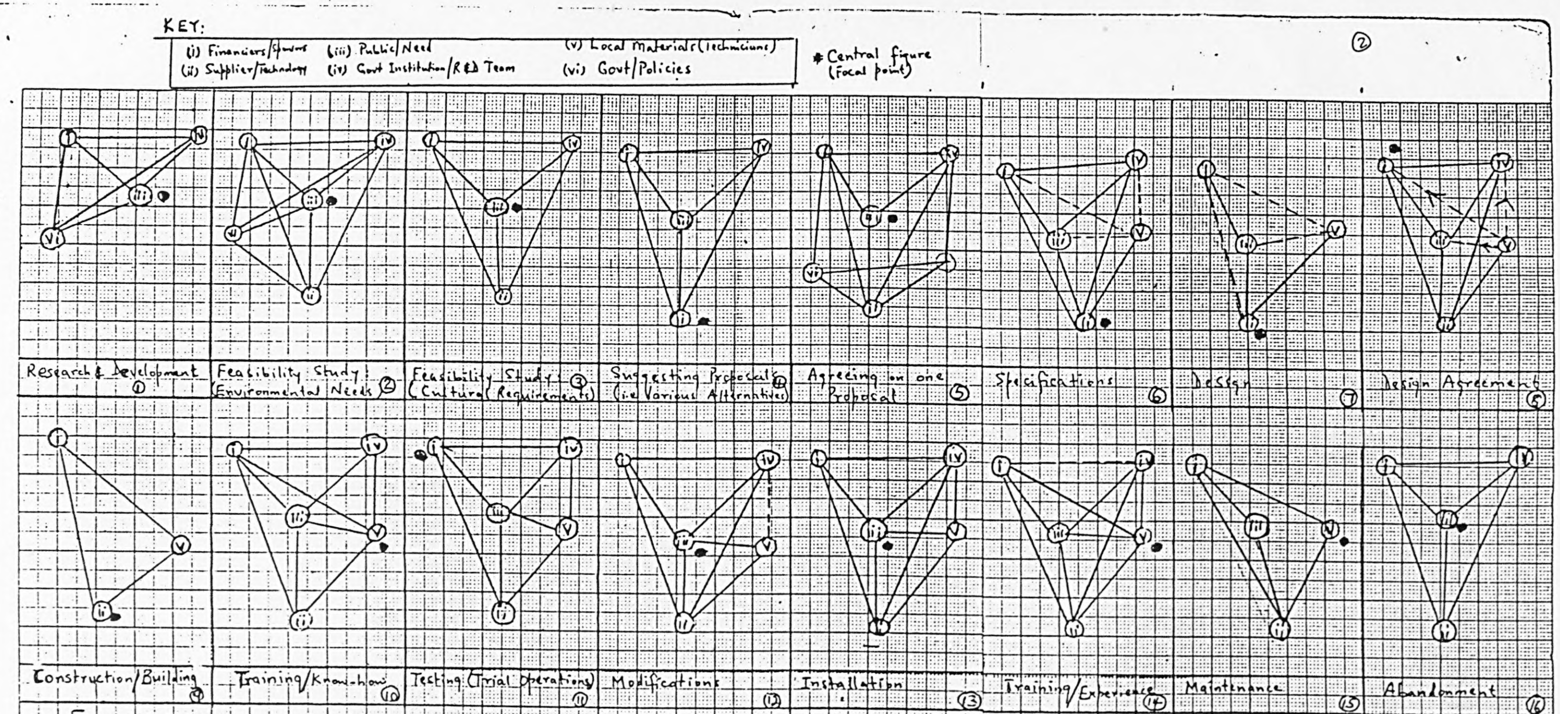
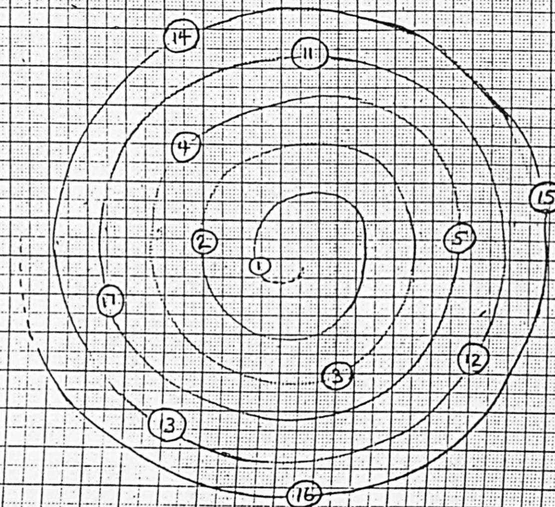


Figure 2.3.6



- Steps ⑥, ⑦, ⑧, ⑨ & ⑩ above constitute System Development, Step ⑰ in the diagram.
- For clarity, the iteration processes have been omitted.

Fig. 2.3.7. Necessary Steps of the IMPLEMENTATION Stage.

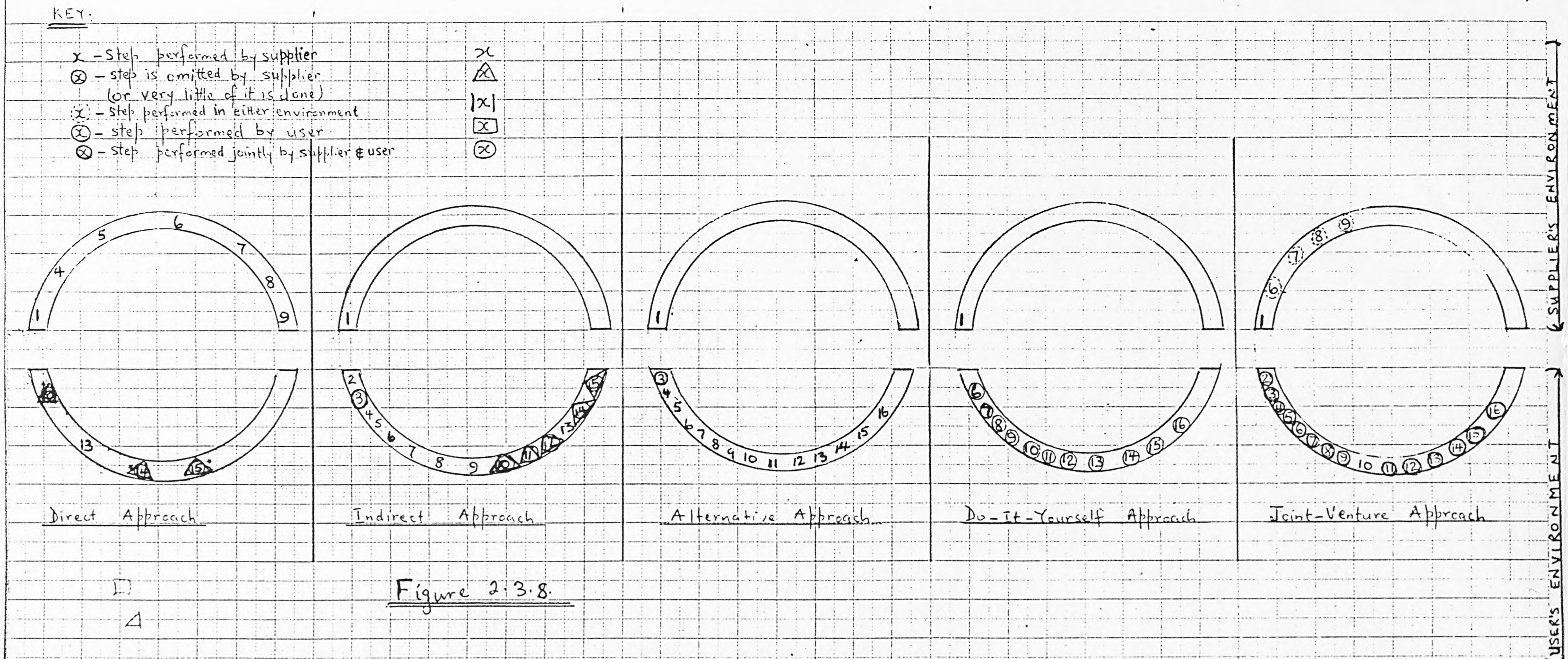

KEY.
x - Step performed by supplier
step is omitted by supplier (or very little of it is done)
step performed in either environment
step performed by user
step performed jointly by supplier & user
Direct Approach
Indirect Approach
Alternative Approach
Do-It-Yourself Approach
Joint-Venture Approach
SUPPLIER'S ENVIRONMENT
USER'S ENVIRONMENT

Figure 2.3.8.

(iii) goes further than the linear model to stress the <u>inevitability of iterative processes</u> during the overall process of technology transfer. This is a useful information for managers to remember in their scheduling of activities.

(iv) it shows the need for <u>reduction of iterations</u>: too many iterations are costly in time, and in utilisation of resources; they also tend to lead to loss of control over operations.

2.3.4. <u>The (JAYS) Tree Model.</u>

The previous models had suggested the necessary stages to be adopted in the process of transferring technology from one place to the other; the spiral model in particular has suggested an allowance for iterative procedures. The tree model varies slightly from them because it appears to concentrate on the aspect of acquisition of technology. While the other models had assumed a general (same) pattern for all methods of acquisition of technology, the tree model <u>distinguishes</u> the activities involved in the different methods of acquiring technology prior to the utilisation.

In Figure 2.3.9, <u>M</u> represents "determination of the actual problems" plagueing the Society and subsequently the manager's area of interest. <u>S</u> represents the "definition of objectives" stage. For the purpose of compatibility with the other models, it may also be taken to include the stages of "deciding on technology", "choosing partners" and "negotiations". In general, it is taken as the perception of ideas about a desired objective and the generation of the 'best' means of achieving this objective. <u>Box</u> 1 represents concept development and <u>research</u>, while <u>Box 2</u> stands for <u>modifications</u> of the developed concept from research, possibly as a result of some environmental factors, a change of requirements or a shift in interest. <u>Box 3</u> denotes <u>System Development</u> either directly from the objective (as in Alternative Technique), or after the necessary modifications (as in the Indirect and Do-It-Yourself approaches). <u>Box 4</u> represents the <u>Technology Product</u> (e.g. a set of operational procedures, or a pilot product and machinery to be used in the production of the final products or services),

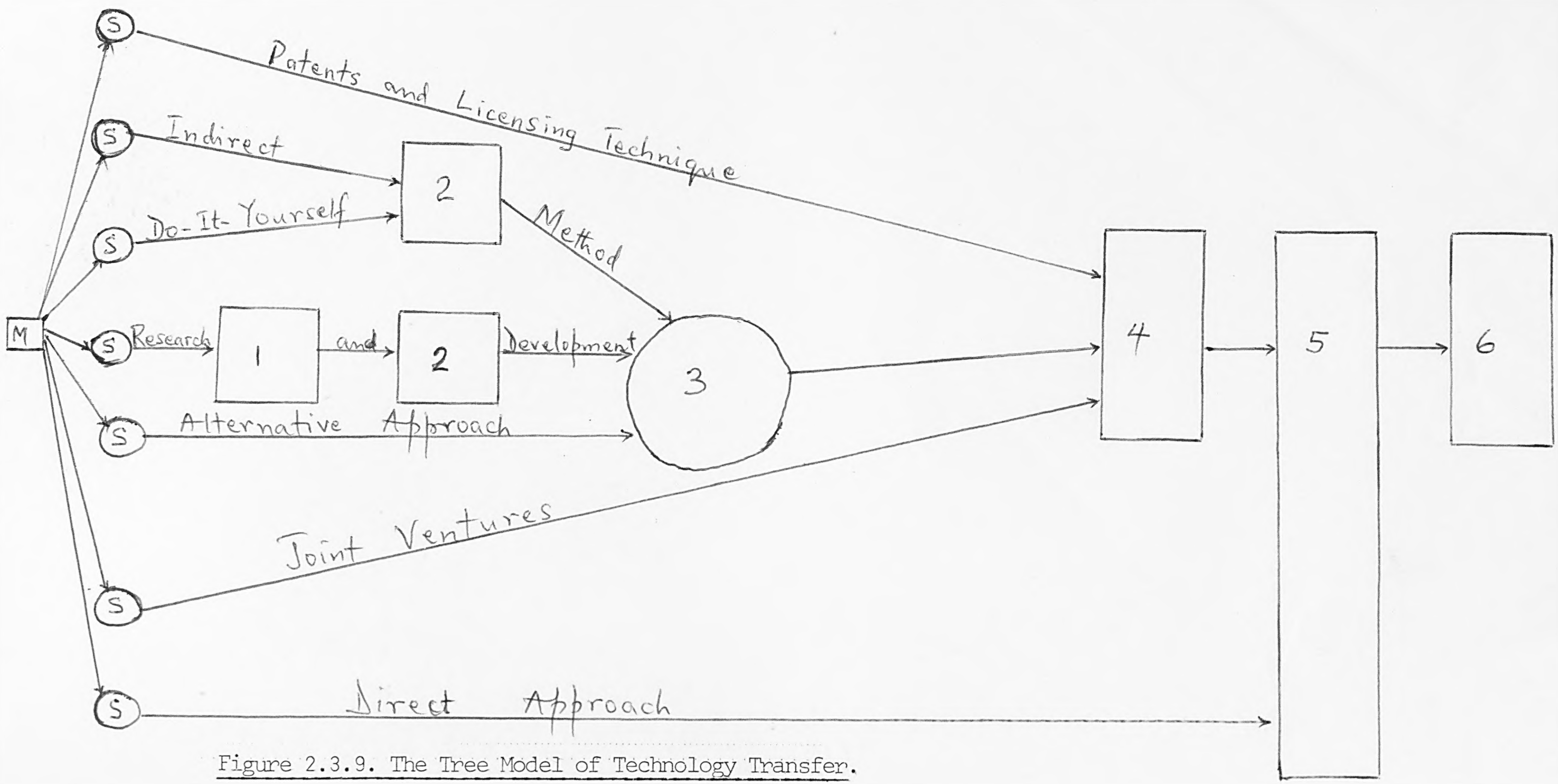


Figure 2.3.9. The Tree Model of Technology Transfer.

while Box 5 denotes the physical installation of the technology or the end-point.

It is pertinent here to explain the term end-point. A typical turn-key agreement may require the technology supplier to carry out a full range of technical and managerial operations needed to establish an enterprise in full operating condition. He then turns over the management of the enterprise in full operating condition to the local owner. This is an end-point(8). The end-point in that context does not extend to such dimensions as final products or services obtained from the enterprise.

In the context that Box 5 is not an end-point, then Box 5 represents utilisation of technology (i.e. operations and maintenance) and Box 6 indicates the final products and/or services; this will be assumed to include the activity of evaluating the final products and comparing same with the defined objectives.

The fact that the Direct Method does not include Box 2 and Box 3 does not suggest that these stages are non-existing; the truth of the subject is that these activities are done by the technology supplier devoid of any participation by the recipient. Similar arguements hold for the Alternative and Joint-Venture methods which omit Box 2. A more detailed treatment of the differences between the various methods of transfer is given in Section 6.2.

The advantages of this model to managers of technology transfer are two-fold.

(i) it shows the activities (or stages) involved primarily in the different methods of transfer.

(ii) it allows the representation of a big national plan, (i.e. a group of desired projects) as a series of activities that could be embarked upon concurrently using different methods for each project, where the satisfactory completion of one project leads to another project or group of projects (as opposed to the concept of "one project at a time" suggested by the earlier models).

In this sense, M represents the starting-point, and S represents the set of activities stemming from M. The activities take different paths until a convergence is achieved at Box 5.

Summarising, although the tree model appears to be silent on iterative processes, it does assume and allow for such situations; but for clarity sake this has been omitted in Fig. 2.3.9.

In conclusion, studying the models of technology transfer has disclosed the Key structures of the process i.e. the stages. This is particularly useful to management for planning and/or scheduling purposes. The iterative procedures would enable management to monitor the quality of the "products" at each stage, and subsequently, at the end of the day, to realise the defined objectives. In particular, the models have suggested that there are some inherent factors that cause problems in the management of technological innovation and transfer. These include:

1. perception of the subject
2. identifying the groups of personnel to be involved.
3. organising for the process, i.e. identifying the components of the process and providing the necessary resources for their success.
4. arranging the various activities to enhance effective utilisation of available resources including the technology that had been acquired from elsewhere, i.e. planning and scheduling.

2.4. The Conditions for Success in Technological Innovation

Introduction: The industrial firm is the main agent of technological innovation. It transforms scientific and technological knowledge into new or better goods and services which satisfy economic and social needs. The objectives of innovative activities in industry are, in economic terms, profit and growth. Therefore our discussions on the conditions for success in technological innovation would be industry-oriented for most of thetime. A few of the important conditions are identified as:

- research and development;
- good management (incorporating planning and control),
- creativity;
- government's interest and policies in technological development;
- cooperation between the government, universities and industries;
- an environment receptive to innovation (market opportunities);
- availability of funds for development;
- education and training

(they are not in any order of importance).

(i) Research and Development

The importance of R & D to technological innovation cannot be overemphasized. As a matter of fact Sharwell (2) Contended that they are constituents of the same element when he said "R & D and innovation is a major factor in assuring a nation's economy". Twiss (3) declared,

> "Commercial success rates are frequently as low as 10% of the projects initiated - put the other way this means a 90% failure rate. There is ample evidence to show that many of these failures were avoidable if there is a significant improvement in the resources devoted to R & D".

The literature has also shown a positive relationship between amount of research done (by way of investments in R & D) and technological progress (4). Thomas, (5) showed the expenditures of some western countries on R & D as a percentage of their GNP; these are developed countries.

Countries	Time	Per centage
United States	1963/64	3.4
United Kingdom	1964/65	2.3
Holland	1964	1.9
Japan	1963	1.4
Germany	1963	1.4
France	1963	1.6

In contrast the developing countries do not appear to have learnt the lesson of the fruits in R & D. For instance, available evidence showed that total expenditure on R & D in Nigeria in 1972/73 was N22.3 million (0.31% of its GNP) (6).

Cost of R & D.

Some reasonably comprehensive data on the cost of industrial R & D projects and innovative ventures have been collected in the U.S.A. by Seiler in a survey of R & D in over 100 large companies (8), and by Myers in a survey of 567 successful innovations in five industries(9). They show that the majority of R & D projects and innovations are not very costly: 73% of R & D projects and 65% of the innovations cost less than about $120,000 (about £63,000). These figures suggest that many innovations require relatively small R & D inputs, and draw largely on existing and widely available scientific and technical knowledge. The only real cost of R & D is time as it is usual for its fruits to take as much as a decade, in some cases, to be enjoyed (2). However, there are lots of occasions when major break-throughs occurred in very short times. Therefore, this "seeming wait" should not discourage industries from active R & D because at the end of the day, its fruits quite clearly overweigh the cost of waiting.

(ii) Good Management

Management ability is also related to the success of new industries, particularly science-based firms (11). Roberts has found that successful enterpreneurs have been those who explicitly recognised the importance of the management, marketing and personnel functions (12). And a recent report to the U.S. Government has concluded that the main factor of successful innovation in industry is management: " Are highly innovative industries progressive because of the manner in which they respond to technological opportunities? Are they primarily this way because their managements have extraordinary capabilities for grasping and managing technological change? What characterises the relatively uninnovative industries? Are they this way because they failed to exploit innovative opportunities?

Because they possess excessive builtin barriers to technological change? Is it that their managements have not learned the importance of utilising technological opportunities and innovative skills?

We find that we answer each of these questions affirmatively. The main barrier is one of attitude and environment. It is primarily a problem of education".

Such innovative skills advocated above would incorporate good planning and control systems. A vivid example of how lack of a planning system can deter technological success is illustrated in the Kainji Dam Technology in Nigeria, where it increased the gestation period of the project (13).

(iii) Creativity

Roberts (14) has shown that there is a correlation between technological success and industries where 'creative' men work. Jewkes et al (15) also showed that where you have creative men, there is always a high degree of success in technological innovation. Roberts thinks the creative technical enterpreneur will mostly:

(a) come from homes in which father was self-employed (i.e. they receive enterpreneurical heritage)
(b) be "well" educated (Ph.D. not necessary)
(c) be in their early 30s to late 30s
(d) be persons who are development oriented, rather than research oriented.

Jewkes et al agreed with the age factor when they said "....Get Him while He's Young". Other qualities of good innovators or technically progressive managers include:

(e) being able to be respectfully skeptical of what is known;
(f) an openness to new ideas;
(g) ability to communicate (speak out their minds);
(h) more receptive attitudes to science;
(i) ability to undertake risks;
(j) orientation towards achievement (results) rather than process; and
(k) having reputations of getting things done.

These are very useful hints for developing countries as these (factors) might have far-reaching effects on their personnel selection, particularly in managerial posts with technical orientation.

(iv) Government's Stimulation

Drury's study (which was highlighted under Research and Development) has shown how Canadian government's commitment enhanced technological innovation. Caves (16) argued that government-set airline prices have resulted in service-improving innovations. Similarly, Averch, et al (17) showed that there is a propensity among regulated firms to develop capital-intensive innovations (where regulation and policies take the shape of injection of funds into the industry), since the government has a considerable albeit often indirect influence on the process of technological innovation.

Apart from financial investments, the government can influence the morale of those engaged in innovation by sheer moral support. A classical example of such an action was in Mrs. Thatcher's speech at the opening of Shell U.K. Exploration and Production's £25m North Sea Oil Control Centre (18):

> '...you have shown that new technology is the "true friend of full employment, the indispensable ally of progress and the surest guarantee of prosperity"..... The challenge of the 1980s is for other industries in Britain to follow the lead which you have given'.

And this, amongst other factors, really spurred the industry into greater actions, with the result of higher profits over the previous years.

Comments.

The government's efforts to convince the public to pursue new avenues of technology i.e. through investments (particularly foreign investments), can be enhanced through incentives(19), (20). Some of such include:

(a) tax incentives over the money spent on training and R & D (Nigerian Experience);

(b) change of bases of paying royalty from profit to volume of sales (again Nigerian experience, 1980);

(c) Japan's National Diet has passed a long-awaited bill allowing foreign security dealers to open offices in Japan; this liberalised direct foreign investment in 50 : 50 joint ventures in securities businesses. (21)

(d) the Office of Foreign Direct Investment (OFDI) in the U.S. announced exemptions that tend, on the balance, to give investors somewhat flexibility (21). And to attract creative men into innovation (and keep them there)

(e) all companies operating in the Netherlands have to prepare for a comprehensive pension sheme amounting to at least 70% of retirement pay for all the workers.(21).

(v) Cooperation Between the Government, Universities and Industries

Staats (7) argued that perhaps the major subjective problem inhibiting Government-Industry cooperation is the lack of mutual trust. Many government officials are suspicious of industrial motives and the potential economic and political power of large corporations, especially those with multinational affliations. On the other hand, industry is concerned that government officials do not understand and appreciate the profit motive. Industry also believes there is lack of understanding by government officials of the technology innovation process. This sort of situation of non-cooperation opposes the fundamental belief of technological innovation where the government finances the agent of change (the industry). It is definitely a barrier to innovation. Important subjects that demand government-industry cooperations are developments concerning health and welfare, air and water pollution, transportation, urban development and national security (22).

Modern universities have a tremendous range of social roles. They must train people to occupy everything from the ivory tower to the other extreme of the executive and the manager, and manpower development is a major interest of the government for growth.

As for cooperation between universities and industries the literature is of the opinion that it is of paramount importance to economic growth via technological development. Universities seem to have long learned one major benefit from cooperation with industries: that one way to combat mental stagnation in their good men is to give them sabbaticals; chase them into a new environment and expose them to a fresh set of ideas, notably in the industries. Industries, on the other hand, take better advantages of the industry-orientated courses recently introduced by the universities, like the M.B.A., Diploma and Certificate courses, as well as 'innovated' professional courses, including short management programs. These situations obtain very much in the Western World mainly and the United Kingdom especially (22).

Comments

Concluding, what then can be done? Many things are actually being done; in some cases perhaps not enough, or not fast enough, or perhaps without enough understanding of the problems or importance of the problems.

First and above all, we must realise that these are joint responsibilities, and much is gained on the part of the academic world, the industrial world and the world of government by understanding of these problems.

Secondly, one thinks the major responsibility rests on the shoulders of industry. Enlightened industry is already beginning to recognize this and is putting forth much effort, by way of sponsoring university researches, and by way of working "hand-in-hand" with the government. But the result will be limited unless industry receives from the academic world, guidance, and sympathetic understanding on the part of the government.

(vi) An environment receptive to innovation

It is well argued and established that a 'healthy' environment leads to higher productivity.

But applied to technological innovation, environmental factors are much more important, where mobility is related to the degree to which industrial firms "encourage" their scientists and engineers to "spin off" and create their own firms, thereby interrupting "continuity" of industrial innovation, if the industrial environment is not perceived by these scientists and engineers to be receptive to good working (23).

Table 2.4.1. shows a comparative study of origins of science-based firms (as spin off) in U.S. and Europe.* The sample is heavily weighted against government and the universities in the U.S.A. The interpretation of this would be that generally, scientists and engineers are more mobile in the U.S.A. than in Europe. In Nigeria, employees generally stay on their job for an average period of 5 - 10 years. While this may be seen as a hinderance to the formation of new firms, the fact that there is continuity of programmes (particularly those oriented towards technological innovation) is very important.

Table 2.4.1. THE ORIGINS OF SCIENCE-BASED ENTREPRENEURS: A COMPARISON OF U.S. AND EUROPEAN SAMPLES

Percentages

INSTITUTION	U.S.A.	EUROPE
University	23.6	3.7
Industry	18.0	77.0
Government and Quasi-Government Laboratories	55.9	7.4
Private Non-Industrial Laboratories....	2.3	11.9
TOTAL	100.0	100.0

* (Source: U.S.A. - E.D. Roberts, "The Route to Scientific Progress. No. 134, Paris, October 1969. Europe:- European Enterprises Development Company, Paris.)

(vii) Funds

Probably more important is the availability of capital for science-based enterpreneurship. A U.S. report noted that regional differences in science-based enterpreneurship in the U.S.A. could be explained, to some extent at least, by differences in the degree of communication and linkage between capital sources and science-based enterpreneurs. Furthermore, it identified the following potential sources of capital available for science-based enterpreneurship in the U.S.A.: personal wealth; insurance companies, investment funds and trusts; corporate sources; investment bankers and underwriters. (23). Thus, the finance available for science-based firms depends not only on the amount of capital available in a country, but also on the degree of confidence and comprehension existing between the scientific and banking communities. This is an important lesson for developing countries. The government cannot supply all the fund needed for technological innovations. The firms should therefore take advantage of these other avenues. At present in Nigeria, only the Nigerian Investment Development Bank (NIDB) sponsors industrial programmes at some appreciable level (largely because it, itself, is funded by the Nigerian government and the World Bank). In most developing countries, the "only and immediate" recognised source of financial assistance for industrial (and at times social) programmes is the World Bank.

(viii) Education and Training

Shone (24a) suggested that there are ways of developing people for problem solving (in our case, technological problems) - through education, through training, and by practice in solving real problems. A few authors on technological innovation choose to be silent on the importance of training. The reason is probably because they assume the importance is an automatic understanding, and possibly, an understatement and therefore taken for granted.

However, Shone (24b) thought that management education and training for innovation is <u>essential</u> for two reasons:

> "Education is necessary to develop those individuals who will instigate innovation. This education must encourage individual creativity, perceptivity, initiative and receptivity to new ideas ....Complementing the strategic educational effort must be training of a tactical kind, designed to achieve new practical company objectives".

<u>Comments</u>.

Developing countries seem to have realised the value of education and training in overcoming skilled manpower shortage, but probably haven't <u>linked</u> these factors <u>directly</u> to technological innovation. The feeling is that in the West, they seem so obviously related that little effort, if at all, is needed to make the point.

Less developed countries can encourage training for innovations through government and industrial investments in scholarship awards and training incentives (e.g. allowances and tuition-paid courses). Developing countries can also <u>attract</u> their skilled nationals from abroad. Because of their trainings in (and exposures to) industrial environments, these skilled personnel would have a lot to offer in the process of technological innovation.

<u>Summary</u>.

Summarising, we shall look at Gee and Tyler's (25) summary on technological innovation:

> "follow the principles of organisational success, not the form of a successful organisation".

The statement has a good point in advising that technically-successful organisations should not be copied in situ, because what worked for 'A' doesn't necessarily work for 'B'. The feeling, however, is that examination of the structures of operational activities of successful organisations will indicate a set of factors which form a common denominator to these industries. This set of factors is what managers of industries oriented towards technological innovation need to interest themselves in. And for developing countries, one hopes the eight factors identified above do collectively have a domineering share of such set of factors in the match towards technological innovation, and subsequently, technological independence.

2.5. Conclusion

1. The literature survey discussed three different perceptions of technological innovation: innovation is considered as a new invention, or as an adaptation of an existing process (i.e. internalisation); innovation is also seen as the application of any idea, practice or material perceived to be new and applied for some purpose by the relevant unit of adoption, irrespective of when the practice or material was first introduced.

2. The survey discussed the theories that govern how technological development should be tackled, viz: solely by gaining through knowledge from those who started their development earlier, i.e. innovation by adaptation; and secondly by solely developing technologies for one-self (i.e. autarcky). Both theories have their strong points and their limitations, Understanding the advantages and disadvantages of these theories allows management to balance between time and cost on the one hand, and national satisfaction, pride and prestige, on the other, when formulating policies (principles and rules) governing innovation.

3. The survey also studied the different models of technological innovation and transfer: the focal points of the models vary considerably, ranging from product development (i.e. marketing activities), through components of processes that are oriented toward individuals or organisations, sequence of major activities (i.e. phases or stages of the process), the inter-relationships between the major activities (i.e. complex interactions), to method of managing the innovation based on organisational separation of phases of the process. A comprehensive model of the innovative process is developed from these varying models which breaks the process into its basic structures (or components) and identifies a focal point for each major activity (or phase) of the process, thus making the process easier to understand.

4. By analysing the various models of technology transfer the literature survey has suggested that there are some inherent factors that cause problems in the management of technological innovation or transfer. These include: identifying the groups to be involved, organising for the process, and organisational arrangements for effective utilisation of available resources.

5. Lastly, the survey discussed the conditions that favour successful innovation (i.e. the infrastructures that support innovation). These include research and development; good middle management; employee-creativity; government's stimulation; cooperation between the government, universities and industries; an environment that is receptive to innovation; funds; and education and training. A knowledge of the conditions that are necessary for innovation enables management to plan its activities, ensuring that the basic infrastructures are provided to support subsequent technical activities.

Summarising, we have laid the premise for the thought that problems of technology management can be any of these types:

(i) problems of awareness and definition of needs, and the setting of objectives and policies.

(ii) problems of understanding what innovation is, and defining a framework within which the innovative process should function, hence problems of choice of technology and method of transfer.

(iii) problems of organisational arrangements for the effective utilisation of resources including the technology which had been acquired from elsewhere.

(iv) problems of appreciating and providing the infrastructures that favour successful technological development.

Most of the issues breeding these problems (severally or jointly) are primarily the function (or the expected responsibilities) of the government and top-management, rather than of middle or operational management.

2.6. Recommendations/Hypotheses.

1. Developing countries are likely to develop more rapidly (technology-wise) if they adopt the third concept of innovation, i.e. consider existing technology as a 'new' material whose application would result in the achievement of qualitative objectives. This strategy would allow them to start and go at their own pace rather than striving to "keep pace" with already-developed countries who have spent years developing their technology.

2. To this end, the following suggestions arising from the literature survey are offered with two intentions:

   (a) as tentative recommendations to developing countries, and

   (b) as hypotheses to be tested during the study, i.e. they form the preliminary framework of the research.

   i. That due to inadequate appreciation and/or wrong concept of the demands of technological innovation developing countries adopt wrong procedures in acquiring their technology.

   ii. That problems of technology management arise more from wrong policies (principles and practices) of the government and top management than from middle management's inefficiencies.

   iii. That technological progress comes with time; in other words, long-established industries are more likely to be successful than comparatively new ones.

   iv. That good planning aids technological success.

   v. That 'creativity' (a necessary ingredient for technological success) does not necessarily come with very high education.

   vi. That there is a positive relationship between training (by way of investments in the training programmes) and technological progress.

   vii. That there is a positive relationship between amount of research done (by way of investments in R & D) and technological progress.

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CHAPTER III.

Preliminary Investigation of Problems Involved in the Management of Technology Transfer.

3.0. Definition of Terms used.

3.1. Introduction

3.2. Utilisation of Past Technologies (in Nigeria).

3.2.1. National Economic Performance

3.2.2. Manpower Development

3.2.3. Expatriate Quota Employment

3.2.4. Investments in Machinery and Equipments

3.2.5. Measurements of Achievements during the 3rd National Plan

3.2.6. Observations

3.2.7. Recommendation (Preliminary)

3.3. Utilisation of Past Technologies in the P & T (Nigeria)

3.3.1. Description of Investigation

3.3.2. Identification of Sources of Problems

3.3.3. Classification of Sources of Problems

3.3.4. Further Analysis of Causes of Problems

3.4. Conclusion.

3.0. Definitions.

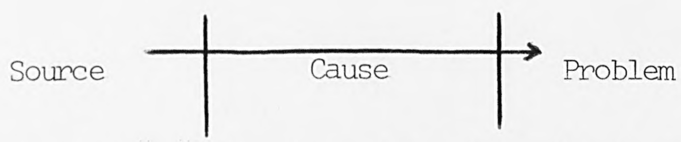
1a. Management - is defined as the guiding of human and physical resources into dynamic organisation units which attain their objectives to the satisfaction of those served and with a high degree of morale and sense of attainment on the part of those rendering the service. This guidance is manifested in a deliberate, calculated, planned and controlled process that blends the rights and needs of all concerned with those of the enterprise as it seeks to serve the maximum interests of all.(1).

1b. Management - is also defined as that group of people responsible for accomplishing results through the efforts of other people. The criteria for successful management, then, include not just the individual manager's personal diligence and effort but also his effectiveness in utilising the total potential of all others subject to his leadership.

2. Problem is a matter difficult of settlement or solution; it is often questionable and doubtful and presents perplexity.

3. Cause is that which produces an effect; or that by or through which something happens.

4. Source - is an origin; an originating cause; or that from which something rises or originates. The relationship between source, cause and problem is as follows:-



In loose usage, source is often interchanged with cause

5. Factor - an element or cause in the composition of a thing that contributes in bringing about a certain result.

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(1) It is a science (or system, just as a space satellite) involving planning and decision-making by which an efficient control is maintained over the operations of an organisation to achieve desired objectives.

6 (a) System - a set of bodily organs of like composition placed together or adjusted into a regular, and hence considered as a connected, whole.

(b) System - is also defined as a set of procedures concurring in function for the achievement of a common objective; practical method(s) in a particular field of industry.

7. Technology - is the practice of any or all of the applied sciences that have practical value and/or industrial use. It can be split into two parts: physical technology (i.e. machinery and equipments) and administrative technology (i.e. pattern of activities that bring about technical results or technical know-how).

8. Engineering - is defined as physical operations or activities

9. Environment - is defined as a sorrounding; or factors influencing the existence, the development or the growth of a body.

10. Component - one of the parts of which something is made up or a type of the thing itself.

3.1. Introduction

A practical method of identifying the factors causing problems in a system is to assess the past performance(s) of the system; in our case, how effectively past technologies had been utilised. This will highlight factors that demand greater "efforts" than are currently available to them.

The objective of this chapter is to strengthen or revise the research framework that was developed from the literature survey.

In this vein, the chapter examines (assesses) the contribution of technology to the national development of a developing country - Nigeria.

An assessment of the specific contribution of technology transfer was almost an impossible task simply because the effects arising from such exercises could not be strictly isolated from other factors. However, an insight was gained into its contribution in certain sectors of the economy when these sectors were studied separately; the overall effects were then matters of judgement from the facts emanating from the separate studies.

The problematic factors emerging from the assessment were broad in nature; they were then subjected to greater scruting by examining how the Post and Telegraph (P&T) Nigeria - which is highly involved in the use of technologies - had utilised its technologies in recent past. From this 'localised' examination, specific factors causing problems in the management of technology transfer began to emerge.

In order to appreciate these problems in some form that enhances solution, there was the need to trace them to their Sources, i.e. the variables that account for their causes. However, breaking down problems into their causes and the causes into further causes can continue into absurdities. The overlaps between the problems, the causes and their sources, created by the breaking-down process, will be taken advantage of by regarding causes of problems and the sources of problems as the same.

The problems (or their sources) so obtained are classified into Internal and External to the organisation; these two groups of problems are each further classified into Technical problems, Administrative problems and Personnel problems. Thus, the classifications produced six 'groups' of problems (or causes of). This classification has two major benefits:

(i) it separates problems that are internal to organisation from those that are external to the organisation.

(ii) the internal - external classifications have logical bearings on the actions of the three levels of management that are of interest to this research. For instance, 'external' problems have bearings on actions of the government and top-management, while 'internal' problems relate to middle management. Similarly, 'technical' problems are mostly for middle management, 'administrative' problems are more for top-management and government, while the three levels of management share the 'personnel' problems (though not exactly equally).

These make for clearer separation of efforts for planning solutions to the problems.

3.2. Utilisation of Past Technologies (in Nigeria)

Some of the benefits expected to accrue from technology transfer include the following:

(a) increase in manpower (general employment)

(b) increase in number of professionals

(c) growth of industries (in number and output)

(d) increase in GDP and GNP, balance of payments and trade favours.

(e) increase in professionalism via training

(f) better or higher standard of living

(g) appreciable national self-reliance (confidence,identity etc)

(h) save in time

  (i) in production

  (ii) increase in leisure time

(i) positive sociological changes in attitude

(j) of course, some of these benefits may come at the expense of cultural identity or awareness (this loss of culture is a sociological cost, or put another way, a negative benefit).

These benefits are either economic or social in nature, or both, and relate to the following four variables, in broad terms:

(a) National economic progress (economic, marketable benefit)

(b) Capacity to absorb technology through manpower development (economic, non-marketable benefit)

(c) Ability to achieve national objectives as contained in National Plans (both economic and social in nature)

(d) Social benefits accruing to the people through the effects of investments in equipments and machinery (social benefits).

These variables will form the bases of our assessment (or examination) of utilisation of past technologies in Nigeria.

3.2.1. <u>National Economic Performance</u>

Because of limitations of resources (time, funds, and other facilities) the idea of assessing the national performances of various developing countries (in greater details) gave way to assessing one single country that is thought to be a fair representation of the developing world - Nigeria.

The Overall picture of Nigeria's performance is that industrial production is on the increase (as shown in Tables 3.2.1. and 3.2.2), but at a rather slow rate (3.1%). Table 3.2.3. shows the weightings of industrial production; mining had been largely responsible for the industrial growth in Nigeria.

Other observations are that expenditure on plant and equipment is increasing (at the rate of 20%), much faster than skilled labour production (1.7%), urbanisation (4.7%), exports (-0.3%) and agriculture (-0.4%). Conversely, import is on the increase (20.6%): this is lilely to be largely due to machinery. Two of the very outstanding issues are agriculture and exports which are declining despite heavy investments in agricultural plants. This would suggest that the equipments (i.e. agricultural plants) are not utilised effectively, either through lack of know-how or because the machines are inappropriate to the agricultural settings in the country.

Table 3.2.1

CONTRIBUTIONS TO GROSS DOMESTIC PRODUCT (GDP) BY VARIOUS SECTORS

AT 62/63 PRICES

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Mining	678.1	801.5	898.8	5,927.6	5,859.7	5,066.9	5,350.2			
Agricultural products	2137.2	2244.0	2311.3	3,246.5	3,636.2	3661.7	3758.2			
Manufacturing	356.6	410.1	451.1	626.5	681.2	952.3	1,150.2			
All Products	4928.2	5402.4	5780.1							
				At constant 1974/75 Factor cost						
Construction and Building	376.6	417.0	477.4	710.8	837.8	1299.9	1429.4			
Educational Services	122.2	134.9	148.4	312.5	375.8	407.3	652.5			
Distribution	547.6	600.3	642.2	910.6	1191.1	1259.5	1385.9			
Other Services	133.6	153.6	176.6	196.7	215.3	233.4	254.4			
Health	49.2	55.6	62.8	109.8	132.0	155.8	185.4			

Sources: Second and Third National Development Plans (1970-74) and (1975-80). Published by the Central Planning Office, Ministry of Economic Development and Reconstruction, Lagos.

INDEX OF INDUSTRIAL PRODUCTION - Table 3.2.2

1ST PHASE OF INDIGENISATION (1972–1974); 2ND PHASE (1976–1980)

	Base Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Manufacturing	1965	176.9	188.1	224.8	227.3						
	1972					147.7	182.2	193.5	221.4	237.5	263.6
Mining	1965	506.5	589.4	665.6	729.4						
	1972					97.8	113.4	114.5	103.6	126.0	112.9
Utilities (Electricity)	1965										
	1972					153.8	184.5	212.3	260.6	345.2	398.5
Total Industries	1965										
	1972	87.9	100	116.2	122.3	115.1	137.1	142.1	145.0	167.0	168.0
Agriculture (Export Commodities)	1960	80.1	84.2	67.6	69.1	76.7	77.3	57.2			
	1972										

Sources: Progress Reports on the Second and Third National Development Plans (1970-74) and (1975-80). Both published by the Central Planning Office, Federal Ministry of Economic Development and Reconstruction, Lagos.

Table 3.2.3

PRODUCTION WEIGHTINGS: (1977-79)

Manufacturing	233.4
Mining	480.6
Electricity	18.0
Total Industries	732.0

Table 3.2.4

UNEMPLOYMENT AND INDUSTRIAL RELATIONS

		1st Phase				2nd Phase				
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
** Registered Unemployment (Total)	12605	15481	20872	20918	21330	19553	19287			
Lower grade workers	12303	15210	20524	20694	21155	19416	18053			
Professional and Executive	302	271	348	224	175	137	234			
School Leavers	(3671)	(4235)	(6879)	(6554)	(5481)	(3714)	(4916)			
** Vacancies (Total)	1583	1756	1962	4186	3541	4747	3515			
Lower grade workers	1520	1643	1866	4061	3403	4583	3387			
Professionals and Executives	63	113	96	125	182	164	128			
INDUSTRIAL RELATIONS										
Trade Disputes	317	210	208	338	775	422	172	142	155	355
* Work Stoppages	176	73	75	129	346	213	93	78	755	265
Workers involved	78469	55622	38958	62565	107489	76297	59270	105522	204742	221088
Man-days lost	209562	155223	128543	144881	435493	213186	136349	875137	2038855	2350998

Source: Same as for Tables 3.2.1. and 3.2.2.

* This shows that there are problems of internal organisation.

* Trade disputes due mostly to improvement on the conditions of service.

This situation is similar to the Mexican experience of Green revolution in 1965 where technology seemed to have had a negative effect on agriculture. One last issue that generates some concern is the fact that as much as 1% of the GNP is spent to 'service' external debts. The thinking here is that technology has been acquired through external loans but had not generated enough returns to pay off those loans, and the country had have to service these debts, regretably, from its GNP, by as much as one per cent.

Unemployment (registered) was on the decline (though slowly) through 1973 to 1977. This may be because the introduction of new technologies had created more jobs for the unemployed. (See Table 3.2.4.). However, the rate of increase in vacancies for professionals and executives in managerial posts is higher than that of lower grade workers. What seems to be happening is that more managers are "made" to supervice the workers without a proportional increase in the number of workers. This will ultimately increase the overheads. This situation is probably a direct consequence of the Indigenisation Decree of 1972 (the first phase was in 1972 and the second in 1976), which made it mandatory for the industries to fill a certain percentage of their senior posts exclusively with Nigerians. The intensions were definitely genuine as they sought to give a reasonable control of the economy to Nigerians, but whether it has yielded the required results is another story.

Number of trade disputes rose very sharply in 1975 but got into a steady decline thereafter, except for another fairly sharp increase in 1980; the same story obtains for work-stoppages, and workers involved. Most of these trade disputes were mostly over improvements of conditions of service. The number of man-days lost during these disputes and stoppages are staggering, escallating from 209, 562 in 1971 to 2,350,998 in 1980.

The tentative conclusion is that there are management problems involving the working settings in the industries; this is to say that the invironments (internal and possibly external) don't seem to be conducive to good performance of technology, and this might, in a way, explain why technology transfer had not been satisfactory.

3.2.3. Manpower Development

From the published "Study of Nigeria's Manpower Requirements, 1977" it is observed that a little over one million (1,015,339) persons were employed in the various establishment that responded to the study. Of these about 40 per cent were employed in the private sector, while the public sector accounted for the rest. (See Table 3.2.5). It would have been more meaningful if the table could be compared with tables of other years. However, it does give some insight into the manpower situation in Nigeria. In a country where the public sector (that is government and its corporations) accounts for about 60 per cent of the total employees, the inference is that the country has surplus labour, and therefore problems of unemployment, (except if the response rate was significantly higher in respect of public-sector establishments than for private establishments). In any case, a fair deduction from the situation is that there is still the need for the establishment of more industries, particularly in the private sector.

The problem of manpower shortage as defined in terms of staff vacancy, is clearly highlighted in the results of the study. For example, the vacancy rate as at 1st April, 1977 was slightly over 50 per cent in respect of many scientific and technical categories of manpower. In other words, the additional requirements of the economy for these categories of manpower were more than the existing stock.

To correct this situation the government increased efforts towards:

(a) the provision of industrial-attachment programs, occupational guidance, and similar schemes which are aimed at bridging the gap between education and training and the world of work.

(b) strengthening of existing educational and training facilities, and establishment of additional ones in identified areas of need.

Table 3.2.5

Distribution of Total Employees by Type of Employer

Type of Employer	Total Employees				
	Male	Female	Total	Females as % of Total	% Share of Employees
Federal Govt. (Civil Service)	154,099	22,468	176,567	12.7	17.4
Fed. Govt. (Corporations)	93,715	16,059	109,774	14.6	10.8
State Govts. (Corporations)	54,112	9,520	63,632	15.0	6.3
State Govts. (Civil Service)	159,717	33,631	193,348	17.4	19.0
Local Governments	53,225	9,571	62,796	15.2	6.2
Private Sector	366,718	42,504	409,222	10.4	40.3
Total	881,586	133,753	1,015339	13.2	100.0

Source: Second Progress Report on the Third National Development Plans. Published by Federal Ministry of Economic Development, Lagos.

As a result, there was a substantial increase in student enrolment in various educational institutions, particularly at the primary and tertiary levels. Thus, for example, total enrolment in the Universities increased from about 31,500 in 1975/76 to about 57,800 in 1979/80 session. Similarly, out-turn of University graduates was about twice the out-turn for 1975/76 session - from 4,004 to slightly more than 9,000. The expansion of the facilities of the Polytechnics can be better illustrated by the fact that their number rose from 8 in 1973 to 24 in 1979, while student enrolment correspondingly increased from about 8,000 in 1973/74 to roughly 35,800 in 1979/80 session. All these efforts by the government stem from the realisation that there is shortage of skilled and executive manpower which could be (as indeed it is) a crucial constraint in the implementation of development projects.

This then ties up with the first hypothesis that "if management (as in this case government) can be helped to vitualise the problems of Technology Transfer then they are likely to reduce the effects of problems of technology transfer".

3.2.3. Expatriate Quota Employment

Another factor of measurement considered was the role being played by foreign experts in technology transfer into Nigeria. If there is any positive yield from these transfers, reflection of this would have been a decline in the number of expatriates engaged in various disciplines. The intuitive feeling is that "there had been no significant reduction in the expatriates employed in various fields in Nigeria over the past five years". The point being made here is not that all the posts occupied by foreigners should have been taken over by local personnel, as a test of success of technology transfer, but that through trainings (both formal and on-the-job), knowledge and know-how should have been passed to the local personnel to an extent that would have enabled them to take over some of the posts that were occupied by the expatriates since 1974. It is appreciated that the country needs the services, expertise and advice of these foreigners in certain disciplines where it might take some five to seven years before government's efforts to produce qualified local personnel in these disciplines make any appreciable impact. But definitely, it should not be in every discipline, and even if it had to be so at the beginning, there should have been a reduction in the number of their employment. One method by which the government felt it could reduce (or at least limit) the number of expatriates employed was to cut down on the expatriate quota allocation in the various sectors of the economy. This in effect meant that any expatriate being brought into Nigeria by any firm must be cleared by the Ministry of Internal Affairs, in conjunction with the Ministries of Establishment, and Trade and Industries. These allocations are based on applications from the industries, and returns are made by the industries to the Ministry three times a year, viz. March, July and November.

Findings show that on the average, about 25 per cent of the expatriates employed are in the Manufacturing and Processing Sector, about 35 per cent are in the Construction industry and about 14 per cent are in the Financing, Insurance, Real Estate and Business Services. These are the three major sectors where expatriates are employed. In the agricultural sector, for example, only about 0.4 per cent of them are found there.

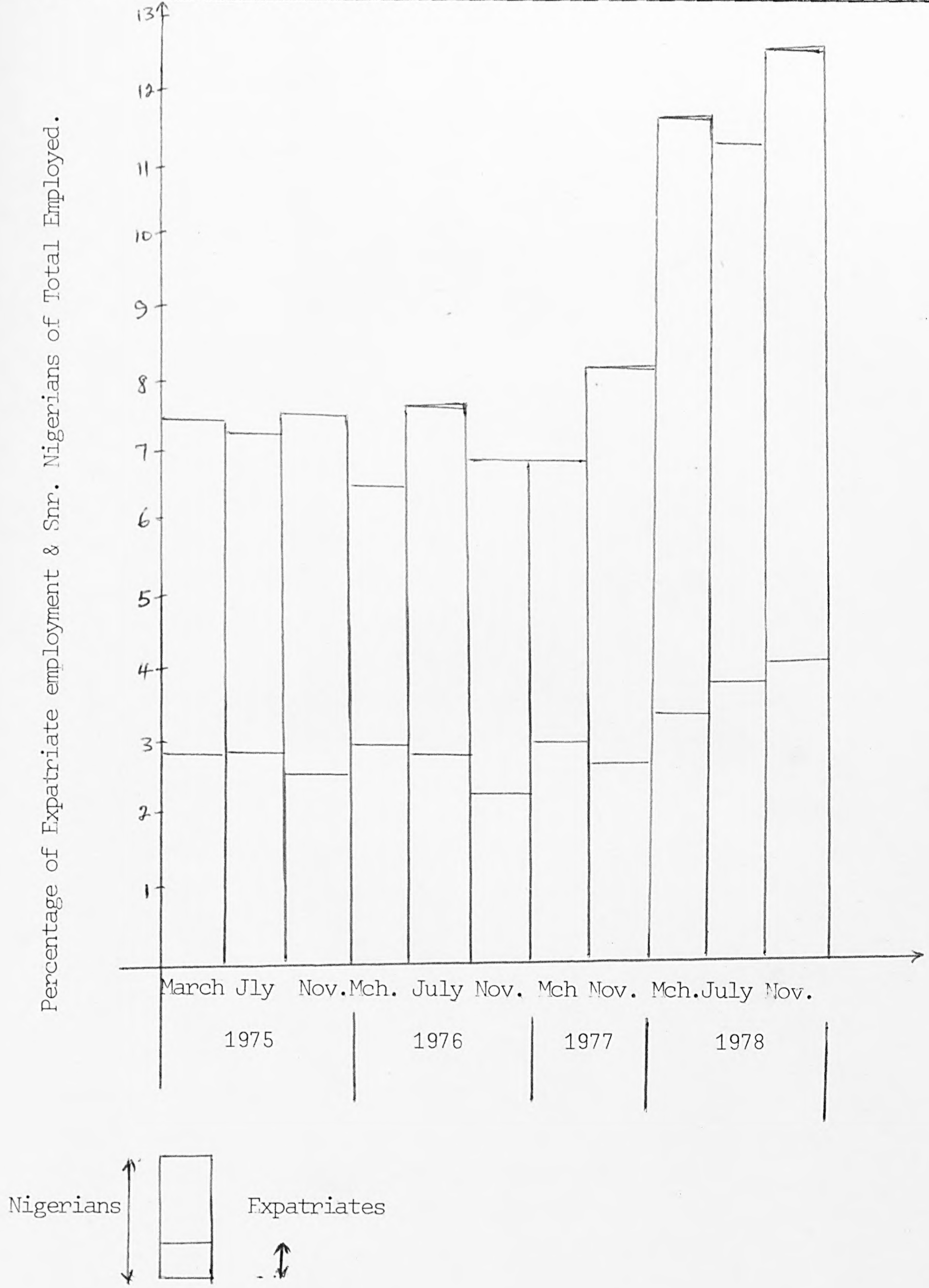
A conclusion from this is that foreigners seem to be more interested in those sectors where they can make quick and easy money. However, the main interest is the trend of their employment. A corollary to the intuitive feeling expressed earlier is that "there is no significant increase in the number of Nigerians employed in senior management positions (comparable to those held by their expatriate counterparts) in various fields over the past five years".

After the Indigenisation Decree (which was passed in 1976 to ensure that qualified Nigerians have some opportunities in decision-making positions) there was still no improvement in the number of senior positions held by Nigerians until 1978, when there was an average increase of about 3.6 per cent over 1977. (See Table 3.2.6).

3.2.4. Investments in machinery and equipments

During the period under study (1976-80) the national investments in machinery and equipments were very high. In 1978 there was a general embargo on importation, but this had very little effect on the level of importation (in monetary terms). Hardly anything at all was manufactured in Nigeria. From 1977 to date, three motor-assemblying plants have been established, viz. a Peugeot assemblying plant in Kaduna, a Volkwagen assemblying plant near Lagos and a Trunk assemblying plant in Ibadan. Despite these efforts there was/is hardly any decrease in the level of vehicle importations into Nigeria.

Table 3.2.6. Summary of percentage expatriate employment of total employees



It figures then that Nigerians are fun-loving people who believe in luxuries, even when they have to import such luxury and its equipments; and a nation like that is hardly ever going to be able to supply its own needs. This is an evidence of living about one's level of production.

The other observation of this section of the study is that the amount of money spent on machinery and equipment had always been on the increase since 1969. As mentioned earlier, there was this embargo on importations in 1978, but even this did not produce any significant effect, the desired effect being a noticeable drop in machinery importations. For instance, the total investment on machinery and equipments in 1979 was N2.4 billion compared with a corresponding figure of N3.5b in 1978. At a glance this may appear to be a reasonable decrease, but a look at Table 3.2.7 would indicate that the items that account for the drop mainly belong to the class of low technology. In one sense, if these heavy investments in machinery imports were matched with manufactured exports the story would have been more savoury. What happened was that there was no export of any manufactured produce during that period. In another sense, if there were not exports and there were also no imports of essential commodities, the story would, again, have been more savoury. What we have is an ever increasing investment in machinery and equipments, plus an equally increasing investment in importation of foreign products.

The conclusion from these is that investments in importation of equipments and machinery have not satisfied the purposes for which they were intended.

3.2.5. Measurements of achievement during the Third Plan

In the communications industry there is a wide gap between planned targets and actual performance. For example, only about 20,000 additional exchange lines would be made available out of the planned capacity of 95,000 additional lines, and 398 additional telex working lines out of a total of 1,080 additional ones planned for the same period.

Table 3.2.7 Summary of Nigerian Trade Figures (External) for Imports (Machinery) in millions of Naira

ITEM CODE	DESCRIPTION	1969	1974	1975	1976	1977	Embargo 1978	1979
711	'Machinery and Transport Equipments	2.64	19.20	45.83	49.81	68.25	118.96	81.99
712	'Agricultural Machinery	1.02	10.79	58.95	61.32	73.90	73.66	50.81
713 714	Office Machines including Calculating Machines & Computers	0.87	6.41	11.78	15.46	20.46	20.66	15.63
715	Metal Working Machinery	0.40	4.35	9.76	16.22	20.82	23.83	14.46
716 717	Textiles Machinery and Leather Machine (Sewing Machines)	6.42	26.76	58.49	66.83	90.60	102.39	84.90
718	Machines for Special Industrial (Printing, book binding and graphics)	5.24	89.03	207.14	288.06	425.56	383.81	199.07
719	Machinery and appliances other than Electrical	13.95	103.51	251.99	383.86	490.02	561.77	377.88
720 721 722	Electric Power Machinery and Switchgear	3.28	36.58	88.19	114.52	197.19	348.69	191.16
723	Equipment for Distributing Electricity	1.61	9.47	28.41	32.13	59.95	99.91	66.14
724	Telecommunications	4.37	26.51	76.08	204.68	272.94	314.88	167.84
725	Domestic Electrical Equipments	0.81	11.86	30.59	34.46	65.80	77.61	41.41

ITEM CODE	DESCRIPTION	1969	1974	1975	1976	1977	Embargo 1978	1979
726	Electric Apparatus for Medical and Radiological purposes	0.26	1.50	3.04	4.08	4.62	11.01	5.40
727								
728								
729	Other Electrical Machinery	3.84	27.22	43.82	70.80	132.60	226.36	172.34
730								
731	Railway Vehicles other than Steam or Electric	0.82	1.75	19.79	21.03	36.10	39.71	4.89
732	Road Moter Vehicles (Passengers Cars)	22.05	200.05	550.44	947.90	1212.75	981.32	799.81
733	Road Vehicles other than motor vehicles	2.68	17.32	39.99	85.14	106.65	112.24	83.40
734	Aircraft	2.01	10.00	12.29	18.99	67.40	34.60	22.86
735	Ships and Boats (Warships of all kind)	0.94	9.03	29.52	29.43	32.19	31.48	20.73
	TOTAL	73.21	611.79	1562.01	2441.72	3386.78	3562.89	2400.72

Sources: Second and Third National Development Plans (1970 - 74) and (1975 - 80). Published by the Federal Ministry of Economic Development and Reconstruction, Lagos.

There were some performances, however, that deserve mentioning, e.g. an international telephone switching centre was established at Necom House, for connecting the national telephone network with international switching centres in the rest of the world; the nation's external telecommunications made progress during the Third plan, but unfortunately, this was not matched by the development in the internal telecommunications. These examples point to the fact that the country pays more attention to what one would want to call <u>prestigeous projects at the expense of providing the basic needs of the people.</u>

In the Sewerage, drainage and refuse disposal sector, in spite of the efforts of the government, the gap between the present condition and the standards required for a healthy environment is still wide. This is hardly surprising because there was always a <u>sharp difference between planned targets and actual achievements</u> in the Third plan. (See Appendix II). Except in Bauchi State, the actuals are less than 40 per cent of planned targets. In the agricultural sector, the country under-utilises its agricultural land in a quantitative sense, and the qualitative depreciation of most of the land under regular cultivation is even more apparent. This is largely responsible for the characteristic low productivity of Nigerian agriculture with an avarage output per worker of N175 per annum (N1 = £0.79). During this Third Plan the Federal Government tried to encourage food crop production by establishing these bodies:

(a) National Accelerated Food Production Program (NAFPP)

(b) National Grains and Root Crops Production Companies

(c) Rural Integrated Development Program

(d) River Basin Development Authorities

(e) Agricultural Mechanisation

However, a food balance sheet for Nigeria published in "The Green Revolution: A Food production Plan for Nigeria" in 1980, shows that an average Nigerian consumed 1,887 Kcal and 45.1 grams of crude protein in 1976. Minimum requirements according to FAO are 2,191 K cal and 53.8 grams of crude protein.

Table 3.2.8: A Summary of the observations from assessing the effectiveness of past technologies in Nigeria.

Costs and Beneficial Factors	Observations	Remarks
1. Investments in equipments and machinery (i.e. industrial imports	Increasing very rapidly	The embargo on imports decreed in 1978 had a slight effect on the level of imports in 1979 (but only for that year).
2. Industrial production	Increasing, but very slowly	Minning contributes very heavily to industrial production; manufacturing is on the increase but at a very slow pace.
3. Manpower development	Increasing very slowly	Additional requirements are more than existing stock
4. Employment		
(i) Expatriates	Increasing	But not too rapidly
(ii) Low-grade Nigerian	Increasing fairly rapidly	
(iii) Senior (Managerial) Nigerians	Increasing	Faster than low-grade workers; and not much faster than expatriates
5. Industrial Relations	Getting worse	Increase in number of workers involved and in man-days lost
6. Achievements from National Plans:		
(i) Communications	Internal targets not met, External operations excellent	More energy is devoted to prestigeous operations at the expense of basic internal requirements.
(ii) Sewerage, drainage, refuse disposal, etc.	Targets far from being met	
(iii) Agriculture	Target far from being met	Production actually decreases over the years.
(iv) Urbanisation	Increasing very slowly	
(v) Literacy	Increasing	But very slowly indeed.

Similarly, the figures for 1976-1980 show that production of all commodities in grain equivalent rose by an average of about 1.1 per cent per annum. This is much below the population growth rate estimated at 2.5 per cent, and by implication led to a heavy reliance on import of food items to supplement domestic production.

Once again, it is the same story of not being able to provide its own basic needs, this time, much typified in actual achievements being very much less than planned targets.

The same situation obtains in almost all the other sectors, except in Education where the achievements are really commendable - that is not to say that the planned targets were reached but at least the differences between plans and actuals are not very wide.

So all rolled together the observation is that during the Third Plan (1975-1980), most (if not all), the planned targets have not been met.

3.2.6. Observations

(i) The assessment exersise has indicated that there are problems of shortage of manpower, problems of effective organisation (i.e. creating 'virile' conditions for working), problems of executing planned actions, problems of choice of development projects, and problems of turning investments in equipments and machinery into benefits that satisfy the purposes for which they were intended.

(ii) It has been argued that the intangible benefits to be derived from technology are more than those benefits that are of economic nature. Decisions on choice of technology should therefore be made in favour of these intangible benefits.

(iii) The problems of executing plans are reflected in grave differences between national plans and actuals. The study has also shown that choice of projects to be executed is a major source of problem; there is the tendency to indulge in prestigeous and grandiose projects at the expense of the provision of people's basic needs.

Lack of basic ammenities and infrastructures creates an environment that is not conducive to technological development.

(iv) There is a feeling from the study that transferers of technology are not totally dedicated to the aspirations of the transferees, as reflected in the sectors of the economy in which they operate mainly.

(v) Finally, an inference from the exercise is that there is a problem of educating people about the dignity of labour and self-reliance.

Summarising, the chapter has confirmed that there are management problems of organisation; in addition, it has shown up the complexities of other management problems, i.e. problems of turning human potentials and equipments into dynamic organisations, problems of choice of development projects and problems of creating 'comfortable' conditions for the working populace. The exercise has suggested that management is not looking in the right direction, regarding assessments of plausible benefits from technology: assessments are currently based mainly along economic lines, while other types of benefits (i.e. social benefits and economic - but non-marketable benefits) are not given important considerations.

The problems identified in the exercise are summarised as follows:

Related to / Kind of Problems	Government	Top-Management	Middle Management
1. Problems of choice of development project	Arising from incorrect definition of objectives		
2. Shortage of manpower	Part of infrastructures for successful technological development		
3. Problems of internal organisation			Organisational structure to reflect the demands of technologies
4. Problems of working settings (Internal)			Arising from the Rules, regulations and procedures that constitute the system
5. Problems of working settings (External to business)		Arising from conditions that result in non-conducive environments	
6. Problems of executing planned actions to achieve targets		Arising from lack of planning system or incorrect planning system	
7. Problems of turning investments in machines and equipments into benefits			Arising from either the use of wrong technologies or lack of knowledge of the application of the technologies

Continued on next page.

8. Problems of "education and training" to change societal orientation to work	Arising from societal value for "high tastes" and conversely, from lack of zeal to work		
9. Problems of assessing benefits	Arising from lack of model for assessing benefits and definition of objectives		

3.2.7. Recommendation

As a lead-in to more empirical work that follow, the following proposition can be set forth as an hypothesis to be tested and as a tentative recommendation for would-be innovators (based on the findings of the assessment exercise):

"That problems of management of technological innovation in Nigeria (and there-fore developing countries) are more related to the government and top - management than to middle management".

3.3. Utilisation of Technologies in the P & T (Nigeria)

3.3.1 Description of Investigation

Nigerian Post and Telegraphs is highly involved in utilising acquired technologies (particularly in the Telegraph Division). For this reason it was chosen for a study of the factors affecting successful transfer of technology to a developing country searching to utilise acquired technologies, i.e. to manage innovation.

The causes of problems within the P & T were discussed with four groups of people, corresponding to our 3 tiers of management and an outside party which has no direct involvement in the operations of the organisation. These are:

Group A. those who partake in the decision making and would therefore need or want to defend/protect the name or interest of the establishment.

Group B. the employees of the organisation other than those in group A above; this group is responsible for the actual operation of the establishment and therefore in a position to understand where the major problems are

Group C. members of the outside environment who, by certain designs, are charged with the responsibility of playing the public watchdog's role

Group D. members of the public (supposed to be neutral) who think they have some understanding of what is/are wrong with the establishment.

The respondents that belong to group A, include Alhaji Akanbi Oniyangi, the Minister of Communications and Chief Etem Okoh, a Minister of State in the Ministry. Those in group B include Mr. Olaniyan Sowora, a Senior P & T Staff; Mr. G.O. Uluocha, the General Secretary of the National Union of the Posts and Telegraphs Employees; Mr. Ngozi Ajokubi, the Director of Research and Publicity of the Students Union of P & T Training School, Oshodi, Lagos. Those in group C include Mr. Ambrose Gapsuk, Chairman of House of Representatives Sub-Committee on Communications; Mr. Hassan Summonu, President of the Nigeria Labour Congress; and Mr Mattin Omosola, a Radio and Television special correspondent in charge of Communications. The respondents in group D include an ex-employee of P & T who would not want his identity disclosed, and Mr. Durosinmi Irojah, a Chartered Engineer.

Interviews were held with these prople in their respective offices (between October 1980 and June 1981), during which they were asked to comment on why the P & T (Nigeria) had not been able to utilise acquired technologies effectively. Whenever a sign of reluctance was detected from the respondents in answering the questions, a set of inefficiencies were levied against the section of the P & T to which the respondents belong. This brought them out of their shells.

Their subsequent comments to the issues varied according to their interests; they all seemed to want to put the blame on another person's door. In this sort of investigation it is very difficult if not impossible to collect 'hard' data as we are dealing with a subject that is 'behavioural' and therefore not easily quantified.

3.3.2. Identification of Sources of Problems.

Respondents in Group A.

Alhaji A. Oniyangi admitted inefficiencies were levied against his ministry but was quick to deny that the total blame lies with his establishment. He, however, identified some major problems within the P & T. These include:

a. Overcentralisation which creates some bottlenecks within the organisation; he said that the two departments (Post and Telegraphs) of his ministry would be separated "to make way for better services". 1.

b. Lack of private and reliable lines where the President and other top government personnel can discuss strictly confidential matters in absolute privacy. 2.

c. Insufficient subscription to the use of post office boxes by the public. He feels that a wider use of post office boxes would enable letters reach their destinations on time. 3.

d. Lack of proper identification of the streets that leads to difficulty in locating street addresses by the postman. 4.

e. The haphazard nature of house-numbering on the streets. 5.

In the view of Chief Etem Okoh, some of the problems of the establishment stem from:

a. Incessant digging by National Electric Power Authority, the Rural Electricity Board and some road contractors that results in constant P & T cable-cuts. 6.

b. Lack of resources in some plans, e.g. in the provision of alternatives to transmission lines. 7.

c. Lack of authority to raise or obtain money or loans from outside (e.g. from banks, financiers) created by governmental bureaucracy; the Nigerian External Telecommunications, another arm of the same Ministry of Communications is granted sole powers. 8.

Group B.

Mr. Sowora identified the following sources of problems:

a. The refusal by other arms of the department of Posts (e.g. Engineering, Finance, Personnel, etc) to accord first position recognition to the postal division (in total summation, this is lack of cooperation between various arms). 9.

b. Lack of training, in his words "A good percentage of the junior workers are yet to be trained. At Lagos Territory, for instance, the management simply parade a lot of untrained post men and postal officers". 10.

c. Square pegs in round holes; for instance "Modern III and uncertified Secondary School goers employed as sorting clerks only go in to muddle up things"; they can not even receive the training when given. 11.

d. Poor equipment. 12.

e. Inadequate resources to cope with the ever increasing volume of mails. 13.

f. Lack of promotions or incentives for workers. 14.

g. Acts of favouratism by management. 15.

h. Unsuitable conditions of work, e.g. mailmen delivering letters in the rain. 16.

i. Unhygenic working environment which leads to low morale and reduction in production. 17.

j. Lack of authority to operate its own administrive, pay roll, transport and stores sections. 18.

k. Bureaucracy that disallows patriotic groups with dynamic ideas about postal business from helping. 19.

Mr. Uluocha identified the following sources of problems within the establishment:

a. Lack of adequate reward for hard-working employees (motivation), i.e. the system fails to even identify the hard-working ones. 20.

b. Lack of adequate and proper equipment. 7,12.

c. Lack of incentives to workers generally. 21.

d. High cost of training. 10,22

e. Lack of proper training of employees. 10.

f. Governmental bureaucray over promotions that leads to low morale. 8,19,23

g. Over centralisation of administration. 1.

h. Unhygenic working environments 17.

i. Lack of constant reorganisation exercise to enable officers to work in various departments and gain different and useful experiences. 24.

Mr. Ngozi Ajokuloi would not agree that the employees are not well trained. He however quarrelled with the training facilities and conditions at the Training School. His view could be summed up as follows:

a. Lack of good welfare. 16.

b. Unsuitable training environments. 10,17.

c. Non-award of recognision Certificates after training. 10.

d. Lack of freedom of expression which leads to 26.

e. Tension and, 25.

f. Low morale and therefore, 23.

g. Ineffective training. 10.

Group C.

Mr. Ambrose Gapsuk spoke of the following ills of the establishment:

a. Concentration of P & T in Lagos, i.e. over centralisation 1.

b. Administrative ineffectiveness due to bottlenecks. 19,34

c. Poor handling of P & T work by indiginous contractors; this is strictly due again to governmental bureaucracy whereby the P & T could not award its own contracts, but had to look upon the government. 27.

d. Nonchalant attitude of some workers. 28.

Mr. Summonu blamed the ills of the department on:

a. Bad system of awarding contracts whereby huge contracts are awarded to single contractors. 29.

b. Lack of incentives to workers. 21.

Mr. Mattin Omosola identified the following sources of problems:

a. Vast discrepancies between plans and actuals in terms of production, the latter being much less than the former. 30.

b. Under utilisation of resources, e.g. in any given period, the amount spent on P & T projects is usually much less than what was originally allocated. This leads to so many other problems like insufficient services, lack of recommended systems and modern equipments. 12,32

c. Poor handling of telecommunication projects by some contractors. 27.

d. Lack of telephone exchanges to facilitate the execution of certain projects. 31.

Group D.

The contact who would want to remain anonymous spoke of the following ills:

a. Wrong attitude to work 28

b. Wastes due to inefficient untilisation of material resources and finance. 32

c. Acts of pampering the establishment by the government, e.g. its budget requests are always honoured with little prunning - this breeds lack of management drive for survival. 33

d. Lack of proper contract - award systems. 29

e. Constant digging, resulting in the destruction of underground cables. 6

f. Wrong calibre of people making wrong decisions. 11

Mr. Irojah thought the following are the sources of problems of P & T:

a. Organisational structure - the P & T is run like a Civil Service, e.g. security of tenure makes for lack of descipline or removal of inefficient personnel. 19,34

b. Haphazard arrangement of rewards to effort, e.g. seniority is more important in determining promotion rather than ability to do a particular job. 19,20 23,34

c. Lack of incentives. 21

d. Failure to go commercial (the profit orientation would make employees realise that they can only make profits if their organisation is efficient). 35

e. Wrong calibre of people on wrong jobs. 11

The numbers at the right hand side of the sources of problems refer to the numbering of sources of problems in Table 3.3.1. This enumeration is necessary because certain sources of problems were identified by more than one respondent. Thus a total of 35 sources of problems were identified as follows:

1. Overcentralisation
2. Lack of private telephone lines
3. Late arrival of mails
4. Street identification
5. House numbering
6. Incessant street digging
7. Lack of resources
8. Insufficient fund
9. Lack of deptal cooperation
10. Lack of training/Certificates
11. Wrong people in wrong jobs
12. Poor equipments
13. Inadequate resources
14. Lack of promotions
15. Acts of favouratism
16. Unsuitable working condition
17. Unhygenic environment
18. Lack of precise authority
19. Bureaucracy
20. Lack of rewards
21. Lack of incentives
22 High cost of training
23. Low morale
24. Lack of reorganisation
25. Tension
26. Lack of freedom of expression
27. Poor handling of contracts
28. Non-challant attitude to work
29. Bad contract award system
30. Deviation between plans and actuals
31. Lack of telephone exchange
32. Wastes due to underutilisation
33. Acts of pampering or over-indulgence
34. Organisational structure
35. Failure to go commercial.

3.3.3. Classification of the Sources of Problems

As could be observed from the list, almost all the sources of problems identified were, in one way or the other, related to the environment according to our definition of the component environment. This suggests that that component (i.e. environment) appears very broad, and management may not be able to plan actions distinctly on that basis to tackle the problems.

To overcome this deficiency, a different classification of the sources of problems is employed, based on their relatedness to Technical factors, Administrative factors or Personnel factors within problems that are Internal and External to the organisation. Thus, the classification produces six 'groups' of causes of problems. (See Table 3.3.1.). These groups of causes of problems are:

	No of Sources in the group	Attributable to
1. Poor Operating Systems	9	Middle Management
2. Poor Man Management	8	Middle Management
3. Poor Know-How	6	Middle Management
4. Poor Equipment Supply	6	Top and Middle Management
5. Poor External Political Supervision	3	Government
6. External Social Climate	3	Top Management

It is accepted that ordinary counts are not adequate to determine specifically the magnitude of each source of problem. The effect(s) created by some problems on the management of technology are more important than others (in actual practice), i.e. as the (sources of) problems vary in nature so do the effects they create.

PROBLEMS	ENVIRONMENT		Total No. of Problems
	Internal to Organisation	External to Organisation	
Technical (i.e. Physical)	Know-How 2,10,30,31,32 (5)	Equipments machinery, etc problem forced by say contractors etc 3,4,5,6,12,13,27 (6)	11
Administrative (Formal management e.g. paper works, etc)	Operating System (e.g. Incentives, etc) 1,11,14,19,20, 21,24,26,34 (9)	Problems Imposed by external agencies 22,29,35 (3)	12
Personnel (Informal adminis-tration, sociological)	Operational (Managerial) 9,15,16,17,23, 25,28 (8)	Influences by Public, Politic-ians, Financiers, etc. 7,8,18 (3)	11
Total No. of Problems	22	13	35

Table 3.3.1 Classification of Causes of Problems in P & T (Nigeria) (on basis of individual causes)

Consequently the measurements of these effects are bound to be in different terms and therefore fairly difficult to compare. However, for purposes of comparing like terms, the magintudes of the (effects of) (sources of) problems are taken as being reflected by the numerical strength of their occurrences. They therefore indicate the order of magnitude of the sources of problems in utilising acquired technologies in the P & T (Nigeria).

Observation

The Key to effective utilisation of acquired technologies would seem to lie in the middle management recognising the deficiencies in their formal and informal administrative systems, and taking remedial actions to reduce the effects of these problems, as well as arming themselves with better know-how, e.g. through training. Top management should determine more properly what equipments (or technologies) are appropriate for their operations and purchase same, as well as strive to improve social relations. The government should effect an improvement in its relations with both top management and the society at large.

3.3.4. Further analysis of the Causes of Problems.

Because some of these causes of problems are similar in relation to the problems that arise from them, they are analysed into groups on the basis of how closely they give rise to very similar problems. For instance, 'poor contracting system' and 'lack of control on contractors are two sources of problems which give rise to the problem of loss of control over contracts and are therefore grouped together. If a source of problem appears not to give rise to a problem as does another, such source of problem is discarded. This analysis by 'grouping' therefore produced a more comprehensive list of 9 sources of problems, shown below (with no. of sources in each group).

1. Beauraucracy, Overcentralisation and Effect on morale - 6
2. Lack of Training and therefore Know-how - 5
3. Poor Equipments, and lack of resources - 5
4. Lack of Incentives, Nonchalant attitudes - 5
5. Poor Contracting System, Lack of Control on Contractors - 4
6. Poor working conditions - 3
7. Lack of Authority to raise Fund - 2
8. Mismanagement of Resources - 2
9. Effects of External Agencies (e.g. incessant digging of roads) - 2

The partitioning of these sources of problems may not be very distinct as some of them are interrelated; for instance (3), (5) and (8) are closely interrelated. However, these results suggest that the administrative system (i.e. formal way or written-down pattern of management) in the organisation causes a lot of problems - middle management problems are therefore the most common, e.g. lack of training and Know-how, lack of incentives, overcentralisation, etc.

The results also suggest that a lot of problems arise from sociological administration, e.g. Lack of control on contractors; non-challant attitudes. These are included in top-management problems of beauraucracy, lack of equipments and resources, etc. Causes of problems that are traceable to government actions include beauraucracy, lack of organisation's authority to raise fund and effects of external agencies.

As in Section 3.3.3, these results suggest that problems of utilising acquired technologies arise from middle management, top-management and the government, in that order.

Going back to Table 3.3.1, the classification can be done, not specifically by individual sources of problem, but by the frequency of identification by the respondents (Refer to the Sources of problems identified). The number of times that the sources of problem are identified by the respondents show how serious the problems arising from the sources are. This model of analysis incorporates 'repeats' of sources, but gives a very good indication of their seriousness. Thus, a new classification is obtained as shown below, in Table 3.4.1.

Table 3.4.1. Classification on basis of frequency of identification

PROBLEMS	ENVIRONMENT		Total no. of problems
	Internal	External	
Technical	(Know-How) 2,10,10,10,10,10,10, 30,12,32,32 (11)	(Equipment Supply) 3,4,5,6,12,12,27, 27,27,6 (10)	21
Administrative	(Operating System) 1,11,14,19,20,21,1, 24,26,1,19,34,21,31, 11,19,34,19,20,34, 21,11 (22)	(External forces related) 22,22,29,29,35 (5)	27
Personnel	Operations (Management) 9,15,16,17,9,23,17, 16,17,25,23,28,28, 23 (14)	(External Social Effects) 7,8,18,7,33 (5)	19
Total No of problems	47	20	67

The new classification produces the following results (regarding sources of problem):

Operating Systems	22
Man Management	14
Know-How	11
Equipment Supply	10
External Forces	5
External Social Effects	5

3.3.5. Observations

(i) The analysis has revealed the same order of magnitude of the sources of problems as the first two and the percentages of each group (of their respective totals) are very similar in the three analyses.

(ii) If sources of problems relating directly to internal administration (i.e. operating system and managerial) are grouped together, and a similar grouping is done for sources which are people-related but are external to the business, then the following table emerges.

Problems	Internal	External	Total
Technical	11	10	21
Admin & Personnel	36	10	46
Total	47	20	67

A chi-square test on this table produces 4.1727. This is significant at approximately $P = 0.04$. This suggests that the chances of administrative and/or personnel problems occuring inside a business utilising aequired technologies are very high.

Summarising, the two sets of analysis have shown that at least, over 66% of the problems encountered in utilising foreign technologies arise from middle management alone. Problems traceable to top-management action are second, and that relatively few problems arise from government's actions/ inactions.

The analyses have also shown that problems of managing technology are largely due to poor operating systems, poor man management and poor technology (physical and Know-how).

3.4. Conclusions.

The two investigations have produced a 'stalemate' - while the 'nationwide' exercise suggests that problems of management of technology arise more from government policies and top management actions, the P & T investigation suggests a different order, viz: middle management, top management and the government.**

But because the findings of the P & T investigation are more specific on technology transfer than in the contributions and effects of technology on the country's national development, the temptation is to accept the later suggestion, i.e. that problems of management of technology transfer in developing countries arise more from middle management than from top management and the government, in that order.

However, in order to validate the findings of the P & T investigations a similar exercise is desirable, this time, nationwide. The next chapter therefore looks at the problems involved in technology transfer in Nigeria as a whole.

** This seemingly conflicting situation is expected, given the facts that:

(i) the nationwide exercise is a macro study and is likely to reflect the effects of policies and efforts of government and top-management governing the acquisition of technology; hence the order of relatedness to the 3 tiers of management.

(ii) the P & T investigation is micro in nature and is bound to be more nitty-gritty about the internal operations of the organisation, i.e. utilisation of acquired technology.

Appendix

SEWERAGE, DRAINAGE AND REFUSE DISPOSAL
THE THIRD NATIONAL DEVELOPMENT PLAN: 1975-80

PLANNED AND ACTUAL CAPITAL EXPENDITURE BY GOVERNMENT

Government	Plan Allotation	Actual Expenditure 1975-76	1976-77	1977-78	1978-79	1979-80	Total Expenditure	Estimated percentage of Project Physically Collected or Status of Work
1. Anambra	14.165	-	-	-	-	-	-	-
2. Bauchi	1.550	-	0.050	0.087	0.362	0.420	0.919	82.40%
3. Bendel	58.000	0.050	3.916	5.471	5.180	-	14.617	39.00%
4. Benue	8.350	-	0.031	0.246	-	-	0.277	2.00%
5. Borno	8.000	-	0.063	0.029	0.080	-	0.172	2.00%
6. Cross River	7.100	0.081	0.250	0.187	0.150	-	0.668	21.40%
7. Gongola	2.058	-	-	0.192	-	-	0.192	9.00%
8. Imo	5.320	-	-	0.230	0.190	-	0.420	4.00%
9. Kaduna	13.150	0.150	0.311	0.355	0.524	-	1.340	8.00%
10. Kano	9.890	0.312	0.767	0.540	0.687	-	2.308	12.70%
11. Kwara	4.181	-	0.075	0.327	-	-	2.305	23.90%
12. Lagos	70.000	-	1.054	4.091	3.099	-	8.244	29.40%
13. Niger	0.300	-	0.044	0.236	0.020	0.075	0.375	95.00%
14. Ogun	2.660	-	-	0.420	-	-	0.420	5.60%
15. Ondo	4.400	0.187	0.046	0.158	0.015	0.472	0.878	20.12%
16. Oyo	43.100	-	0.503	3.459	0.928	-	4.890	23.30%
17. Plateau	11.838	0.128	0.248	0.663	0.392	-	1.421	3.70%
18. Rivers	26.500	-	0.182	0.431	0.619	1.225	2.457	12.70%
19. Sokoto	10.400	-	0.059	0.360	0.180	1.190	1.789	6.00%
TOTAL (ALL STATES)	301.562	0.908	7.599	17.472	12.426	3.382	43.693	-
FEDERAL	-	-	-	-	-	-	-	-
TOTAL ALL GOVTS.	301.562	0.908	7.599	17.472	12.426	3.382	43.693	-

CHAPTER IV.

Problems Affecting Technological Innovation in Nigeria - Empirical Study.

4.1. Introduction

For the purpose of 'upholding' the findings of the P & T investigation, an investigation, wider than that done for the P & T, was carried out to determine the problems responsible for the failure of technology in Nigeria.

The methodology was similar to that adopted for the P & T exercise. In some cases, industries were visited and their operations were observed. This provided a chance to observe the attitude of the personnel to their work. In some cases, the observations lasted a working week (5 days).

A detailed description of how the investigations were carried out is contained in the References in the Appendix.

4.2. Identification of Sources of Problems in Technological Innovation (i.e. Utilising Technologies) in Nigeria.

Because of the geographical size of the area under study, the method of investigation could not be limited to interviewing only. Data was collected through direct interviews as well as from other interviews reported by newspapers, journals, radio and the television. To strengthen the case of the study, one or two problems are identified outside Nigeria.

The categories of the respondents are similar to those in Section 3.3.1. References to the identified sources are indicated at the end of each source, and these references are in the Appendix. The sources are:

(i) Indiscipline of workers and the Society in general (22,25).

(ii) Unsuitable social setting

- (a) laxity towards work, especially in government enterprises (7,21,25).
- (b) Society overvalues material possessions, and does not appreciate the dignity of labour (7,25).
- (c) lack of national consciousness - a reflection of which is the feeling "what can I obtain out of the system, rather than what can I contribute to the system? "(7,11,25)

(iii) Underutilisation of existing resources e.g. a Firm operating one or two shifts only, instead of three (16,25).

(iv) The Weather - the hot weather generates too much heat for any workers comfort. This hot weather also complements the heat generated by machines to result in frequent breakdowns of machinery (dust and corrosive chemicals in the air) (26)

(v) Congestions at service points, e.g. airports, post offices, sea ports,banks, roads, and other public places.

These result in late delivery of essential goods like spare parts. (These problems can themselves be considered as evidences of failure of technology transfer in Nigeria) (26).

(vi) Lack of executive ability to absorb technology, e.g. lack of expertise at negotiations (10,26).

(vii) Lack of essential infrastructures e.g. irregular electricity and water, very poor roads, poor sanitations etc (15).

(viii) Lack of highly skilled manpower to plan and execute plans (6,16,26).

(ix) Lack of funds e.g. for payment of royalties, patency, as well as plants and machinery(or even salaries) (16,26,34)

(x) Marketing problems - some products don't sell because people feel dissatisfied with locally produced products (or services) (26). Reasons for these inferior products might be

(a) insufficient quality controls (26)

(b) simply due to mentality: (foreign products are superior)

(c) lack of funds to purchase appropriate (adequate) machinery for good output. (26)

(xi) Constraints posed by licensing, patents and other agreements (34)

(xii) Overpricing (1)

(xiii) Lack of communications between transferee and transferer i.e. tranferee is unable to communicate his desires to the transferer (2,21)

(xiv) Differences in scope of expectations of the transferee and the transferer (12)

(xv) Frequent requests for major changes after the system installation, possibly because the transferee is unfamiliar with the "predefined plan" (way) of working (19)

(xvi) A rush to develop which results in improper understanding of the system; the transferee expects to get accurate and current output from the system quickly and easily, without going through the system's complexities. (24)

(xvii) High overheads (3,21)

(xviii) Undermanning of industries; the industries are also underequipped and the workers underpaid. (4,16)

(xix) Inefficient management (5)

(xx) Misplaced priorities - desire for grandiose projects at the expense of provision of the basic infrastructures (5,6,10,13,22)

(xxi) Lack of proper records/lack of system (7,23)

(xxii) Lack of encouragement to local scientists (8)

(xxiii) Objectives are solely economic oriented (8)

(xxiv) Lack of public awareness of the benefits of technology (8,9)

(xxv) Technological hypocrisy of the transferer/Lack of genuity (11,24,27)

(xxvi) Lack of long-standing experience (34)

(xxvii) Lack of will to forge ahead (12)

(xxviii) Over - exposure of the intellectuals to Western system - they become so immersed in that system that they don't fit into the local environment, as such they can't contribute to technological development. (12)

(xxix) Security of tenure of office - this breeds inefficiency (14)

(xxx) Lack of properly organised general incentives (14,17, 21)

(xxxi) Bureaucratic effects (14,21,34)

(xxxii) Effects of culture (28)

(xxxiii) Overcentalisation of operations (8,15,18,19)

(xxxiv) Lack of openness on the part of management to their surbodinates (16,19)

(xxxv) Wrong value of judgements, e.g. paper qualifications are overvalued, resulting in inappropriate personnel on technical jobs (16,28)

(xxxvi) Lack of equipments - this problem is one step higher than shortage of equipments. (19,28)

(xxxvii) Generally poor conditions of service and remunerations (18,19)

(xxxviii) Lack of adequate trainings (12,17,19)

(xxxix) Lack of career prospects (17,19) which leads to

(xL) High labour turnover (17,28)

(xLi) Frustration at work (19)

(xLii) Lack of ability to generate dynamic ideas (19)

(xLiii) Lack of autonomy to make broad decisions (19,20)

(xLiv) Lack of job satisfaction (21)

(xLv) Open display of ostensible wealth by the bosses - which generates ill feelings and discouragements amongst the workers. (21)

(xLvi) Mismanagement of resources (22)

(xLvii) Lack of management continuity due to mobility - especially due to the desire to set up private business (14,22)

(xLviii) Cultural differences between the transferee and the transferer (22,28,31)

(xLix) Lack of opportunity for the general workers to develop/inadequate exposure (14,24,28)

(L) Economic domination by Multi-national Companies (24)

(Li) Lack of cooperation from the MNCs/Selfishness.

(Lii) Education curricula that do not support technological innovation (12,14,22)

(Liii) Brain drain (22,25,32,33,34)

(Liv) Lack of enthusiasm by the government, especially in implementing proposals or recommendations. (22,25)

(Lv) Monopolistic (selfish) attitudes by those in authority (12,22)

(Lvi) Acute shortage of technological evaluation studies of performance and policies (22,25)

(Lvii) Lack of research and development. (14,21)

(Lviii) Lack of interaction between policy makers, managers of technology and the R & D community (i.e. lack of cooperation between the government, industry and the University). (14,21,22,25)

(Lix) Time lag between agreement of a project and its completion, such that events are usually overtaken by other events; e.g. costs might have risen, change of government etc. (12,17,22).

(Lx) Frequent changes of policies due to frequent changes of government e.g. through coup detats (22)

(Lxi) Effects of politics, e.g. the American House of Representatives requested that the transfer of four (4) warships to Turkey be held up because of slow progress on Cyprus peace talks; and Turkish delays on an exchange of prisoners in the U.S. and Turkish Jails. Another example is the offer of the Department of Criminology from the Canadian government being turned down by the government of Cameroons for political reasons. (30)

(Lxii) Human Resistance to Technology. (29)

(Lxiii) Inability to identify appropriate technological requirements (20,22)

(Lxiv) Malpractices of government functionaries (15,19,34)

(Lxv) Strikes; e.g. 16 - days stoppages of work by members of the Trade Union, which involved virtually every worker in the industrial Sector (12,22)

4.3. Analysis of the Sources of Technological Problems in Nigeria.

The bases of analysis of the sources of problems affecting technological innovation in Nigeria remain the same as for those done for the P & T in Sections 3.3 and 3.4. of Chapter III.

Thus, the most common (causes of) problems affecting management of technology in Nigeria are:

1. Societal values (or lack of them), attitudes to work, etc 13
2. Bureaucracy, inefficient operating system, management 12
3. Lack of know-how, training 9
4. Lack of Incentives, labour turnover, strikes, frustrations 9
5. Lack of active participation by government, political influences 8
6. Conflicts arising from differences of interests and objectives between transferer and the transferee 7
7. Poor Equipment, and Lack of Resources 4
8. Mismanagement of Resources 3

PROBLEMS	ENVIRONMENT		
	Internal to Business	External to Business	
Technical	(Know-how) 3,6,8, 10a,15,18,36,38, 42, 49,56,57,63 (13)	(Outside the control of business) 4,7,11, 12,53 (5)	18
Administrative	(Operating System) 2c,13,17,19,21,24, 26,29,30,31,32,33, 34,37,39,43,45,46 (18)	(Imposed by External Agencies) 5,14,25,47,50,51 52,58,59,64 (10	28
Personnel	(Managerial) 26,16, 22,23,27,28,40,41, 44,55,65 (11)	(influences by powerful bodies) 1,29,9,106,20,32, 48,54,60,61,62 (11)	22
	42	26	

Table: 4.3.1. Reclassification of Problems affecting Technological Innovation in Nigeria.

The classification produces six 'groups' of causes of problems in utilising technologies in Nigeria as a whole. These are

	No of Sources in group	Attributable to
1. Operating System	18	Middle Mgt.
2. Know - How	13	Middle Mgt.
3. Man - Management	11	Middle Mgt.
4. External Social Climate	11	Top Mgt.
5. External Factors related (e.g. political	10	Government
6. Poor equipment Supply	5	Top/Middle Mgt.

A comparison between this set of analysis and the P & T set shows an agreement that

(i) problems of managing technology are very highly related to middle management, thean to top management and, to a much less degree, to the government.

(ii) formal system of management, and lack of training and Know-how are collectively major sources of problems.

However, there are variations in the order of magnitude of the groups of the sources of problems. While the first set of analysis suggested that formal system of management on its own causes the greatest problems, the second set of analyses is suggesting that societal values (or lack of them) cause the greatest problems in the management of technology.

The explanation for these slight disparties in the order of magnitude of the sources of problems would lie in the fact that the first set of analyses was on the P & T which is highly technical, whereas the second set of analysis covered a much wider spectrum of technical businesses including private indigenous, foreign, government and joint-ventures, which will tend to allow societal values to permeate to the businesses. However, a further research is recommended to ascertain whether the disparities in the orders of magnitude occurred by chance or are real.

4.4. Conclusion

Summarising, from the second set of analyses (in this section), it is shown that there are sociological problems arising from informal management; there are also major problems arising from formal management; lack of incentives, training and technical Know-how constitute other major sources of problems in technological innovation in Nigeria.

The classification indicates that there are grave management problems, both formal and informal. With regards to problems that arise from outside the business, lack of active participation by the government, coupled with political influences and constant changes of government (i.e.unstable government) affect technological innovation a great deal in Nigeria. Problems arising from conflicts of interests and objectives between technology transferer and the transferee are also of major concern.

These observations are basically the same as those inferred from the results of sections 3.3. and 3.4 of Chapter III. The two findings individually and collectively suggest, amongst other things, that problems of management of technology transfer arise more from middle management than from top management and the government, in that order. Hence,the research framework is hereby revised (in relation to the second hypothesis from the literature survey) to reflect the magnitude of efforts directed at finding the problems associated with the three tiers of management.

The order of magnitude of efforts does not however dictate the order in which the respective problems are investigated. In fact, it is considered wise to start with problems of acquisition of technology because 'one would have to "acquire a thing" before one can "utilise the thing"'.

Therefore, the next chapter looks at the problems involved in the procedures adopted in the acquisition of foreign technology in developing countries.

4.5. Appendix

4.5.1. Recommendations.

From our definition of management, a very important ingredient of success is a high degree of morale on the part of those rendering service. The two investigations thus far have shown that this is lacking in the technicians involved in technological innovation in the P & T, and in Nigeria in general. The studies have also shown management ineffectiveness due to lack of sociological deligence, in addition to inefficient formalised way of guiding human and physical resources into dynamic organisation units.

Other management problems shown by the studies include failure to provide adequate trainings, and subsequently, inability of the technicians to develop their technical potentials; management has also been shown to be facing a lot of problems external to the business.

These problems have to be solved (or at least reduced) by management if a sense of attainment is to be achieved by all those subject to its leadership, and more importantly, if objectives are to be attained to the satisfaction and maximum interests of the enterprise.

If it is accepted that the results of these studies done in Nigeria represent what obtain in developing countries, then this piece of work is suggesting that there are high management problems in developing countries in their effort to utilise acquired technologies. The problems are attributable to middle management, top management and the government, in that order, and the Key to effective utilisation of foreign technologies in developing countries would seem to lie in the middle management recognising the deficiencies in the formal and informal administrative systems, taking remedial actions to reduce the effects of these problems, and ensuring that they acquire more Know-how through better training. Secondly, top management should device a more efficient system of determining what variables are required for technical operations (e.g. equipments, social relations with government, middle management and external agencies like technology transferers), while the government should improve its political relations with top management and the society at large.

For effective utilisation of acquired technologies in Nigeria, the society has got to be educated about its "negative" value, and the significance of positive societal values that are vital in creating an environment conducive to technological development. In particular, the policy makers (i.e. government and top-management) must be made to develop more positive interest and active participation in processes sorrounding technological development, e.g. technical Know-how through trainings for the local technicians, and incentives for those rendering services.

There is the need for new developments of both formal administrative and informal managerial systems of operations. There is also a need for management to reduce the effects of external factors on its operation.

Remedial Actions.

Problems can be analysed in very many different ways, depending on the interest and focus of the analyst. For the purpose of finding remedial actions to eliminate or reduce the problems involves in managing technology, it is felt that analysing into the following aspects would be very beneficial:

(a) whether the problem is due to poor quality of a "service" provided, or quality of the means of providing the service (this stems from problems of end-products identified earlier).

(b) whether the problem is due to lack of a tool or means of providing a service.
(this stems from the analyses that have just been completed).

(c) whether the problem is due to some excessiveness of a situation or tool of providing a service (e.g. societal values)

(d) whether the problem arises because of interruptions in the course of providing a service. (e.g. strikes).

The individual problems can then be tackled by one or more of the processes of Elimination, Simplification, Purchase (or Provision), Training (or Education) and Modification.

In this regard, the problems identified have been grouped as follows (with regards to problems of technology in Nigeria as a whole):

Problem Cause:		
Quality	2a,3,4,5,10a,13,14,16,19,23,27,29,35,37, 42,45,46,52,55,64	20
Lack of	1,2c,6,7,8,9,10c,18,20,21,24,26,30,34,36, 38,39,43,44,47,49,51,54,56,57,58,63	26
Excessiveness of	12,17,28,29,31,32,33,50,53,59,60	11
Interruptions	11,15,25,40,41,40,61,62,65	9

It will be observed that a high proportion of the problems are due to lack of essential means of providing services and quality of the services provided. Remedial actions would then have to be more of provision and modification of tools employed in providing services. Indeed, most of the problems arising from lack of tools or means can be rectified by improving the quality of the existing tools. Concretely, the following remedial actions are suggested for the problems of technological innovation in Nigeria:

1. Educate the public about dignity of labour and the benefits of national patriotism, to replace personal interests.
2. Modify the existing operating system to encourage a more efficient usage of resources
3. Provide adequate trainings to enable absorption of technology
4. Eliminate favouratism and nepotism from the systems of management (particularly informal management)
5. Purchase good and adequate equipments.
6. Simplify the existing rigid managerial 'differentials' into more flexible ones, such that would encourage the development of employees' potentials.
7. Modify the system of communications between the business and external agencies to augment cooperation and openness, including liberal conditions from technology transferers, and assistance from the governors, politicians and financiers.
8. Eliminate bottlenecks due to overcentralisation and bureaucracy.
9. Modify the system of incentives to employees to reduce frustrations and labour turnover.

10. Reduce the over-recognition given to academic certificates to favour technical abilities and professional expertise.

11. Modify the employment policies to stop brain-drain

12. Encourage research and development through adequate funds and by granting research bodies (e.g. government agencies like the Federal Institute of Industrial Research) a good level of autonomy in their operations.

Remedial Actions by Effector on	Business	External Agencies
	1,2,3,4,6,8,9,10 (i)	1,4,7,10 (ii)
	5,10 (iii)	5,7 (iv)

According to the model above, remedial actions in Box (i) are to remedy internal managerial problems; those in Box (ii) are directed on external agencies whose actions cause problems to technological innovation; those in Box (iii) are to remove internal technical problems, while those in Box (iv) are ment to solve the problems of physical equipments caused again by some external actions.

Finally, there is a scope for further development of recommendations based on a different type of analysis. To this end, the next chapter will look at how middle management had 'managed' past technologies in Nigeria, since it has been established that the greatest problems of utilising technologies arise from middle management.

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4. 3rd National Development Plan of Nigeria (1975-80) Volume 1 pp.229-236
5. Government's White Paper on 3rd National Development Plan of Nigeria (1975-80). pp.12-15
6. Idowu Farai, (a Technical Correspondent); "Going Nuclear is another Waste"., Sunday Sketch, April 12th 1981. pp.12.
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15. An interview with Abayomi Olabisi, a Senior government official in the Ministry of Science and Technology, Lagos (September 21, 1980).

16. Alhaji Akanbi Oniyangi, Minister for Communications - an interview on Friday, June 13, 1980.

17. Umoh James Umoh, "Labour Notes"; Daily Times of Nigeria, (March 24, 1980).

18. Demol, Erik and Nihan, Georges; "The Modern Informal Sector in Yaounde. International Labour Review, Vol. 121, No. 1, Jan - Feb. 1982.

19. Olaniyan, Sowora in a lecture "Why P & T can't cope with mails". Mr. Sowora is a very senior P & T staff, who had worked in the organisation for more than 25 years.

20 Chief Etem - Okoli, Minster of State in the Federal Ministry of Communications - an interview on 9th July, 1980, when he declared

> "Although Nigeria External Telecommunication (NET)is part of the Communications, it is autonomous in that it can obtain money or loans from outside, e.g. from the banks, whereas the P & T can not do the same because of government's bureaucracy".

21. Chike Bob Emenike, the Production Manager of Lever Brothers - an interview (Dec. 21, 1980). The interview was followed by an inspection tour of the industry, lasting 2 days.

22. Ayida, Allison; This interview was probably the most revealing because of Mr. Ayida's unique past experiences: a former Permanent Secretary in the Ministry of Finance and Secretary to the Federal Military Government of Nigeria (1975-77); Permanent Secretary, Federal Ministry of Economic Development and Reconstruction; Chairman of four government Companies; a member of Board of Directors of the Central Bank of Nigeria and some other companies; and today he is an Economic and Financial consultant and Chairman of an Investment Firm, Central Point Investments (December 27, 1980).

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26. Madu, F.M. a Principal Assistant Secretary at the Federal Minstry of Science and Technology, Lagos, Nigeria.

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CHAPTER V.

Actual Model of Procedures Adopted in Transferring Technology into Developing Countries: Nigerian Experience.

5.1. Introduction.

5.2. Model of Procedures.

5.2.1. Actual Model of Procedures

5.2.2. Explanation of the Model of Procedures

5.2.2.1. Actual Problems (or Area of Interest)

5.2.2.2. Definition of Objectives

5.2.2.3. Deciding on Technology/Research & Development.

5.2.2.4. Choosing Partners

5.2.2.5. Negotiation with Foreign Partners

5.2.2.6. Approval by the Business Advisory Board

5.2.2.7 Registration by the Nigerian Office of Industrial Property

5.2.2.8. Implementation

5.2.2.9. Evaluation.

5.3. The Use of Procedure Analysis Chart.

5.4. Observed Pitfalls of the Adopted Procedures

5.5. Conclusion.

5.1. Introduction

The objective of the study is to see if the pattern of transfer activities or procedures will reveal why technological innovation has failed in developing countries, with particular interest in problems that are related to principles and practices of the government, top management and possibly, middle management.

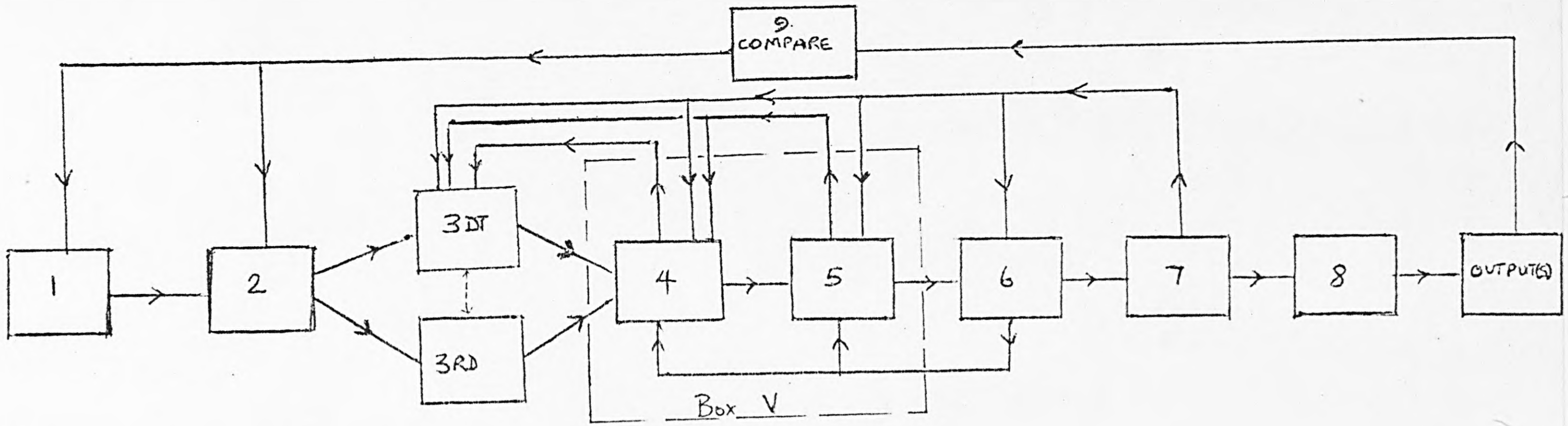
The tool employed in the detailed analysis of these procedures is procedure Analysis Chart.

5.2.1. Actual Model of Procedures

The Linear Model of technology transfer identified in the literature survey has provided a good insight into the actual model of procedures of acquiring and utilising technology in Nigeria. This linear model was presented to, and reviewed by, the Officials in the Federal Ministry of Industries and the Ministry of Science and Technology, both in Nigeria. The former ministry is charged with the responsibility of approving the set-up of businesses, while the latter examines the objectives, negotiation contents and terms of agreements of these businesses with their (foreign) partners - particularly, technologically oriented businesses - before registration certificates are issued for their operations. These functions, which are specified by the Civil Service Regulations called the General Order (GO) along with other procedures, are examined in this Section. The individual reactions of the Ministry Officials to the linear model resulted in the development of the model for the actual procedures, with the infussion of the functions of these Ministries to the linear model.

A major critism of the linear model by the ministry officials was that it misses out the fact that actual procedures involve going backwards and forwards (i.e. iterations). The correct situation is therefore that the Spiral Model (See Chapter II) best describes the actual procedures of technology transfer in Nigeria. The model is shown in Figure 5.2.1., which is linear in nature, only for purposes of clarity.

ACTUAL MODEL OF PROCEDURES OF TECHNOLOGY TRANSFER IN NIGERIA.



KEYS.

1. Actual Problems or Area of Interest.
2. Defn. of objectives.

3DT. Deciding on Technology.

3RD. Research Development.

4. Choosing Partners.
5. Negotiations with Foreign partners.
6. Approval by the Business Advisory Committee (Board).
7. Registration by the Nigerian Office of Industrial Property.
8. Implementation.
9. Review and Evaluation.

Fig. 5.2.1.

5.2.2. Explanation of the Model of Procedures

5.2.2.1. Identifying Societal Problems and Defining Area of Interest

A prospective industrialist (whether private or public, individual or government) examines the society to determine in what area(s) he can contribute to the development of that society. Such decisions are based on many factors, some of which could be economic, social, political, or prestige-bound. An effort might be geared towards any of the following goals:

(a) direct provision of basic needs, e.g. water, electricity, transportation, etc.

(b) application of ideas (or research and its ideas) aimed at providing some useful products and/or services to meet local technological needs, e.g. electronics for radio and television; medical research for health purposes; automobile research for the provision of cheaper, yet safe, vehicles for transportation needs, etc.

(c) money making: while providing these products and/or services the main aim of the enterpreneur (the technology transferee) might be to make money from the venture, or at least, this thought might be at the back of his mind, or perhaps an offshoot of the process.

5.2.2.2. Definition of Objectives

The identification of area(s) of interest would naturally lead to the definition of the objectives of the enterprise. These objectives would come under different spheres, in consonance with the prevailing necessities in the society:

(i) Strategic: Long term objectives may not be realised in the immediate future. Some spin-offs might be obtained, but the main goal would take some years to be achieved. A good example is the establishment of an Iron and Steel Industry by the Federal Government. The main expectation from this long-term project is the provision of major ingredients needed for industrialisation.

The period within which this main objective can be realised will vary according to situations. On the average, five to ten years are allowed for gestation. During this period (and indeed, almost from the start of the project), some of the spin-offs would include: more employment opportunities; development of more rural areas into urban settlements through the provision of infrastructures to support the industry; the emergence of trade and businesses via contracts, supplies, consultancy jobs, etc. This is a Nigerian experience with regards to two such industries at Ajaokuta in Kwara State, and Aladja in Bendel State.

(ii) Tactical: This is similar to strategic objectives, the only major difference is the time-scale; a period of one to five years might be allowed for gestation. Using the example of the iron and steel industry again, the medium-term expectations include some copulation effects with motor assembly plants through the manufacture of small 'nuts and bolts', 'spanners and chissels' that are used in the motor assembly industries.

(iii) Operational: These are short-term objectives; periods set for such objectives might range from one to six months.

5.2.2.3. Deciding on Technology/Research and Development

Based on the objectives that had been defined, the industrialist (transferee) now comes to consider the ystem* that would allow him achieve these objectives. Depending on the governing factors, the transferee might decide on immediate purchase (i.e. importation) of an operational system; or he may be interested in a gradual and systematic approach to the goal via research and development.

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* System is defined here as an aggregation (or composite) of machines and equipments, men, operating procedures, time, training facilities and other resources and requirements that are needed to execute the laid-down plans.

One might consider the last option as painful, costly and time-consuming but the defined long-term objective of the industry forces the issue. For instance, research and development is a very appropriate system if the major objective of the industry is to encourage knowledge, innovation and creativity in the society so as to supplement the contribution made by other industrialisations towards a 'reasonable' degree of self-reliance.

In the Nigerian experience, if such research and development is intended to be handled by a foreign organisation, a prior approval must be obtained from the Research and Development Board. The Board reaches its decision after considering the following major factors:

(i) the impact of the research on the society (immediate and long-term)

(ii) the possibility of the exercise resulting in foreign exchange drainage

(iii) time-scale

(iv) availability of personnel (i.e. local employment)

(v) expatriate quota desired by the organisation

(vi) training opportunities for the local nationals

(vii) the risks that accompany such research, e.g. pollution in a chemical industry; and easy access to dangerous and destructive weapons in the case of an ammunition industry.

(viii) national security: the location of the industry and the possibility of working with very sensitive data.

As indicated in Figure 5.2.1., the two activities of deciding on technology and research and development are not totally mutually exclusive. That is to say that the adaptation of one does not totally exclude the other; rather, they could be supplementary to one another depending on circumstance - infact, one may necessitate the other. For instance, a discovery from a research might require a type of system to be imported for full benefits of the research findings to be enjoyed. Unfortunately, however, research and development does not enjoy any appreciable patronage in Nigeria. Those that are established are not well funded or equipped.

5.2.2.4. Choosing Partners

As of the time of writing this research report the practice in Nigeria is for the transferee to decide on his partners, trading or operating**. Usually, the same partner enjoys the two offers of trading and operating partnership, but occasionally for some reasons, situations arise when these two functions are performed by different foreign parties.

Borrowing from the Nigerian Iron and Steel Industry once more, the bulk of the equipments are obtained from the Soviet Union, while training of the managers to man the industry goes to a consortium of consultants (notably British), an arrangement reached through some World (international) bodies. In this example the training of the operating technicians goes to the Soviets and Japanese, while the training of the 'tactical' men (i.e. managers) is given to this set-up of consultants.

It should be realised that this particular example is a very gigantic set-up and is not exactly representative of technical ventures in the country. However, it has served to illustrate the split between trading and operating partnerships.

The transferee would have had to sift very carefully the various options of partners (transferers) available in the market.

** Trading partnership takes care of the aspect of buying and selling of the necessary equipments and other machinery, while operating partnership deals with how these machines and equipments are utilised to produce the desired products or services; the second aspect would also include maintenance agreements for a specified period and training plans for the local nationals, with a view of making them sufficiently proficient to take over from the partner (transferer) at the expiration of the agreed period.

Amongst his determining considerations are history of success (or failure) of a similar venture, the availability of the equipments and the practicality of that technology, given the environment in which it is expected to operate. This stage may compel the transferee to re-examine his choice of technology and subsequently the partners. Here, we have the first taste of the iterative processes that might, and do, come to play in the technological venture. The merits and demerits of the transferee making sole decisions on these issues are subjects of discussions in the next section.

5.2.2.5. Negotiations with Foreign Partners (Transferers)

Having made his choice of partners, the transferee goes ahead with the negotiations. This is a very important aspect of the venture because poor handling of this would almost always lead to a failure of the whole project. Much of what is made of the negotiations depends on the skill of the transferee and/or his aides; it is therefore quite necessary that he or his aides be very knowledgeable about the various dimensions (factors) of the transfer, some of which were highlighted in Chapter II.

These factors, to a very large extent, form the very foundation for the success (or failure) of the project - they include cost, restrictive clauses (e.g. dependence on one supplier), tied aid, foreign exchange controls, maintenance agreements, training for local technicians, concentrated structure of industry in the transferee's environment, over-all time-table, contract conditions, and the use of local materials, technical skills and management (and not displacing them).
A breakdown of negotiations usually compels the transferee to select an alternative partner, or even technology. As had been the case in Nigeria, the three adjacent set of activities, i.e. deciding on technology, choosing partners, and negotiations with the transferer, absorb a substantial proportion of the transferee's efforts, his energy, and his time. Together, these set of activities are very important to the overall chances of success of the transfer. The example of the Nigerian Liquified Gas project may be relevant at this point:

An agreement was signed with the Russians, who were to take liquified gas by the pipelines built via Siberia for an agreed fee. The building of the pipelines were almost completed when the Americans came in with another enticing proposition, which would not only "pay more for the repatriated liquified gas (about 50 percent more), but will ensure a longer life of the project". The Nigerian government felt the American version of contract terms was "better" and therefore went on to cancel its earlier agreement with Soviet Union. Naturally, the cancellation involved some cost to the Nigerian government for breach of contract. However, almost a year passed and the Americans hadn't made a start on the project. Instead, the best offer from the U.S. firm was an agreement to review the whole contract, and this was only when the Nigerian government detected some loop-holes in the "enticing" contract. A closer study of this contract revealed that the home government would incur more cost on the long run. At this point, the home government couldn't find an easy way of going back to the Russians.

The point being made here is that the negotiators (transferee) did not have sufficient knowledge of the very many factors involved in the project, and therefore could not negotiate successfully. This leads to many types of costs to the transferee's home government: cost for terminating agreements, cost in time, loss of friendship*, loss of face, and possibly loss of self-confidence at negotiations. As of the time this study was done, no final decision had been made on whether the project would be given back to the Russian, or the Americans would keep the project after renegotiations, or possibly whether a new transferer would be sought altogether and if so it could be the old friend, Britain. This example has offered evidences of iterative processes (having to change transferers, agreements or even technology) that are encountered in transfer of technology.

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* There is no political undertone in making this point.

5.2.2.6. Approval by the Business Advisory Committee (or Board)

The descriptions of the set of activities involved in 'Choosing Partners' and 'Negotiations with Transferer' were made under the following assumptions:-

(i) that the transferee is a Nigerian or a body already resident in Nigeria.

(ii) that the transferee would require the participation of foreigners, and

(iii) that the foreign partners do not play any major role in the decision on choice of technology.

If the transferee is a foreigner, obviously he would have decided on what technology to adopt, and wouldn't need any major contract agreements except with the technicians (or servicemen) to implement the project. In this situation, activities in sections 5.2.2.4 and 5.2.2.5. are not as prominent as the others. It is not being suggested that they are completely missed out, but that their relative importances (as they were under the above assumptions) are drastically reduced.

When all investigations have been concluded (here investigations would include activities up to those in5.2.2.5) and the transferee has decided to start a business in Nigeria (in our case, to acquire and utilise some technology in Nigeria), he proceeds as shown in Table 5.2.2. The processes in this figure are aggregated and described only as 'approval for investment realisation', i.e. approval to undertake a venture.

Membership of the Business Advisory Board (BAB) is drawn from the following bodies:

Federal Ministry of Finance,
Federal Ministry of Industries,
Federal Ministry of Trade,
Federal Ministry of Commerce,
Federal Ministry of Labour,
Federal Ministry of Works,
Federal Ministry of External Affairs,
The Cabinet Office, and
The Nigerian Enterprises Promotion Board.

Table 5.2.2. QUICK GUIDE TO INVESTMENT REALIZATION PROCEDURE IN NIGERIA

Regulation	What Form to complete	How many copies	Where to obtain Form	Where to Submit the complete Forms	Fee Payable
1. Immigration Approval or clearance or Business Permit with/without Expatriate Quota Allocation	Immigration T/I	Ten	Permanent Secretary Fed. Min. of Internal Affairs, Federal Government Secretariat, Ikoyi, Lagos	Permanent Secretary Fed. Min. of Internal Affairs, Lagos	Free
2. Additional Expatriate Quota	Immigration T/2	Ten	"	"	"
3. Incorporation of Company (We suggest Proprietors obtain professional legal assistance) (Again incorporation is a statutory requirement)	Forms C.O.I, C.O.6, C.O.7 Printed memorandum and Articles of Association	One of each Form Four(4) copies	Bookstores; Self printed and Compiled	Registrar of Companies Federal Min. of Trade, Lagos	Subject to assessment and professional charges.
4. Registration of Business Name (Good for sole-proprietorships, partnerships, and professional practices)	Form 1 or Form 2	One	"	"	N5.20
5. Residential Permit permission for an alien to reside in Nigeria for an extended period of time is given to firms with expatriate quotas	A letter from the Nig. Company requesting permission to employ an Expatriate	Two, plus valid passport	Immigration Department via Consular Authorities	Consular Authorities	According to nationality of applicant

Table 5.2.2. Cont'd.

Regulation	What Form to complete	How many copies	Where to obtain Form	Where to submit the completed Forms	Fee Payable
6. Multi Entry Visa	Immigration 22	One plus valid passports and letter from employer	Federal Ministry of Internal Affairs, Immigration Department Lagos	Chief Federal Immigration Officer, Immigration Department, Federal Min. of Internal Affairs, Lagos	According to nationality of applicant
7. Exchange Control Approval (Approved Status)	Letter of applica-t tion based on Fed. Ministry of Finance questionaire	Two	Exchange Control Officer, Federal Ministry of Finance Lagos	Exchange Control Department, Federal Ministry of Finance Lagos	Free
8. Notification of intention to incur capital expenditure (i.e. equipments over N20,000)	Form 1	Two	Federal Ministry of Industries, Industrial Inspectorate Division, 11, Kofo Abayomi Road, V/Is Land	Director, Industrial Inspectorate Division; Federal Ministry of Industries 11, Kofo Abayomi Rd. V/Is land	Free
9. Approved User Licence (e.g. for Raw Materials)	Form SAE	Three	Permanent Secretary Fed. Ministry of Industries, Lagos	Permanent Secretary Federal Min. of Industries New Secretariat, Ikoyi	Free
10. Pioneer Status	Form AP1/2	Five	"	"	N100

N.B.
N1 = £0.80

Source: Nigerian Investment Information & Promotion Centre, Fed. Ministry of Industries, Lagos.

It is worth noting that the National Office of Industrial Property (NOIP) is not represented on this Committee despite its major rule (See Figure 5.2.1.).

Non-success to get this approval may be due to a number of reasons, and this usually requires the transferee to 'retreat' to some other activities. For instance, if the foreign partners had been refused entry visas into the country (for whatever reason(s)), the transferee does not get the business approval, and may be forced to choose some other partners, i.e. go back to 5.2.2.4. If, on the other hand he fails to get the approval because he had been refused the <u>approved user licence</u> (See Table 5.2.2.), or <u>approval to incure capital expenditure</u>, the transferee may have to go back to 5.2.2.3.

As for the overall time it takes to run through steps 1 to 10 of Table 5.2.2., nobody can say precisely because a lot of shuttling forwards and backwards are involved, and the amount of shuttlings vary considerably from situations to situations. On this point, not a single official of the Federal Ministry of Industry or Trade was willing to stick out for the time required. After much pressure, however, some officials of the Nigerian Enterprises Promotion Board suggested 'a couple of days' for each step. These modest suggestions were attempts to protect the image of the various ministries represented on the BAB. In practice, experience had shown that with a lot of luck (and knowing <u>whom</u> to talk to), the transferee might just be able to get through in two to three years. If however, the project did not require the participation or services of foreigners then the phase would not have posed such a big problem to the transferee. But we are talking about acquisition and utilisation of technology of which the transferee has little or no knowledge. There is therefore no escape as yet from foreign participation.

5.2.2.7. <u>Registration by the Nigerian Office of Industrial Property</u>(NOIP)

Undoubtedly, the most gruelling activity so far is trying to get approval from the Business Advisory Board (BAB).

Perhaps equally gruelling is the attempt to get a registration certificate. The BAB can be said to have concerned itself more on the type of personnel to be involved in the project, and ability of the transferee to execute the project.

Here in Phase 7, the NOIP examines the contract terms and agreements to satisfy itself with the following factors, amongst others:

- (i) the economic viability of the project (Cost-benefit analysis)
- (ii) imposed limitations and obligations by the transferer
- (iii) the legality of the agreements
- (iv) the technical abilities of the foreign partners (i.e. the transferers).
- (v) the practicability of the project in the environment of the transferee
- (vi) duplication of an already existing technology.

A flip back to the Research and Development Board in phase 3 (RD) would suggest that the consideration factors of NOIP are very similar, to a large extent, to those of the Research and Development Board; the principal difference lies in the legal examinations performed by NOIP (See Procedure Analysis Chart in Figure 5.3.2). The final outcome expected from NOIP is a Certificate of Registration of the contract and the agreements reached between the transferee and the foreign partners (the transferers); without this certificate the project can not be started. Perhaps it is necessary at this juncture to differentiate between the outputs from phase 6 and phase 7: the approval from BAB in phase 6 is a permission to establish a firm, whereas the Certificate of registration from phase 7 is an authority to prosecute a particular project. Having said this, it may now appear as if phase 6 is a once-and-for-all process, and once-established, the firm needs only apply to NOIP for every project it intends to undertake, thus creating the impression that for an already established firm wishing to transfer technology, phase 6 is missed out. This may be so if, and only if, the enterprise does not require the participation of foreigners.

The argument arises once more as to what sort of technology transfer would not require the services of foreigners. The truth is therefore that phase 6 cannot be missed out. Failure to get the Certificate of Registration from NOIP may mean going back to any of the earlier phases depending on why the certificate was not issued. A deficiency in the legal aspects of the agreements may mean a backstep to phase 5. A foreign partner with history of past failures would cause the NOIP not to issue the certificate, thereby forcing the industrialist to go back to phase 4. Similarly a history of failures of similar ventures would necessitate a rethinking on the technology to be adopted. A dubious foreign partner (or his aides) on the black-list of NOIP would not be registered and the industrialist would have to go back to phase 6 to seek clearance again for such personnel.

5.2.2.8 Implementation

When the Director of NOIP is satisfied with the specifications of the contract or agreement he shall thereafter issue the applicant (industrialist) with a certificate in such a form as may be prescribed. The industrialist may then proceed with other requirements, such as final negotiations regarding acquisition of site for the business; application for concessions e.g. Income Tax Relief, Import Duties Relief, Approved Status etc. This is the phase where the project is actually executed according to the agreed terms of phase 5, and in accordance with the prescribed form of phase 7. Some of the elements of implementation, amongst other things, may include:

(i) bringing in the physical machinery

(ii) construction of site and/or buildings

(iii) providing the necessary facilities and infrastructures to support the project (e.g. good roads, electricity and/or electricity generators, water, telephone, etc.)

(iv) installing the machines.

Usually, training of local personnel forms part of the agreement(s) and this may come just before implementation or it may be alongside implementation (i.e. on-the-job training). On the other hand, the training may be after the physical installation of the machines, particularly where the main objective focusses on eventual but efficient maintenance by the local nationals. The type of project or transfer most invariably dictates the type and timing of training.

5.2.2.9 Evaluation

It is at this phase that data (information) is obtained as to whether the initial objectives have been met, and if not why? The transferee makes his own assessments of the project at an appointed or appropriate time but such assessments are mainly economic in nature. There are occasions (for instance, government projects) when the expected benefits from a project have some social orientation or political undertones. In these situations, the costs of the projects are of secondary importance; what really matters is whether the social or political objectives have been realised. As part of its functions, the NOIP makes an assessment of the project at an appointed time, in consonance with the previously registered agreements. If the NOIP assesses the project as very viable, a Company profit tax of 45 percent is imposed. If it is operating at a loss, the NOIP steps in to detect the causes of this unhealthy situation; some of these might be due to

(i) non-demand of products

(ii) too much payment of salaries

(iii) lack of technical know-how, and

(iv) a host of other reasons

This evaluation exercise is done two to five years after the take-off of the project. For instance, social evaluation is done after two years; economic evaluation, after three years; and effect of training on local nationals, after five years. If at the end of these periods the respective evaluations are nagative, the NOIP may decide, on the basis of these and other factors, to withdraw the certificate of registration of the contract agreements, which implies that the project must terminate its operations.

5.3. Procedure Analysis - as applied to Technology Transfer into Nigeria.

When applied to the actual procedures of transfer into Nigeria (See Figure 5.3.1), it was particularly useful in detailing the operations of the National Office of Industrial Property (NOIP). This is the government body charged with, amongst other things, the responsibilities of

(a) encouraging a more efficient process for the identification and selection of foreign technology.

(d) developing the negotiating skills of Nigerians with a view to ensuring the acquirement of the best contractual terms and conditions by Nigerian parties entering into any contract or agreement for the transfer of foreign technology.

(c) the registration of all contracts or agreements having effect in Nigeria for the transfer of foreign technology to Nigerian parties.

As of now, it is the last responsibility (i.e. (c) above) that preoccupies the NOIP. The office believes that the other objectives can, and will, be realised by fulfilling this particular function.

From the application of the Procedure Analysis emerged the actual procedure of transfer which was very much like the Linear model identified in Chapter III; the only major addition being the function of the National Office of Industrial Property (NOIP). Its position within the system, as of now, comes after the negotiations and contract agreements have been made, i.e. before the implementation stage (as shown in Figure 5.2.1.). These negotiations and contract agreements are usually done at the micro-level. In other words, except in a government project, NOIP has no part to play until after stage 5 of Figure 5.2.1. However, if it is a government project the office is involved, at least at consultancy level, in stages 2 to 5.

Figure 5.3.1

C = Consult
D = Perform O = Order S = Supervise R = Review T = Train

M = Send U = Material/Equip. used P = Material Produced

PROCEDURES ADOPTED IN TRANSFERING TECHNOLOGY INTO NIGERIA.

Industrialist (Govt, Individuals etc)	Foreign Partner or Supplier of Technology	National Office of Industrial Property	Local Technicians	Technical Advisers	Legal Experts	Business Advisory Board	ELEMENTS OF WORK REQUIRED	Application for Industrial Approval	Objectives	List of Govt. Priorities (drawn by the Ministries)	Individual Industrialist's Area of Interest	Technology Market	Choice of Technology	Market of Technology Suppliers	Contracts and Agreements	Application for Registration	Certificate of Registration	Implementation Schedules	Appraisal (Usually of monetary nature)	Approval by Business Advisory Board
D							1. Identifying area of interest			U	P									
D							2. Drawing objectives		P		U									
D				C			3. Deciding on type of Technology		U			U	P							
D	C			C			4. Choosing Supplier of Technology							U						
D	D			C	C		5. Drawing up Contract & Agreements		U				U		P					
D							6. Applying to Business Advisory Board for Approval	M												
						D	* 7. Boards Approval (See Fig. 5.3.2)	U												P
D							8. Applying to National Office of Industrial Property (NOIP).								M	M				M
		D					* 9. NOIP's approval & registration of industry (See Fig. 5.3.2)								U	U	P			U
	D		C				10. Implementation of Technology.								U			U		
D							11. Appraisal of business	U					U						P	

This in effect obliterates its original position between stages 5 and 6; or put in another way, the functions of NOIP are spread over the whole system in cases of transfers with government interest.

At the macro-level (government level) these negotiations and agreements are considered as behind- the-scene activities and would vary in different circumstances particularly box 'V' (See Figure 5.2.1) where what happens depends largely on the ownership and the method of transfer (the method of transfer itself depends on the type of ownership)*. These activities are important (one admits) but it is the decision of the NOIP that <u>kills</u> or <u>approves</u> the intended transfer of foreign technology. In these circumstances, the operations of the NOIP would need to be looked into more closely with a view to identifying the various activities and their relationships. Such an analysis would likely suggest some areas where things are not exactly as they should be. The operations of the Nigerian Office of Industrial Property are shown in Figure 5.3.2. The Chart was redrawn as a Travel Chart to show, at a glance, who talks to whom and the sequence of events (See Figure 5.3.3.). The same Procedure Analysis was employed to analyse the operations of the Business Advisory Board (See Figure 5.3.4.).

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* This is an hypothesis that will be tested in Chapter VII.

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Figure 5.3.2

ACTIVITIES OF NATIONAL OFFICE OF INDUSTRIAL PROPERTY (NOIP) WITHIN THE PROCEDURES ADOPTED IN TRANSFERRING TECHNOLOGY INTO NIGERIA.

Perform O = Order S = Supervise R = Review T = Train C = Consult

M = Send U = Material/Equip. used P = Material Produced F = File

Director's Office (Admn. Arm of NOIP)	Economic Arm of NOIP	Technical Arm of NOIP	Legal Arm of NOIP	Local Industrialist	Foreign Partner(s) or Transferer(s)	Governing Council of NOIP	Federal Revenue Court	Minister for Science & Technology	Ministry of Finance	Central Bank of Nigeria	Other Licensed Banks in Nigeria	ELEMENTS OF WORK REQUIRED	Reports of Monitoring Activities	Registration Application Forms	Certified True Copies of Contracts & Agreements	Annexures	Certificate of Registration (A)	Certificate of Cancellation of Contract	Notice of Appeal	Certificate of Registration Re-issue (B)	Rulings of Governing Council	Annual Reports	Audited Accounts	Ammended Contract or Agreements	Lists of Required Conditions to be Satisfied
				D								1. Application for registration of Contracts and Agreements		M	M	M									
	D	D	D									2. Examination of Contract Documents. If Satisfied Go To (6)		U	U	U									U
D												3. Returns Documents to Industrialist			M	M									
				D	D							4. Ammendment of Contract and/or Agreements			U	U								P	
				D								5. Ammended Version goes back to NOIP												M	
D												6. Files Documents			F										
D												7. Director Issues Certificate of Registration					P							U	
R	R	R	R									8. Re-examination of the Contract Agreements and Monitoring of the Operations of the Business every 5 years	P											U	U
D												9. Director Collates Reports	U												
R	C	C	C									10. Examination of the Progress Reports of the Business. If Satisfied Go To (16)	U												
D												11. Issues Cancellation of Registration	U					P						U	U
D												12. Sends Certificate of Cancellation to Industrialist						M							
				D								13. Appeal to Governing Council. If Industrialist unsatisfied with Council's decision, Go To (15)						U	P						
D												14. Issues Certificate of Registration								P	U				
				D								15. Appeal to Federal Revenue Court. If Appeal holds Go To (14)						U	P		U				
D						C	C	C				16. Reports Progress to Ministry ...	U												

Figure 5.3.3 Travel Charts Showing the Paper-work movements and Decision in the processes of Technology Transfer.

Sent by \ Sent to	Director	Econ. Dept.	Tech. Dept	Legal Dept.	Local Industrialist	Foreign Partners	Governing Council	Federal Revenue Court	Minister of Science and Technology	Federal Ministry of Finance	Central Bank of Nigeria	Local Bank of foreign Partner	
Director (NOIP)		2;8	2;8	2;8	4;10;13		12						
Econ. Department	3;9;11												
Tech. Department	3;9;11												
Legal Department	3;9;11												
Local Industrialist	1;7					5	14	16					
Foreign Partners					6								
Governing Council					15				17				
Fed. Revenue Court													
Minister of Science and Technology										18			
Fed. Min of Finance											19		
Central Bank of Nig.												20	
Local Bank of Foreign Partner						21							

Explanations of the representations on this figure are found overpage.

Explanations of Travel Charts Showing the paper-work movements and Decision in the processes of technology transfer

KEY

1 - 3	:	Applications from prospective industrialists and the Scrutiny of same
4	:	Notice of reject
5 - 6	:	Redraw of Contract agreements
7 - 9	:	Applications resubmitted and re-examined
10	:	Registration or rejection again
11	:	Reports of monitoring activities (Some five years after registration)
12 - 13	:	Withdrawal of Certificate of Registration
14 - 16	:	Processes of Appeal
17	:	Reports of Activities and Audited Accounts
18 - 21	:	Procedures for payment to foreign partner.

Figure 5.3.~~2~~ 5.6

ACTIVITIES OF BUSINESS ADVISORY BOARD (BAB) WITHIN THE PROCEDURES ADOPTED IN TRANSFERING TECHNOLOGY into NIGERIA.

D = Perform O = Order S = Supervise R = Review T = Train C = Consult

ELEMENTS OF WORK REQUIRED	(i) INDUSTRIALIST	(ii) FOREIGN PARTNERS TRANSFERER	(iii) BUSINESS ADVISORY COUNCIL	(iv) PERM. SEC, Ministry of Internal Affairs	(v) REGISTRAR OF COMPANIES (Ministry of Trade)	(vi) CONSULAR AUTHORITIES	(vii) CHIEF IMMIGRATION OFFICER (Ministry of Internal Affairs)	(viii) PERMANENT SECRETARY (Ministry of Industries)	(ix) DIRECTOR-Industrial Inspectorate (Ministry of Industries)	(x) EXCHANGE CONTROL OFFICER (Ministry of Finance)
1. Application to (iv) for Business Permit	D									
2. Returning form to BAB, & BAB Approves			D_B	D_A						
3. Application to (v) for Incorporation	D									
4. Returning for to BAB & BAB Approves			D_B		D_A					
5. Application to (v) for Business Name Registration	D									
6. Returning form to BAB & BAB Approves			D_B		D_A					
7. Application to (iv) for Expatriate Quota (or Additional)	D									
8. Returning form to BAB & BAB Approves			D_B	D_A						
9. Application (thru vi to vii) for Residential Permit	D_A					D_B				
10. Returning form to BAB & BAB Approves			D_B				D_A			
11. Application to vii for Entry Visa	D									
12. Returning form to BAB & BAB Approves			D_B				D_A			
13. Application for Capital Expenditure Approval	D									
14. Returning form to BAB & BAB Approves			D_B						D_A	
15. Application for Foreign Exchange	D									
16. Returning form to BAB & BAB Approves			D_B							D_A
17. Application for User Licence	D									
18. Returning form to BAB & BAB Approves			D_B					D_A		
19. Application for Pioneer Status	D									
20. Returning form to BAB & BAB Approves			D_B					D_A		

M = Send U = Material/Equip. used P = Material Produced F = File

ELEMENTS OF WORK REQUIRED	Immigration Form T/1	Immigration Form T/2	Forms C.O.1, C.O.6, C.O.7 Articles of Association	Business Registration Forms 1 or 2	Application for Expatriate Quota	Application for Exchange Control	Immigration Form 22	Form SAE 65	Form AP 1/2	Capital Expenditure Application Form 1	Valid Passports	Application for Residential Permit	P_1 - Business Permit/Expatriate Quota	P_2 - Approval for Additional Expatriate Quota	P_3 - Certificate of Incorporation	P_4 - Certificate of Business Name Registration	P_5 - Residential Permit	P_6 - Multi Entry Visa	P_7 - Exchange Control Approval	P_8 - Capital Expenditure Approval	P_9 - Approved User Licence
1.	$M_{(v)}$				M																
2.	M_A U_B											F_A	P_B								
3.			$M_{(4)}$										$M_{(4)}$								
4.			M_A U_B										M_A U_B		P_B						
5.				$M_{(1)}$											M						
6.				M_A U_B											M_A U_B	P_B					
7.		$M_{(v)}$			M								M								
8.		M_A U_B										F_A	M_A U_B	P_B							
9.												M_{AB}	M_{AB}	M_{AB}							
10.												F_A	M_A U_B	M_A U_B			P_B				
11.							M				M		M	M			M				
12.							M_A U_B				M_A U_B		M_A U_B	M_A U_B			M_A U_B	P_B			
13.										M			M		M						
14.										M_A U_B			M_A U_B		M_A U_B					P_B	
15.						M							M		M					M	
16.												F_A	M_A U_B		M_A U_B				P_B	M_A U_B	
17.								M					M								
18.								M_A U_B					M_A U_B								P_B
19.									M				M		M						
20.									M_A U_B				M_A U_B		M_A U_B						

N.B. The numerical subscripts indicate the no. of copies involved when there are more than one.

5.4. Observed Pitfalls of the Procedures adopted in transfering technology into Nigeria; and Recommendations

It is an obvious fact that no system is error free; it is also an understatement that where a system or procedure fails to achieve the desired objectives, that system or procedure suffers some deficiencies. A look at the assessment of technologies already adopted in Nigeria suggested that there is plenty of room for management improvements particularly in the procurement phase, and that is putting it very mildly. It is against this background that the model of actual procedures was examined. The examination revealed some drawbacks in the procedures. The recommendations that follow each drawback are made, assuming that a change from the current procedures can not be effected immediately (for whatever reason).

(a) The adopted procedures are, in the main, in line with accepted procedures and normal practices for a project. However, the observation is that right from phase 3, it is apparent that the transferee operates from a position best described as a straight jacket, i.e. when he comes to decide on what technology to adopt. Experience has shown that the transferee, more often than not, jumps at the first technology presented to him. He does not give himself the chance to 'shop around' for alternatives. Usually, he is drawn in by 'sweet talks', through advertisements of the transferer. This is an error of omission. Secondly, the situation is worsened by the fact that majority of the transferees (including their so-called expert advisers) do not possess enough know-how about the factors surrounding the choice of a 'good' technology. In these circumstances, the transferee commits himself to acquiring the technology introduced to him, and starts to negotiate with the transferer. This is an error of commission.

In the author's view a prospective transferee should not be 'drawn in' very easily by the supplier's salesmanship. He should 'windowshop' to afford himself a reasonable chance to consider other alternatives. Such careful considerations would allow him to make the best choice. This way, he will not be tied down to any particular Supplier. On the question of negotiations, the advantage of shopping around is that at the end of the day he would have had a fair chance to compare the terms of various suppliers. It is only reasonable to suggest that the prospective buyer of the technology should allow himself a thorough study of the terms of, say, the best three or four of the alternatives.

(b) As shown in the model in Figure 5.2.1., it is quite possible for the prospective industrialist's application (for approval to establish a venture) to be turned down by the Business Advisory Board. In which case time, energy and effort had been lost. The situation could be very demoralising.

To avoid this situation it is suggested that a prospective industrialist should get familiar with the requirements of the Business Advisory Board or the criteria upon which the Board bases its decisions. One of such criteria is the calibre of partners and/or personnel that the industrialist intends to have, and therefore the technology buyer should always check on the list of those who might have been black-listed by the Board. The Board would be doing a whole world of service to prospective industrialists to compile such lists and to update same quite regularly, making them available to industrialists (possibly on demand).

(c) As of now, the composition of the Business Advisory Board is so large that almost every Federal Ministry is involved. This allows the normal inefficiency due to bureaucracy to come into play. Secondly, for every procedure in figure 5.3.4. the Board would have to meet.

This is an obvious waste of man-hours. Each ministry should be allowed to deal with whichever aspects come under its jurisdiction; it would only invite another ministry if it needs some advice, and such invitations should be purely on advisory bases. If, however, it is considered that a joint meeting of the ministries (as currently practised) would eliminate or reduce the chances of favouritism and some other bad practices, then the least that could be done is to prune the composition of the Board down to the barest minimum necessary, ensuring that those on it are very versatile with, and up-to-date in, the various knowledges that the task demands.

(d) It could be terribly disheartening for a prospective industrialist to go through the rigour of phase 6 only to be refused certificate of registration by NOIP in phase 7. It would have been an easier 'ordeal' for the industrialist if he only has to face a combined body of Business Advisory Board and NOIP. However, as it was pointed out at the beginning of this section, the suggestions herein are based on the assumption that the present system of technology transfer cannot be changed overnight. In the light of this, it is suggested that the two arms keep one another abreast of what they have done, so as to avoid duplication of efforts. The ideal thing would have been a fussion of the two into one body.

(e) The forms to be completed in phase 6 are so terribly complicated and laborious. Most of the information asked for are unnecessary, i.e. decisions can be reached by the Board without some of these items of information. But because they are asked for, the Board ensures that they are provided. This method of operations aids (or results in) a lot of delays. At times decisions on applications are not reached till after two to three years by which time the technology chosen might have become outdated or the original desired services or products have been overtaken by events.

Furthermore it is quite possible that the foreign partners, by this time, have grown tired of waiting or the terms of agreements might have to be completely reviewed: (An undertaking was given to the ministries that specimens of these forms would not be published.) However, the suggestion here is to keep the forms as simple as possible.

(f) The rigour through which the transferee is made to go when his project does not require much participation by foreigners is much less than when foreigners take active part. The inference from this is that transferees are discouraged from embarking on projects that would attract the participation of many foreigners. The intentions of the policies might be to protect local employments and national securities, but the true position might be that these projects requiring the participation of many foreigners are in fact more beneficial to the country, economically or socially. The Board will therefore be doing a lot of more effective service if it finds a way of loosening up its tight grips on the conditions for approvals of projects requiring foreign participation, while the good intentions of the government policies are still maintained.

5.5.1. Conclusion

The pitfalls of the procedures have shown that there are procedural problems with technology transfer in developing countries, if it is agreed that the Nigerian experience is fairly representative of the practices in developing countries. Certain difficulties stand out very clearly above others.

(i) The procedures which transferees have to go through are too many and rigorous, the likely effect of which is that prospective transferees are easily discouraged.

(ii) The policies governing the procedures of transfer are heavily loaded against foreign participation; this reduces the number of prospective technical enterprises in the country, as well as denying it the advantage of a wider variety of projects that can aid its development.

(iii) The travel chart in Figure 5.3.3., shows that there is too much paperwork in the administration of the procedures of transfer; this results in loss of time and possibly, loss of control of the operations.

(iv) The chart also reveals that activities in the transfer process are overcentralised, e.g. the Director of the National Office of Industrial Property (NOIP) has a say in almost every thing - that is, his position becomes a bottleneck for the system.

Other factors causing problems in the procedures are:

(v) The composition of the Business Advisory Board, which is too large in its present form. The large size of the Board results in bureaucratic difficulties which breed inefficiency. Secondly, since fewer ministries (and therefore fewer people) can take decisions effectively, the cost of the present composition in terms of man-hours is a waste.

(vi) A lot of unnecessary information is demanded from the enterpreneurs; undoubtedly, decisions can be reached (whether to approve applications of enterpreneurs or reject them) without the 'load' of information supplied by the enterpreneurs. It takes so much time to 'paddle' through the huge forms, and this gives rise to delays.

(vii) A large proportion of the information demanded by the Advisory Board is also demanded by the National Office of Industrial Property, and each body checks through the same information (more or else) - duplication of effort.

(viii) The existing procedures allow enterpreneurs to choose what area(s) of economy they want to operate in. Unfortunately, enterpreneurs are usually guided mainly by prospects of financial returns, and therefore often choose projects which are likely to yield profits quickly. Such projects many a time do not contribute much to the technological development of the country. In other words, there is the problem of too many projects that are not likely to increase the nation's technological development, a result of government policies not being 'loud and clear' enough.

Other factors in the procedures adopted in the transfer process do relate to the predicament of individual enterpreneurs.

(ix) Judging from the responses of the enterpreneurs in their papers received by the Business Advisory Board, it is evident that the local enterpreneurs do not possess enough Know-how about the factors sorrounding the choice of what technology is appropriate for their chosen operations. And worse still, the Advisory Board itself is not competent to advise those enterpreneurs, neither is there any other body (technically competent) to give advice to them.

(x) Similarly, local enterpreneurs are left on their own to negotiate with foreign partners when they (the former) lack the ability to carry out negotiations that are technically sound.

From records in the ministries (which again are "not to be reproduced in any form") it was observed that the most widely adopted method of transfer is the Joint Venture; this is a clear contradiction to the suggestion from the literature survey that Joint Ventures do not offer much to developing countries, i.e. the objectives/benefits expected from technology are not realised. The underlying reason for technological failure in developing countries may well be wrong method(s) of transfer.

The research will therefore turn its attention to how widely each method is adopted, their merits and demerits, and the problems involved in the individual method.

5.5.2. Implications of the Study for Developing Countries.

While each of the three bodies of management shares in one way or the other in the blame for this phase of technology transfer, it seems that the government bears the brunt of the blames regarding the pitfalls of the procedures adopted in transferring technology. This is because these procedures are defined and governed by government policies/ directives through the appropriate ministries.

There is therefore the need for the government to review its policies such that would:

(i) Be Loud and Clear on 'priority areas' requiring technological attention, and still

(ii) Liberalise the procedures which transferees have to go through

(iii) Encourage foreign participation in technology transfer

(iv) Decentralise activities in the transfer process to remove (or minimise) bureaucratic effects

(v) Ensure the participation of technically - competent government agencies in negotiations with transferers.

CHAPTER VI.

Problems Involved in the Methods of Acquisition of Technology in Nigeria.

6.1. Introduction

6.2. Detailed Information on the Responses

6.3. Analysing the responses

- 6.3.1. Direct Method
- 6.3.2. Indirect Method
- 6.3.3. Alternative Method
- 6.3.4. Try-It-Yourself Method
- 6.3.5. Joint Ventures Method
- 6.3.6. Patent and Licensing Method
- 6.3.7. Own Research and Development

6.4. Observations

6.5. Conclusion

6.6. Implications for Developing Countries

6.1. Introduction

This chapter examines the different methods of transfer to accent the problems of management in its choice of transfer (acquisition mainly), which is usually based on management's perception and/or knowledge of a method. The problems associated with each method are reflected in the limitations of the individual methods.

The method of investigation is as shown in Figure 6.1.1. The benefits, strengths and limitations indicated in the text were gathered from the respondents (managers of technology) who had used the particular method(s) before.

The acquisition of technology takes place in other and somewhat more diverse ways, and there are special problems for developing countries. Amongst the most important ways of acquiring technology are:

(i) By the flow of books, journals and other published information

(ii) By licensing, patent and know-how agreements

(iii) By foreign investments and the associated transfer of Know-how and equipment

(iv) By technical aid programmes, multi-lateral and bilateral, governmental and private

(v) By the movement of people between countries, including immigration, return of emigrants, study visit, and other travels for purposes of research and/or development

(vi) By the import of machinery and equipment.

Most developing countries employ all six methods individually, although some deliberately restrict foreign investments and hence this method of technology transfer (foreign investments) is not universally applicable. Frequently all the methods may be combined for a particular project. For example, the construction of a chemical complex in India did cost in total about $25 million, of which about 5 per cent was the cost of licences and know-how, 1 per cent the cost of training technical personnel in India and abroad,

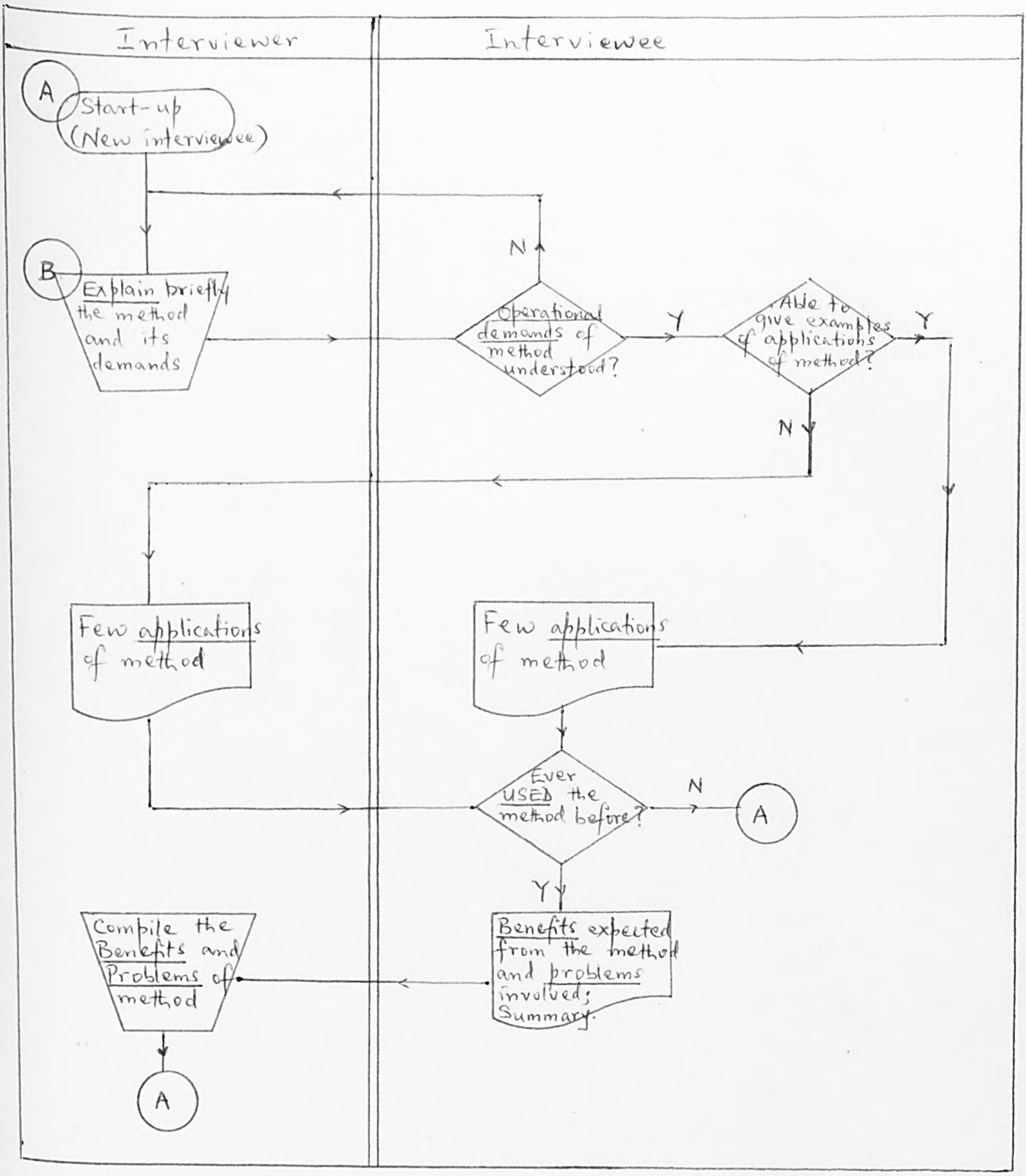

Figure 6.1.1. Methodology of Data Collection on Benefits of, and Problems involved in, the methods of transfer.

15 per cent the cost of design and engineering (most of which would be paid abroad), 50 per cent the cost of hardware and equipment, (about half of which was to be procured abroad) and the remainder the costs of construction and off-sites. The plant was to be financed by private foreign investment and public agencies and under aid programmes. The conclusion of the contract would be preceded by (i) and (v) above.

The ultimate objective of this Indian Financial model is the possibility of being able to determine the relative quantitative importance of the different methods of (technology) transfer.

This study, however, does not employ a financial model in determining the relative adequancies of the methods because such data would not be made available by the respondents. Instead, the respondents were asked to indicate the problems they had encountered in the course of adopting a particular method.

6.2. The Responses - Details of the Investigation

This section explains the operational demands of the methods (as given to the respondents) and presents the responses of the managers interviewed.

6.2.1. The Direct Method

This technique of technology transfer physically transports a system which is operational in a developed country to a developing country. This is a "turn-key" type of transfer. In early 19th Century during the reign of Muhammed Ali, the Arabs attempted industrialising the Arab World by employing this method (1). Two recent examples are by South Africa and Saudi Arabia, South Africa is to buy twelve (12) Boeing 737 aircrafts at the cost of £65 million, while Saudi Arabia is involved in a hospital-system contract (2). The following advantages were revealed:

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(1) Zahlan, A.B., ibid.

(2) Financial Times, 9th August 1979.

(i) Quick and cheap end-product; it takes less time, and therefore less money is involved, compared with other methods.

(ii) Very little time (if any) is spent by the transferee on actual system development

However, it suffers certain limitations, which include:

(i) User would often be interested in acquiring the technological Know-how, rather than the physical system. This method of transfer does not favour such interests.

(ii) The user's cultural requirements are not taken into consideration by the transferer at the design of the technology, since the technology was originally meant for the designer's environment; the result is that the transferee just has to accept what he can get from the transferer.

(iii) The end-user interface is often in a language foreign to the user and often with a different orientation, e.g. reading and writing from left to right as opposed to the Arab way of reading and writing from right to left; using alphabets versus some form of representations (for instance, Chinese).

(iv) Since the user has had little or no chance to participate in the development of the system, he finds it difficult to use and/or maintain it without some continuous "foreign" support.

(v) A technician often has the responsibility for developing a system when he does not have the necessary authority to control the resources, such as hardware or operating personnel needed to get the job done.

(vi) Lack of knowledge of local conditions by the foreigners.

The summation of the situation is that, for lack of knowledge of local conditions, the technician faces so many difficult obstacles during the development phase that he often leaves the project partially completed, frustrated and discouraged; the development stagnates in a chaos created by the touch of too many different technical hands; the development time is usually very long and the project may finally be delivered in a state still unsuited to the user.

Summarising, this method affords gain in time but the results are, more often than not, undesirable because while the transferee has a system, he often has very little or no knowledge about its design and maintenance.

If managers are pressed with time for a transfer the direct method is probably what they should go for, because it involves the least number of stages in the transfer process (as shown in the Tree model).

6.2.2. The Indirect Method

This method transports the technological knowledge in the form of the technician (*), and not the operational system, as in the Direct Method. Once relocated in the transferee's environment, the technician develops the system to the transferee's requirements and in his environment. The key point to this approach is the precise and accurate definition of these requirements. The advantages are:

(i) It has the potential to give the transferee a more satisfactory product or service.

(ii) He has more opportunity to participate in the development of the system, and thus gain more technical knowledge.

(*) " The technician" here is to mean the individual (or collection of) experts that can install the technology.

(iii) He does not have to obtain the right to use any brand-name which goes with the technology, as in the case of patents and licensing.

However, its limitations are that:

(i) He may not have enough knowledge to communicate his requirements effectively to the technician (atimes they may not speak the same 'natural' language and therefore communication is through an interpreter).

(ii) Even where the technician understands the user's language, or vice versa, some languages are very limited in scientific terms.

(iii) Frequent changes in user's requirements as his technical knowledge grows, often result in dissatisfaction on both parts.

(iv) The user expects his own people to be trained during this time; this requires the technician to devote much of his time to this training, a job he may or may not be prepared for, or even like, or do well.

6.2.3. The Alternative (or Mixed) Method

The technique transfers the concepts of technology, in the form of an operational system, (i.e. procedures for development) to the user. This gives the local technicians the opportunity to develop the system from the supplied concepts, install the system under the watchful guidance of the foreign technician, as well as keeping the system running. The only deliverable of the technology supplier is his technological knowledge, in that he has no direct system responsibility but aets merely as a consultant or a teacher. Modifications to the system are designed and implemented by the local technicians in coordination with the user. The Computing Centre of the University of Ibadan in Nigeria adopts this method in its acquisition and adaptation of computing technologies.

The main advantage of this method is the eventual ability of local technicians to develop their technological potentials because the arrangement results in "learning by doing".

However, there may be costs which might have been avoided if the technology-supplier had set up a wholly-managed project. Through the use of local design-engineers and local plant construction, owing to inexperience and possibly ignorance of the production technique, it might take much longer to bring the project to the point of production than would have been the case if the whole business had been left in the hands of the technology supplier. Or the plant might simply operate less efficiently and produce an inferior product because of deficiencies in design.

Summarising, one would say that it may well be true that the fact of having made mistakes on one project will help the engineers, managers and technicians to do better the next time, yet the problem remains that there may be a price to be paid, in the form of production forgone through delays and inefficiency - in using local technical inputs.

6.2.4. Try-It-Yourself Method.

This is similar to the " Alternative Method" in 3.2.3. except that, the technician (foreign) who acted as a consultant or teacher is not involved in that capacity. The user observes some technology usually from abroad through seminars, conferences, industrial visits, or some published information, he goes back to his environment, thinks about the stuff and tries to develop the system with or without modifications. In certain cases, he may have to obtain a license to develop the concept because the idea might be under patency. This technique is commonly referred to as In-house development and is common and fairly successful in India. Mexico employed the same technique successfully when it started its own institute where it built hardware from an idea burrowed from the United States.

A similar experience obtains in Kuwait for its self-desalination technology without any assistance from outside: The country develops its own specifications, constructs plants and operates them. CC Shroff of India is probably the most successful adopter of this technique: he employed Systematic Creativity and Integrative Modelling of Industrial Technology and Research (SCIMITAR) to nurse his Company, EXCEL a Chemical Industry, from 'nothing' to greatness within a very short time (3)

This technique offers the transferee the chance to train his people in the development and maintenance of the self-developed technology; he may even become the consultant to the people who originally developed the concept, that is, if the exercise proves very successful.

However, it suffers a very serious limitation in the sense that in case of a failure there might be some difficulty and/or cost to enlist the support or consultancy of the author of the concept.

This particular set-back of the technique should engage the mind of managers of technology transfer very seriously when one realises (and should accept) the fact that in most cases (particularly in industrial technology) the 'true and complete blueprint' is never really complete to a recipient except, probably, in experiences involving universities and other academic-oriented organisations.

6.2.5. Joint Ventures Method

This is the technique by which the project is jointly sponsored by the user and the supplier of technology. Often the supplier provides the technology, (equipment and technical know-how) while the user supplies the labour force. Such projects are usually sited in the user's environment. There are a few recent examples of this method of transferring technology:

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(3) Shone, K.J; "Mechanics of Creativity: The Contribution of C.C. Shroff to Problem Solving". (1980).

(i) Italy-China agreement to collaborate on construction projects (4).

(ii) United States wants to deploy missiles in Europe to be able to stricke at Russia (5).

(iii) Joint ventures between United States and Japan (6)

(iv) Manufacture and assembly of colour - television between Japan and Britain

(v) Motor assemblies between Nigeria and individual Car industries from Japan, Germany and France.

This method of transferring technology is often adopted by Multinational Companies (MNCs), in a do-it-alone fashion or in Cooperation with private enterpreneurs or the government.

The method seems to eliminate the major limitations of the previous techniques in so far as both parties (i.e. user and supplier) put 'something' into the project and would want it to be economically viable. In this respect, there appears to be sincere vigour towards the project from both sides and equally, the recipient has a chance for his local technicians to learn from the expertise of the foreign partners while the 'expatriates' have the chance to study and understand the recipients environment. The arrangement should also allow the projects to be completed in reasonable times because the experienced foreign partner is directly involved in the operation.

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(4) Financial Times; (8 August 1979) p.4

(5) The Guardian, (8 August 1979) p.6

(6) Peterson, R.B. amd Shimada, J.Y. "Sources of Management Problems in Japanese-American Joint - Ventures. The Academy of Management Review; Volum 3, No. 4, October 1978.

In practice, the difficulties in transferring technology from one place to another (and this usually means from one industrial enterprise to another) means that the transfer takes place only if the organisations possessing technical know-how are prepared to make specific effort directed to the recepient. In the case of profit-making organisations, they will not normally do this unless there is a fairly certain guarrantee of financial compensation. Where a technology is recently developed it is likely to be an important source of monopolistic advantage and bargaining power for the supplier, who will accordingly wish to have a considerable degree of control over its use in the world economy. This spells that the supplier wants (and often gets) control of the transferred technology. This situation creates a disturbing problem for local management of the exercise - a major limitation of the method.

The second limitation lies in the fact that while the supplier focuses attention on profits, the transferee is usually more interested in acquiring the technical Know-how of the process and would therefore want more effort directed towards training the local managers and technicians - a difference of focus.

Another problem created for management by this method of transfer is the inability of the managers from both parties to actually understand the cultural basis of each other's managerial perspective. The basic difference in their epistemological system(*) impact joint ventures through: Selection of the partner; negotiation process and on-going management of the venture. While one party may believe that an analytical or conceptual approach can proceed too far into abstract thinking (and thus distort reality), the other might be more apt to think in terms of absolutes and abstract principles.

(*) Epistemology explains the theory of method, or grounds of Knowledge and practice.

In specific terms one party may expect that, in principle, social obligations will be fulfilled by a voluntary act on the part of the person under obligation, the other party's belief might be rooted in "stick to your rights", which will be regarded, by the former, as a criticism of his character, or a deliberate and unjustifiable attempt of power play. In this situation as in Japanese - American experience, the supplier's usually feel that it is the contract that specifies rights and obligations; the "trust" which results from the particular characteristics of the parties is superflous.

Yet, another problem that arises from this technique is probably an extension of the first limitation; that is, an atmosphere of suspicion that is created be tween the parties. In theory the transferee supplies the labour force, but in practice the supplier tries to occupy every managerial position that matters. Even when the user (or recipient) succeds in securing a few 'important' positions, the supplier would want'his type of man' (i.e. with his type of administrative approach) to occupy such positions - all this because of his position of power. Naturally, these things anger the transferee, the first act is a breach of contract or an usurption of right, while the second act amounts to dictation.

Summarising, the method provides participation by local nationals; it also supports the completion of projects in some reasonably good time; thirdly, the recipient does not have to bear any huge financial burden. However, against these seeming advantages are the prices to be paid in loss of control for local management, binding guarrantee of financial compesation, plus erosion of the recipient's cultural approach to management.

6.2.6. Patents and Licensing Method

This is a method by which technological know-how is obtained under special arrangements. In some cases the right to use a technology or its Know-how is given by the supplier to the recipient under specific payments.

These payments usually take the form of a continuous process (annual payments for a specified period) but there are one - off situations when the financial agreements are settled once and for all. In some situations, agreements between enterprises relating to patents and technical know-how involve interchange on a mutual barter basis without financial flows. This is known as cross-licensing.

Probably the most useful sources of information about these technologies are the licence contracts signed between suppliers and recipients of process technology. In many countries such contracts have to be registered with the government administration, either because they involve payments of foreign exchange which have to be approved (in which case the contracts are often kept in the Central Bank), or because there is some direct control over the technical and financial terms of such contractual agreements. In certain cases, these know-how agreements are "packaged" in the sense that before the supplier agrees to provide this type of "industrial property" he may require to be assured of a high degree of technical and managerial control over the operation. The more modern the technology and the higher the degree of product specialisation the more likely it is that the technology is in the possession of enterprises, often multinational in their operations and the greater is the chance of transfers taking place through direct foreign investments, under special licence agreements, in form of subsidiary or affliated companies. The advantages of this method to managers of technology transfer would include:

(i) As in previous methods time for research and development is saved. In some cases the pilot products would have even been produced, and all the recipients need do, is to apply these pilot products to produce the final product or service.

(ii) Where the special licensing agreements result in the formation of a subsidiary company, the result, at least in theory, is that the two parties (i.e. supplier and recipient) have a willing attitude to the project.

(iii) If the transfer is devoid of any affliation, such transactions between "independents" are generally considered as more reliable.

The limitations of this method for transferring technology are:

(i) Except in affliated companies, the foreign experts (or technology suppliers) are not involved in the operation of the system in the recipient's environment. The method therefore suffers the disadvantages of long setting-up time, possible inefficient running and likely poor products, in addition to lack of trainings to the local managers of the technology. Where the foreign experts are enlisted for initial support, they demand very high salaries and other "atrocious" conditions of service.

(ii) Because of lack of foreign exchange to pay for the rights to patented technologies, developing Countries are often left "tied to the apron" of the technology suppliers who have granted them credit facilities.

(iii) The costs are always exhorbitant. A calculation relating to only two types of cost (i.e. royalties and technical fees) put expenditure on the import of technology by developing countries in or around 1968 at about $1,500 million, a figure that is equal to 5 per cent of the exports of developing countries (excluding major oil exporters) and 40 per cent of their debt-servicing costs. If the tentative estimated growth rate of 20 per cent per annum is correct, this implies annual payments of roughly $9 billion by the end of the decade.

(iv) More often than not, authors of technology prefer cross-licensing (i.e. licensing by barter) to pure financial transactions; this leaves developing countries isolated in the cold because they have no technologies to offer in exchange.

(v) The rise of the multinational corporation (MNC) in recent years through this method has only served to strengthen the dependency of the developing countries on the technology suppliers for export markets, investment capital and technology; these large firms exhibit such a strong base of economic power and associated political leverage and influence(13)

(vi) As in some of the earlier methods mentioned, the owner of the technology has the option of withholding some (and thus not transfer the total stock of) technological information. Since the buyer does not have all this information, he deals in a partial vacuum and may not realise the extent of the technology (or lack of technology) he is purchasing.

(vii) Technology suppliers usually aim to have and retain implicit control of the recipient's operations through restrictive clauses; e.g. imposition of limits on the distribution of the products (can they be exported, may they compete with the seller's own products in other world market segments?); will the buyer also be required to purchase and use trade marks for the products produced? (this represents an additional cost to the buyer); what rights does the buyer have to resell the technology or to make it available to competitors?; the effective duration of any agreement between the buyer and the seller.

In conclusion, this method is probably the most murky of all for management decision because the pros and cons seem to be evenly balanced. On the one hand, the method provides a "quick" way of utilising an already-developed technology with a "seeming" little cost, and a chance for the local managers to acquire the necessary know-hows. On the other hand, the sellers have often managed to maintain control over the agreements and also establish prices very favourable to themselves.

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(13) Lucius; H.W.; "Technology Transfer: Issues and Policies". A paper presented at the Seminar of Graduate Business Administration Department, Ahmadu Bello University, Zaria, Nigeria (May 1981).

In the case where technology transfer is embodied in direct foreign investments there may be no technology charge per se: but an implicit price exists in terms of the amount of profits taken out of the country directly through repatriation or indirectly through higher transfer prices and high capitalisation of technology on the business's accounting records (5). The direct and indirect effects create a lower tax base. The net profit is higher profits for the foreign technology transferer and higher costs for the host country through lower income and larger outflows of foreign exchange.

6.2.7. Own Research and Development Method.

This method of technology transfer involves starting from basic fundamental sciences and progressing through design, development and testing, to final products and/or services (all in the recipient's environment and most importantly by the recipient himself). In some cases, scientists from developed countries may be invited on personal bases to guide certain researches, developments or operations, in which they are well acclaimed; in these instances their involvements are well-defined and the terms of contracts are equally well spelt: contracts are usually for short periods and renewable if both parties so wish.

The movement of people between countries is also an important ingridient to this means of technology transfer. Historically this has been very significant (as shown in the case of Japan), as indeed a successful transfer by all the different methods is usually aided if it is accompanied by the movement of people.

The advantages of this method are enormous: principally they include:

(i) total control over own operations (timing, focus, amount of investments, sequence of focuses, and other factors)

(ii) ability to develop internal technological potentials devoid of any external influences or restrictions.

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(5) The Guardian, ibid.

(iii) retention of own cultures, and ease of building same into the developed technology.

However, as expected the set-backs are almost of equal magnitude compared with the advantages:

(i) the process of research and development is painfully long (some would require a decade for their fruits to be felt; others take much less, depending on area of operation).

(ii) the costs of R & D are usually high, much higher than in mere adaptation of an already-developed technology.

(iii) the chances of an "inferior" end-product are higher (at least initially) for lack of technical know-how.

Concluding, the feeling is that this method transforms the combined disadvantages of the previous methods into its strength, and vice-versa. The implications for management, therefore, is to weigh national self - dependency (but not autarky) against economic and social costs, (the latter arising mainly from long periods required for development).

Summary

Figure 6.2.1. summarises the relationship between the major activities involved in the various methods, as well as the differences between the methods. The differences between the methods are vividly brought out by these activities - performed in the transferee's environment - and account for the peculiarity of different problems to different methods.

Activities (in Recipient's Env.) / Method of Transfer	Research		Development			Production			Implementation		
	Done by Foreigners	Done by Locals	Done by Foreigners	Training Given to Locals	Participation by Locals	Done by Foreigners	Training given to Locals	Participation by Locals	Done by Foreigners	Training given to Locals	Participation by Locals
Direct Approach									PROBABLE	PROBABLE	YES
Indirect Approach			YES	PROBABLE	PROBABLE	YES	PROBABLE	PROBABLE	YES	PROBABLE	PROBABLE
Mixed Approach				YES	YES		YES	YES		YES	YES
By Own Research		YES			YES			YES			YES
Do-It-Yourself					YES			YES			YES
Patents and Licensing								YES			YES
Joint-Ventures						YES	YES	YES	YES	YES	YES

← Utilisation of Technology → (Production: Done by Foreigners – Implementation: Participation by Locals)

← Acquisition of Technology → (Research: Done by Foreigners – Production: Participation by Locals)

Fig. 6.2.1. Model of the Relationship Between the Activities Involved in the Various Methods of Transferring Technology.

6.3. Analysing the responses.

In this section, the tables summarise the benefits of the methods and the problems that resulted from the methods.

Table 6.3.1

Major benefits and problems of the Direct Method and the Indirect Method of technology transfer.

Method	Benefits	Problems Involved and/or Arising	Direct Consequence of the Problem
Direct Method	Quick and 'cheap' end product i.e. save in time	Transferee does not understand the operational complexities of the technology, hence	Affects the utilisation of the technology.
		Difficulty in maintaining the system	As above
		End-user interface is usually foreign to transferer	As above
		Omission of transferee's cultural requirements from the technology, due to lack of knowledge of local conditions on the part of the transferer.	Creates dissatisfaction on the part of the transferee
Indirect Method	1. Potentiality to give satisfactory product or service.	Due to transferee's technical inability to communicate his requirements there are frequent changes in the technology; more often than not, this gives rise to	Increase of costs, notably, timewise
	2. More technical know-how on the part of the transferee	Dissatisfaction on both sides	Tension between the parties.
	3. Right to use any brand-name	'Half-cooked' ability to maintain the system	Affects the utilisation of the technology and the quality of the product or service.

Table 6.3.2. Major Benefits and Problems of the Alternative Method, The Try-It-Yourself Method and the Joint Ventures Method of Technology Transfer

Method of Acquisition	Benefits	Problems Involved and/or Arising	Direct Consequences of the Problem
Alternative Method	Ability of transferee to develop his technical potentials	Takes long time to bring project to point of production or fruition	Costs in input resources e.g. time, money, energy, etc.
		Deficiencies in design and development by the transferee	Inferior products
Try-It Yourself	1. Chance for the transferee to train his local personnel and hence	Difficulty in enlisting the support of the author i.e. the transferer.	Cost in input resources, e.g.fees
	2. Ability to develop and maintain the system by self.	Incomplete 'true blue-print' of the technology	Lack of results, or at best, inferior products or services
Joint Ventures	1. Vigour from both parties towards the success of the project	Monopolistic advantage and bargaining power exploited by the transferer.	Enormous costs to the transferee
			Atmosphere of suspicion
	2. Chance for the transferee to acquire know-how from the transferer	Differences in expectations from the technology.	Tension between the parties
			It affects the quality of the product.
		Differences in the epistemological systems of both parties	Tension between the parties.
			Affects the utilisation of the technology.

Table 6.3.3. Major Benefits and Problems of the Patent and Licensing Method and the Research & Development Method of technology transfer.

Method	Benefits	Problems Involved and/or Arising	Direct Consequences of the Problems
Patent & Licensing Method	1. Saves time	Costs are usually exhorbitant	Inability of the transferee to acquire the technology.
	2. Positive attitude from the transferer to the project	In affliated companies where transferer is not involved in the operation of the system:	
	3. Product has more reliability	Setting-up time is long	Cost in input resources-timewise
		Inefficient running	Poor products
		No training is given to the transferee and the local technicians.	Utilisation of the technology
		Restrictive clauses tying transferee to the apron of the transferer	Continuous reliance on transferer
		Cross-licensing demands by authors of technology	Isolates developing countries in the field of technology
Research & Development.	1. Transferee has total control over his operations	Painful length of time for fruition	Impatience to bring project to point of fruition
	2. Satisfaction in ability to develop technological potentials of local personnel	Costs are usually high	Inability to bring project to fruition
	3. Retention of transferee's cultural requirements in the technology	Transferee has no assistance or training from knowledged or experienced authors or transferers	Poor development of the technology and hence
			'Inferior' end-products

6.4. Observations.

From the various tables showing the benefits and problems of the transfer methods, the following general observations can be made:-

1. That there are communication problems between the transferee and the transferer such that
   - (a) the transferee is not able to present his requirements to the transferer with definite precisions.
   - (b) the transferee is unable to fully understand the end-user interface of the technology (i.e. the working of the technology) obtained from the transferer.
2. That there are problems of 'safe - guarding self interests' by the transferer and hence his seeming 'hard attitudes' to the transferee in the sense that
   - (a) the transferee pays high costs for the technology
   - (b) the transferer imposes certain restrictions on the usage of the technology supplied to the transferee; in some cases these restrictions tie the transferee to the apron of the transferer.
3. That training programs for the transferee are not always built into the methods of transfer, i.e. that trainings whereby the transferee acquires the technical know-how to understand, use and maintain the technology are not always mandatory in the transfers.
4. That because the transferer lacks knowledge of the cultural requirements of the transferee, the technology is usually built according to the perception and need of the transferer, rather than being perceived to suit the cultural demands of the transferee. There are therefore the problems of the technologies not meeting the requirements of the transferee.
5. That there are problems of tailoring transfers to suit the style of organisation and management of the transferee.

These problems (severally and jointly) affect the quality of the technology supplied to the transferee and how effectively he is able to use the technology.

The individual benefits and problems of the methods of transfer are pulled together in Table 6.4.1. and Table 6.4.3. respectively.

Table 6.4.1. Analysis of Methods of Transferring Technology

	Methods of Transfer / Major Benefits	Direct	Indirect	Alternative	Try-It-Yourse-lf	Joint-Venture	Patents and Licensing	Own Research & Development
1.	Overall control of operations	X	Y	Y	Y	X	X	Y
2.	Saves time	Y	X	X	?	?	Y	X
3.	Saves Cost	?	?	?	?	Y	?	X
4.	Recipient's culture bull into technology	X	Y	X	Y	Y	X	Y
5.	Development phase in the recipient's environment	X	Y[a]	Y[b]	Y	Y[c]	Y	Y
6.	Acquisition of technical know-how	X	X	Y	Y	X	?	Y
7.	Training obtained by local managers/ technicians	X	Y[d]	Y[e]	Y	Y	X	Y
8.	Ability to maintain the installed technology	X	?	Y	Y	X	X	Y
9.	Profit from technology (monetary)	?	?	?	?	?	?	X
10.	Quality of end-product	?	Y	Y	X	Y	?	X
11.	Termination of dependency on foreign authors of technology	X	X	X	X	X	X	Y
	Aggregate Scores	1	5	6	6	5	2	7

Key. Y means Yes and is scored + 1

X means No and is not scored

? means Debatable (depending on many other factors) and is not scored.

a. Is done by supplier (or foreign technician)

b. On consultancy basis

c. In conjuction with transferer

d. At least on paper

e. At consultant's convenience.

In Table 6.4.1.

Y - indicates that the method offers the particular benefit (as claimed by a large number of the respondents).

X - indicates that the method does not offer the benefit

? - indicates "no definite decision" (many relating factors affect the judgements).

For purposes of comparison the benefits are assumed to be of equal importance to the transferee (in practice, the relative importance of the benefits are determined by the objectives of the transferee). The aggregate scores would then reflect their adequacies.

6. On these scores

(i) transfer by own research and development offers the largest number of benefits (7 out of 11)

(ii) transfers by Try-It-Yourself (TIY) and Alternative methods appear desirable (6 benefits each out of 11).

(iii) although transfers by Joint Ventures result only in five (5) benefits out of eleven (11), the strong point is that it saves cost for the transferee (when other methods fail or do not appear clear-cut in this direction).

(iv) the least desireable method of transfer is the Direct method whose only real deliverance is save in time.

Table 6.4.2. Suggests that

7. The only fairly likely deliveries of the present methods to the transferee are

(i) that the physical development of the technology will be done in his environment, thereby

(ii) affording him and his people opportunities to be trained on the job.

8. Only about half of the present methods offer the chance for the transferee to

(i) have overall control of his operations

(ii) have his culture built into the technology.

9. Most of the present methods make the transferee dependent on the transferer and the only way to end dependency on foreign authors of technology is to do own research and development.

Table 6.4.2. <u>Deliveries of the methods of transfer</u>

		No of methods that offer the benefit	No of methods that don't support the benefit	No of Controversies
1.	Overall control of operations	4	3	Ø
2.	Saves time	2	3	2
3.	Saves Cost	1	1	5
4.	Recipient's culture built into the technology	4	3	Ø
5.	Development phase in the transferee's environment	6	1	Ø
6.	Acquisition of technical Know-how by transferee	3	3	1
7.	Training obtained by transferee and his people	5	2	Ø
8.	Transferee being able to maintain the installed technology	3	3	1
9.	Profit from technology (monetary)	Ø	1	6
10.	Quality of end-product or services	3	2	2
11.	End of dependency on transferer	1	6	Ø

Table 6.4.3. shows what factors (or benefits) give rise to 'conflict of interest' between the transferee and the transferer. The table suggests that

10. The Direct method of transfer is highly 'opposition-prone'; similarly transfers by Joint-Ventures and by Patents & Licensing involve some elements of conflict of interest, more than by the remaining methods.

Table 6.4.4. suggests that

11. Clear-cut conflicts between the transferee and the transferer are very likely, more than anything else, to arise from
    (i) the culture being built into the technology
    (ii) monetary profit(s) from the technology.

Table 6.4.3. Interests of the Transferee Vs. the Transferer's.

	Methods of Transfer	Direct	Indirect	Alternative	Try-It-Yourself	Joint-Venture	Patents and Licensing	Own Research & Development
1.	Overall control of operations	?	a	a	N/A	Y	Y	N/A
2.	Saves time	?	?	?	N/A	a	?	N/A
3.	Saves Cost	Y	?	?	N/A	a	?	N/A
4.	Recipients culture built into technology	Y	a	?	N/A	Y	Y	N/A
5.	Development phase in the recipient's environment	?	?	?	N/A	a	?	N/A
6.	Acquisition of technical know-how	?	a	a	N/A	?	?	N/A
7.	Training obtained by local managers/technicians	?	a	a	N/A	?	?	N/A
8.	Ability to maintain the installed technology	?	a	a	N/A	a	?	N/A
9.	Profit from technology	Y	Y	Y	N/A	a	?	N/A
10.	Quality of end-product	?	a	a	N/A	a	?	N/A
11.	Dependency on foreign authors of technology	Y	Y	Y	Y	Y	Y	N/A
	Net Scores	-4	-2	-2	-1	-3	-3-	Ø

Key: ? - indicates that the transferer has no intentions that are apparent to be against the transferee's interest, given the benefits of doubt (Score = Ø).

a - indicates that the demands of the agreements are instrumental to the alignment of the interests of both the transferee and the transferer, i.e. no conflicts of interest (Score = Ø).

Y - indicates conflict of interests, i.e. while the transferee wants to minimise the factor, the transferer wants to maximise it, and vice-versa (Score = 1).

NB: N/A signifies that the transferee and the transferer have very little business, if at all, with one another by that method, and therefore no cause for conflicts.

Table 6.4.4. Interests of the Transferee Vs the Transferer's.

	Objectives	No of methods that reflect conflicts of interest for the objective	No of methods that align the interests of the two parties
1.	Overall control of operations	2	3
2.	Save in time	4	5
3.	Save in Cost	1	4
4.	Transferee's culture built into the technology	3	2
5.	Development phase in the transferee's environment	Ø	5
6.	Acquisition of technical Know-how by transferee	Ø	5
7.	Training obtained by transferee and his people	Ø	5
8.	Transferee being able to maintain the installed technology	Ø	5
9.	Profit from the technology	3	2
10.	Quality of end-product or services	Ø	5
11.	End of dependency on transferer	Ø	Ø

6.5. Conclusion.

Analysis of the present methods of technology transfer in Nigeria has confirmed an earlier finding that there are problems of utilisation of foreign technologies; it reveals that a major reason for this difficulty is that these technologies are not always 'accompanied' by the necessary trainings. Other reasons for this difficulty are that there are problems

- of communication between the transferer and the transferee, especially over the latter's cultural and other requirements to be built into the technology;
- of the transferer tending 'to protect his interests', often at the expense of the transferee, primarily because he has a monopolistic and power base; and
- of adopting the technologies to suit the transferee's style of management or vice-versa, because the technologies had been designed to suit the transferer's style of management.

Even though, in practice, the objectives or benefits accruing from technologies are not judged to be equal in importance by each and every industry, the analysis has helped to aggregate the contributions that each method makes towards the realisation of the benefits from technology (which are based on government policies and those of the industries too). The suggestion is that

- transfers by own R & D and by Try-It-Yourself method are the most desirable, both from the considerations of benefits and the avoidance of conflicting situations between the transferee and the transferer.

Furthermore, the analysis is of the opinion that, generally, the present methods do not appear to favour the transferee in realising the full benefits that should accrue from technology.

There is therefore the need for 'improved' or 'new' methods so that the effort put into technology transfer may be more fruitful.

Table 6.6.1. Combined Scores of the Transfer Methods.

	Methods	Scores by achievement of benefits	Scores by no. of conflicts	Total Scores	Rank
1.	Direct Method	1	-4	-3	7
2.	Indirect Method	5	-2	3	4
3.	Alternative Method	6	-2	4	3
4.	Try-It-Yourself Method	6	-1	5	2
5.	Joint Ventures	5	-3	2	5
6.	Patents & Licensing	2	-3	-1	6
7.	Research & Development	7	Ø	7	1

6.6. Implications for Developing Countries.

Table 6.6.1. shows the ranking of the methods based on their combined scores from Table 6.4.1. and Table 6.4.3. The ranking suggests that transfers by own R & D and by Try-It-Yourself Method are the most desirable for developing countries.

Unfortunately, however, transfer by own R & D can be burdensome for developing countries for lack of funds and other resources. It is also true that developing countries might find transfers by Try-It-Yourself method difficult for lack of expertise. The most practicable method would therefore appear to be 'Alternative Method'.

Comprehensive Method

This method can be modified to embrace the strong points of other methods and eliminate their problem-spots. This innovation, resulting in a 'Comprehensive method', might lie in the arrangement of having a go-between for the transferee and the transferer - after all, the 'best teacher' is not necessarily the author of the concept.

The arrangement provides that the transferee receives an operational system, through the go-between, and then reconstructs for himself the process and procedures that sorround it - under some guidance. The arrangement would be such that incorporates training programs, but would not make the transferee directly dependent on the transferer. An example of such a training programme was by a consortium of British 'trainers' appointed by the International Labour Office (ILO) for the Steel Works in Nigeria (See Chapter V).

The goals of this comprehensive method are

(i) to help the transferee to develop a unique technology which takes the people's culture and environment into account.

(ii) to minimise direct situations that can and do give rise to conflicts of interests.

(iii) to ensure some level of self-dependency for the transferee

(iv) to remove problems of communication between the transferee and the transferer, particularly over cultures and styles of management.

An example of a go-between may be a firm of consultants (of mixed nationals) or a group of 'technically educated' local materials (which might form the roots of the R & D team). The group should be exposed to the cultures of the transferer for it to appreciate the transferer's environmental requirements under which the technology operates. Such exposures should not be longer than the minimum necessary, lest the group becomes more 'immersed' in the transferer's cultures and gradually forgets the environmental requirements of the transferee around which the technology is to be built.

CHAPTER VII

Empirical Analysis of the Performance of Technology in Nigerian Industries (i.e. Micro Assessments).

7.1. Introduction

7.2. Abilities and Practices of the Industries.

- 7.2.1. Effects of Technology on Industrial Characteristics
- 7.2.2. Ability to develop internal technology
- 7.2.3. R & D as an integral part of Technological development.
- 7.2.4. Effect of Ownership on Management of Technology.
- 7.2.5. Personnel participation in practical technological innovation.
- 7.2.6. Labour Turnover of employees in technological innovation.

7.3. Assessing the transfer of technology.

- 7.3.1. Assessment by local technicians
- 7.3.2. Qualities of good managers/Reactions of Local Employees to Foreign Employees.

7.4. Economic Assessments of industrial performances.

7.5. Conclusion: Validation of earlier Hypotheses.

7.6. Implications for Developing Countries.

7.7 Appendices.

7.1. Introduction

Some theoretical propositions had been dealt with in Chapters III through VI where, amongst other things, some reasons why technological innovation had not been successful in developing countries were established. This chapter focuses on the remaining propositions, notably to determine how middle management had functioned in technological settings. For these examinations a number of industrial performances are examined, some of which are purely economic; others are economic but non-marketable, i.e. a set of performances not directly or solely profit oriented (See Section 3.2.).

The data came from three sources. First was from economic case studies published within the past six years by the Federal Ministry of Industries in Lagos (Nigeria). This involved taking stratified sample of detailed project evaluation reports written by economic experts or inspection teams of the Ministry. Next was from questionaires administered on technical industries(*) to assess the economic but non-marketable benefits that had accrued in the industries. The following procedures were adopted:

> We examined the practices and abilities of about eighty (80) industries. The industries selected for study enjoy a very wide geographical spread, and cover most areas of the economy.

The third source of information was another set of questionaires administered on employees of an industry that is highly involved with technological innovation. These employees are mostly middle management personnel.

The data from these sources are analysed in such a way as to interrelate what they say about the principles/practices and abilities of technical businesses in different types of technological innovations. The interpretation of the results are seen in relation to our theoretical explanation of how and why innovations had (or had not) taken place.

(*) About 200 questionaires were sent out, and only about 50 were returned completed. Further data, therefore, had to be collected by direct interviews.

7.2. Practices and Abilities of Nigerian Industries.

One way of investigating the problems which give rise to the unsatisfactory effects of technology in developing countries (which were discussed in Chapter IV) is by examining the performances of the local industries i.e. by finding reliable evidences on what had happened in the industries. Good industrial performance is a primary measure of success of technology transfer. Secondary measures of success (stemming from this primary) could be considered along the following lines, amongst others:

(i) improvement in manpower situation, e.g. rapid increase in number of technical personnel and professionalism.

(ii) increase in industries and training schools

(iii) ability to train own staff

(iv) higher labour productivity (e.g. higher output/man).

(v) healthier economic performances, e.g. greater output (or turnover)
higher profits
better returns on investments
more efficient assets management

(vi) improved quality of output

These measures of success mostly attest the practices and abilities of middle management in utilising available technologies. Therefore by examining these measures of success, we can investigate the problems of managing technology, related to middle management.

A different set of questionaire was used (*) in measuring some of these effects of technology.

(*) Availability of records was a major problem and this contributed to our limiting the period under study to six years prior to 1980. Even when the data were available, there was general lack of cooperation (from those involved in managing innovation) in supplying the more meaningful absolute figures. Consequently, a lot of the information required had to be obtained in percentages.

7.2.1. Effects of Technology on some Industrial Characteristics.

Table 7.2.1. shows how those involved in managing technology see its effect on Labour productivity, production of personnel (i.e. self-developed personnel) and Overall Turnover.

(i) On physical production (or turnover), over four-fifths of the industries indicated that technology had either been effective or very effective. However, on labour productivity (i.e. output per man) only about a third feel satisfied while about two-thirds think that past technologies had not been effective in this direction. These two facts suggest that physical production had been satisfactory (possibly on the increase) without any corresponding increase in productivity. The inference from this would then be that the firms had been more concerned with physical output rather than how the available resources could be better utilised.

(ii) On production of personnel (i.e. ability to train own staff) about three-fifths are not satisfied with the effects of past technologies. This would suggest either of two things

(a) that enough trainings are not given, or

(b) that the trainings given are neither effective nor appropriate (i.e. the right type of trainings are not given, and therefore technology is not well absorbed)

These would call for a review of the training system (methods, contents, timing, locations etc).

Table 7.2.2. shows the proportion of technical personnel to total staff over a period of six years. While production of personnel is defined as ability to supply own staff, an increase in the proportion of technical staff comes as a result of past usage and a requirement for further application of technology.

Table 7.2.1. Effect of Foreign Technology on some Industral Characteristics (by no. of firms) based on question 22

Response / Characteristics	Very Effective	Effective	Fairly Effective	Not Effective	Total
Labour Productivity	12	12	17	35	76
Production of Personnel	6	23	18	29	76
Turnover (Production)	58	5	6	7	76

Table 7.2.2. Effect of Foreign Technology on proportion of Local technicians to total personnel (by no. of firms) based question 11.

Year / Proportion	1975	76	77	78	79	80
Less than 1%	30	23	6	7	17	17
1 - 5 %	17	18	23	23	12	12
6 - 10 %	-	6	12	17	12	12
11 - 15 %	-	-	-	-	-	-
Over 15 %	29	29	35	29	35	35
Total	76	76	76	76	76	76

Table 7.2.3. Redundancies of Technical Staff created by the Introduction of Foreign Technologies.

Year / %	1975	1976	1977	1978	1979	1980
0 %	58	58	58	53	58	58
1 - 5 %	18	12	6	6	6	-
6 - 10 %	-	6	12	17	6	12
11 - 15 %	-	-	-	-	6	-
Over 15 %	-	-	-	-	-	6

Good effects of past technologies would invariably generate demands for technicians in the industry (the availability or otherwise of these extra technicians is a different issue).

If a conservative level of 6% (and above) is taken as a point of success, then the observations are:-

(a) in 1975, about 38 percent of industrial firms think technology had generated a high demand for extra technicians.
in 1976, the percentage increased to 46, and that in 1977 and thereafter, it had been above 60 percent.
These imply that past technology had been successful in generating demand for extra technicians.

(b) However, since roughly the same number of industries had constantly indicated an increase in demand for extra technicians since 1977, one would easily draw the conclusion that, give or take, the same set of firms (since 1977) had maintained that stand, while the remaining set of firms had not been able to generate any demand for extra technicians.

Regretably, a large proportion of these firms whose past technologies do not seem to have generated enough demand for extra technicians are found in the manufacturing and construction sectors which form the very foundation of a nation's industrialisation. This situation undoubtedly calls for a closer look at the modus operandi (method of working) of these sectors, for their lack of technical expansion.

From Table 7.2.3, about 3/4 of the industries indicated that no redundancies (at all) had resulted as a direct consequence of introduction of technology over the past six years (i.e. 1975 - 80). These firms are evenly distributed over the various sectors of the economy. The few industries that seem to have suffered between 1% - 10% redundancies are mostly in the Construction Sector.

This would mean that technologies introduced into Nigerian industries so far had required human manning, thereby suggesting that cognizance had been taken of the labour - abundant nature of the economy. This is a positive score for appropriate technology as regards the important issue of employment (or unemployment) in a setting where there are no social or unemployment benefits. A somewhat macro-oriented observation is that although there appears to be surplus labour, oil revenue has forced up the cost of labour, and Nigeria ranks very highly among the countries with very expensive labour. What then happens is that the country is suffering from what is generally known as Dutch - disease (*). The tentative conclusions from this section would be:

(a) that there is general underutilisation of resources;

(b) that trainings have not been effective;

(c) that the methods of working of certain Sectors of the economy (notably, manufacturing and construction) need being looked into, for lack of technical expansion; and

(d) that, on the average, past technologies seemed to have taken cognizance of the labour-abundant nature of the economy.

7.2.2. Ability to Develop Technology Internally

It is sad that there was no technology developed locally for transfer to the outside world. Table 7.2.4. deals only with locally - developed technologies for internal circulation (a form of transfer).

(*) Expensive Capital, as well as expensive Labour. Economists would advise that the currency be devalued to bring down the cost of capital and labour; the country should also strive to export some of its commodities, to create a more suitable atmosphere for solvency.

Table 7.2.4. Categories of Organizations that transfer some technology internally within Nigeria.

Operations / Sector	Transfers Technology	Doesn't transfer Technology	Total	Percentage that transfers technology.
Manufacturing	12	10	22	54.5%
Distributive Services	-	8	8	Ø%
Educational Services	4	1	5	80 % **
Construction	8	16	24	33.3 %
Consultancy	8	2	10	80 % *
Others	4	3	7	57 %
Total	36	40	76	(47 %)

* Sample size is small for unflinching conclusions.

Observations

The Manufacturing Sector enjoys a reasonable success in developing local technologies for internal transfer (55%). On the whole, about 47 per cent of the industries that responded had some technologies for internal circulation.

When the years of inception were matched with internal development of technology, Table 7.2.5. was obtained:

Table 7.2.5. Ability to Develop Technology Internally

Response / Age Since inception (yrs)	Has developed Technology	No Technology to Transfer	Total
1 - 5	3	36	39
6 - 10	13	3	16
Above 10 yrs	20	1	21
Total	36	40	76

The Table suggests that long established organizations are likely to be more capable of developing technically than newly - established ones. A chi-square test suggests significant differences in ability to develop internal technologies between new industries and older industries. The interpretation of these results is that technology grows with time; and this tallies with expectations.

Table 7.2.6. shows development of local technologies on basis of type of ownership.

	Response / Ownership	Transfers Technology	Does not Transfer Technology	Total	%
1.	Indigenous (Govt)	9	3	12	75 %
2.	Joint Ventures (Private & Foreign partners)	9	3	12	75 %
3.	Joint Ventures (at Government level)	7	13	20	35 %
4.	Indigenous (Private)	0	8	8	Ø %
5.	Subsidiary of Foreign Companies	0	8	8	Ø %
	Total	24	36	60	

Observations.

(i) Private indigenous firms and subsidiaries of foreign companies have no local technologies (is it because of resources or secrecy?)

(ii) Less than half of the companies involving the home and foreign governments have been able to develop some local technologies.

(iii) Government companies (i.e. home government) and others that are joint-ventures between private individuals and their foreign partners) are very successful in developing local technologies.

(iv) A chi-square test shows significant differences at P less than .05 between indigenous government companies and companies that are jointly owned at government level i.e. (1) and (3) above. The reason for these differences may lie in the fact that the home government aims at being able to develop its own technology (and therefore concentrates on that) while foreign governments are more interested in other factors (and therefore would not miss any sleep over internal development of technologies).

To verify this, Table 7.2.6. is condensed into Table 7.2.7. as follows:-

(a) all indigenous companies (private or government) are grouped together

(b) companies under joint ownership by the home government and foreign governments, and those under joint ownership by local private individuals and their foreign partners are grouped together.

(c) those companies which are subsidiaries of foreign companies (and are therefore owned by say multinational companies) stand alone.

Table 7.2.7. Ability to develop local technology.

	Transfers local technology	Has no technology at all	Total
Local ownership	9	11	20
Joint ownership through the governments	16	16	32
Foreign ownership	Ø	8	8
Total	25	35	60

Observations.

A chi-square test (X^2) at 0.05 level of significance suggests that there are statistically significant inter-industry differences based on ownership. This would mean that the policies and direction of efforts of the industries reflect the abilities of the industries to develop local technology, and the following conclusions can safely be made:

(i) It can be said that companies owned by foreigners have no technologies at all for transfer, possibly because they have not given any effort in that direction. If the real aspirations of the transferee is technological independence or national reliance, then the foregoing has indicated that technology transferers are not committed to the transferee's aspirations. This validates the hypothesis that

" the factors that interest technology transferers differ from the interests of the transferee".

(ii) With regards to technological development, the chances of it been successfully managed are fairly high when the governments of the transferee and the transferer are both involved.

(iii) There is also a fair chance of success (45%) when the technology is solely owned (and objectives defined) by the transferee.

Investments in Training

When the firms were asked what percentage of their turnover is invested annually in training their technical personnel, the following results were obtained:-

Less than 1%	:	35
1 - 5 %	:	24
6 - 10 %	:	5
11 - 15 %	:	6
Over 15 %	:	6

This means that almost half of the responding industries spend nothing, or less than one percent of their turnover, on technical training (*), and when this was matched against ability to develop some internal technology, the result was as follows:-

Table 7.2.8. Ability to Develop Technology Internally

Response Percentage invested in training	Transfers Technology	Has no Technology to transfer	Total
Less than	0	35	35
1 - 5 %	20	4	24
6 - 10 %	5	0	5
11 - 15 %	5	1	6
Over 15 %	6	0	6

A chi-square test at 0.05 level of significance indicates differences. The interpretation of this result is that the industries that had invested reasonably well in technical training had been able to develop some form of internal technology. Indeed, with the exception of one odd-one-out firm, the result has shown that firms that expend higher proportions of their revenue in training their technical staff had all been able to develop technologically in greater proportions.

If it is accepted that an ability to develop some internal technology is a measure of success then this piece of work has validated the hypothesis that "More investments in technical training result in better chances of success of technological innovation".

(*) Industrialised Countries that transfer technologies spend over 5 per cent of their turn-overs on training their technical personnel.

Locations of trainings.

Where the trainings are conducted could be important because of the type of exposures the trainees get from the trainings. In order to find the impact of training (local or foreign) on technological development, past training programmes of the industries were examined and the findings are:

Table 7.2.9.

Firms / Location of Training	Developed Technology	Has no Technology
Training programs in Nigeria	19	17
Training programs abroad	5	14
Trainings are both local & abroad	12	9

This table suggests that local training is more desireable for technological development, probably because the exposure to the local environment allows the trainees to recognise what could be achieved without foreign technology. Combined programmes (local and foreign) also lead to a fairly satisfactory technical development. One would have expected the combined programmes to have enabled the technician to appreciate a comparison between what obtains in his local environment and what obtains abroad, and that such an appreciation would have resulted in greater ability to develop technically. The suspicion is that the trainings abroad are long enough to make the technicians become so immersed in the foreign environment that they tend to forget the realities of their local environment and thus they no longer 'fit in' on their return. The Table also suggests that local technicians should not be given foreign trainings alone.

With this point in mind that trainings should not be too long, the lengths of trainings were examined on basis of ownership. The results are given in Table 7.2.10.

Table 7.2.10. Trainings on the basis of Ownership.

	Below 3 months	3-6 months	Above 6 months
Indigenous Companies	9	13	5
Joint Ventures	21	6	0
Foreign Companies	8	0	0

The Table indicates that indigenous companies tend to give courses of trainings lasting between 3 - 6 months, and that companies with any foreign touch run only very short courses (below 3 months). This suggests that

" Non-indigenous enterprises tend to give very short trainings to their employees".

If one recollects the fact that indigenous companies had been shown to have developed some local technologies much more than foreign firms, the inference would be that short training courses of 3 - 6 months duration are more beneficial than very short courses. (It will be interesting to see what preference further research would establish between trainings of 3 - 6 months duration and those that last longer than 6 months).

The whole pattern of preferences established by this analysis agrees with the inferences made about appropriate trainings for managers who are expected to be critical of the current performances in their organisations, i.e. good managers. Therefore, for both good management and technical developments, local trainings are more desirable and the duration should range from 3 to 6 months. These trainings in Nigeria, however, could be supplemented by other short training courses abroad, preferably through attachments.

7.2.3. R & D as an ingredient of Technological Development.

The literature review suggested a positive relationship between R & D and technological progress. Chapter VI went on to suggest that acquisition of technology by R & D is very desirable for technological progress in developing countries.

With these in mind, the activities of the industries were examined regarding R & D. The industries were asked if they are engaged in R & D at all (no matter how minimal). The results were as follows.

Engaged in R & D	:	9
Doesn't do any R & D	:	67

This shows that a little over one - tenth of the responding industries did any research and development. This result in itself proves the point that

" Developing industries have not taken enough interest in R & D as an integral part of technological development".

The interpretation of this is that developing countries have perceived technology as a non-questionable venture. For technological success, one should not just subscribe to every technology he finds, but should be able to question some of the theories and operation of these technologies through R & D. If ability to question available scientific knowledge is a step towards technological progress then it is hereby suggested that developing countries have technological problems which they are likely to reduce by practising more R & D.

With this interpretation in mind the group of industries that do R & D was analysed. There were only 9 industries in this group.

Table 7.2.3.1. Industries that do some research and development.

Sector	Does R & D	Doesn't do R&D
Manufacturing	6	14
Distribution Services	0	11
Educational Services	2	5
Construction	0	23
Consultancy	0	7
Others	1	7
Ownership		
Local ownership	1	
Joint Ventures	8	
Foreign ownership	0	

The Table suggests that most of the R & D done in the industries in Nigeria are in the manufacturing sector. These industries are also mainly owned by the combined governments of the transferee and the transferer.

One tentative conclusion from these results is, once again, that the orientation of private transferers are not exactly towards the aspirations of the transferee, which is technological independence. One would remember that this point had been made, regarding adequacy of training investments.

Another tentative inference is that R & D supports technological progress, when one recollects that it was the manufacturing sector that had the greater proportion of internally developed technologies.

In order to prove conclusively that R & D supports technological progress, the investments of the industries in R & D were examined (some of these research and developments are done by universities through the sponsorship of the industries; and some of the research results are made available to the contributing industries on demand), with the following results:

Table 7.2.3.2. Investments in R & D Vs Ability to Develop Technology Internally.

Percentage of total annual investments invested in R & D	Has Developed some technology	Has no Technology	%
0	2	28	7%
Less than 1	5	12	41%
1 - 5	25	0	100%
6 - 10	3	0	100%
11 - 15	0	0	N/A
Over 15	1	0	100%

One is inclined to ask whether it is better if the companies do their own R & D rather than via the universities. This is a potentially useful follow-up to this research as the finding(s) would guide the industries on the appropriate level of cooperation(s) between them and the universities.

Once again, the Table suggests that most industries in Nigeria have not ascribed to the practice of R & D as an intergral part of technological development. If the Western standard of 6 percent (and over) of annual investments in R & D is accepted, then this study is suggesting that Nigerian industries have difficulties in perceiving that investments in R & D are necessary for technical progress.

Looking at the companies that have been able to develop some technology, it was found that

(i) all the companies that spend 1 - 5 percent (and above) of their annual investments on R & D have developed some technology internally.

(ii) Less than 15 percent of those that spend less than 1 percent of their annual investments on R & D have been able to develop some technology internally. It might look suprising that any firm in this group had been able to develop some internal technology at all.

The reason for this seeming success lies in the fact that some of them have relationships with foreign companies and these foreign companies conduct the research on new models of products for them (outside Nigeria).

Inference from these observations is that for technological success, industries need to invest at least 5 percent of their annual investments in R & D. This is roughly in line with the western practice of above 6 percent (See Chapter II).

7.2.4. Effect of Ownership on Management of Technology.

It was shown in section 7.2.3. that the chances of success of a technical project are related to the type of ownership. How does ownership affect the overall management of technology? In a very broad term, the answer would lie in the policies. In a more specific term, one aspect of these policies would be the method of acquisition of the technology. The methods of acquisition were therefore examined on basis of ownership with the results in Table 7.2.4.1. (*)

(*) The numerous methods of acquisition were grouped into three "more-manageable methods:

Method I - Importation of machinery, and Patents and Licensing: (because they involve direct payments and other indirect costs, and at times some conditional agreements).

Method II - Exchange of Books, Interpersonal Communications, R & D and Collaborative Agreements (they don't involve the transferee in any direct costs)

Method III - Direct Investments by the transferer, e.g. Multinational Companies.

Table 7.2.4.1 : Type of Ownership Vs Method of Acquisition.

	Method I	Method II	Method III
Local Ownership	13	15	0
Joint Ventures	22	6*	7
Foreign Ownership	6	4	3
	41	25	10

* These are the 6 companies in manufacturing that do R & D

The Table indicates that the commonest method of acquiring technology in Nigeria is by importation of machinery (i.e. turnkey) and through patents and licensing. A chi-square test (X^2) at 0.05 level of significance suggests that there are significant differences in methods of acquisition, based on the type of ownership.

The interpretation of this is that since the chances of success are related to ownership, and ownership in turn determines the method of acquisition, then it can be said that the chances of managing technologies successfully in Nigeria are related to the method of acquisition of the technology. The temptation is to suggest Method I as more desirable. But when one notices that the six companies employing Method II have been "successful" in developing internal technologies, and that joint ventures in themselves have been proved to be more desirable, the logical conclusion is that Method II is more desirable for the acquisition of technology in Nigeria. (The method, it is remembered, consists of acquisition through seminars and inter - organisational visits).

The result of this analysis has therefore validated the contention in Chapter VI that "Do-It-Yourself" is the most effective method of acquiring technology in developing countries if the real aspirations of the transferee are to be achieved.

In summary, the analysis has shown that policies defined by those concerned with management of technology (particularly, policies affecting the method of acquisition) affect the overall management of the project. For an effective management of technology, the policies should encourage inter-organisational visits and attendances at seminars where knowledge and experiences are shared.

7.2.5. Personnel Participation in Practical Technological Innovation.

For an effective management of technology (or technology transfer) it is important that knowledge and experience on the technology are obtained and shared by the employees, particularly, the local employees. This means that every-body concerned with technology management should be involve , in the practical side especially. To find out what group(s) of personnel are involved in technological projects in the P & T, the functions of the employees were analysed on basis of their academic and professional qualifications, with the results in Table 7.2.5.1.

Table 7.2.5.1. Functions of employees on basis of their Qualifications

Qualifications	Involved in practical Technology	Not Involved in Technical Practice
University & Poly. degrees	18	10
Trade Centre & others	28	5
Total	46	15

A chi-square test at p = 0. 05 suggests that employees with university degrees and similar qualifications don't get involved in technical practice. The suspicion is that these employees have administrative duties that do not reflect technical involvements.

Even if this group of employees have to provide a substantial amount of administrative support for the organisation, yet these non-technical functions do not have to "swallow" about two-fifths of the very highly-trained employees. This is seen as 'wastage of academic and professional trainings'.

When these functions were analysed on basis of status the following results in Table 7.2.5.2. were obtained.

Table 7.2.5.2. Functions of employees on basis of Status

Status	Involved in Technical Practice	Not Involved in Technical Practice
Management Level	20	7*
Supervisor/Foreman	20	3*
Operators and Others	6	5
Total	46	15

The Table suggests that about one quarter (25.9%) of the employees at management level perform duties that are not technical - oriented. Comparing Table 7.2.5.1. and this Table 7.2.5.2. suggests that 3 degree-holders out of 28 are in the Supervisory grade and 2 employees without university degrees (out of 33) perform duties at the management level. The interpretation of these results is that to be a manager, an employee must have a university degree or a similar professional qualification.

Although a large number of those on supervisory grade are involved in technical practice, there are about 13 percent of these employees engaged in other duties that are not strictly technical. In an organisation that is highly technical - oriented, one would have expected that almost all the employees on the supervisory grade would be involved in overseeing the functions of the technical employees, i.e. be involved in technical-oriented jobs.

This Table also suggests that there is a very high management overhead in the organisation (44 per cent).

The trainings that the employees have received since joining the P & T were studied to determine the training policies of the organisation. The results in Table 7.2.5.3. were obtained.

Table 7.2.5.3. Trainings received by Employees since joining P & T

Type of Training Received since joining P & T	Involved in Technical Jobs	Not Involved in Technical Jobs
Degree Course	0	0
Diploma Course	6	5
Short Management Courses and other attachments	40*	10**

* 12 employees with Trade Centre qualifications out of 33 were allowed on management courses and attachments.

** 7 of these have duties at management level

The Table suggests that the training policies of the organisation does not support employees going on degree courses; a few have been sponsored on Diploma Courses, and it looks like the organisation directs its energy at sending the managers on short courses and attachments. It does seem, too, that this benefit is denied non-managers.

When one recollects that a fairly large number of these managers are not involved in technical-oriented jobs the interpretation of these results is that either

(a) the short management courses and attachments are mainly administrative oriented (in a highly technical set-up)

or (b) the courses are technical-oriented but are given to the group of employees who have no need to apply them in their duties.

Looking at those who have been sponsored on Diploma courses, over half of them perform duties that are not technical oriented.

The conclusions from this analysis are that:

(a) the organisation encourages in-service trainings (where huge training allowances are paid) to those at management level, but denies other employees of these benefits;

(b) employees with university degrees and similar qualifications join the organisation straight at management level; thus, the managers are not 'built' through experiences before the job but that the experiences received are after-appointments;

(c) the in-service trainings offered to employees are either inappropriate or they are misdirected;

(d) paper qualifications are ajudged very important for appointments (even technical appointments); and

(e) there are high management overheads resulting in wastage of academic and professional trainings.

The result of our analysis is suggesting that there are errors of judgement in favour of academic qualifications, regarding technically related appointments. Secondly, it is suggesting that the training policies in Nigeria are likely to breed dissatisfaction in employees holding non-managerial positions.

7.2.6. Labour Turnover of Employees in Technological Innovation

In order to determine the level of labour turnover of employees and the effect it might have on the overall success of using technology in Nigeria, the lengths of service of the employees were analysed. It is recognised that the analysis would have been more predictive if the services of the employees who had left the organisation were known. But because of lack of proper records and the uncooperative attitude of those in charge of such records, the study had to be made on the services of current employees, with the results in Table 7.2.6.1.

Table 7.2.6.1. Labour Turnover of Employees in the P & T.

	Less than 1 Year experience	(1-5) Years experience	Above 5 Years experience
Age Group			
Below 30 years	4	6	1
30 - 44 years	0	3	19
45 years and above	0	2	26
Qualifications			
University degrees and Polytechnic qualifications	1	5	22
Trade Centre and Others	3	6	24
Training Exposures			
Foreign trained	1	3	15
Locally trained	2	2	15
Both locally & foreign trained	1	6	16
Total	4	11	46

Controversial as the group analysed might appear in revealing the labour turnover problems, the Table suggests that generally, the technicians in the organisation tend to stay on their jobs irrespective of their age groups. However, if the services are considered at "1 - 5 years" and "above 5 years" levels, it looks as if the employees with high qualifications tend to leave in 1 - 5 years and those with Trade Centre qualifications stay on. Similarly, it looks as if locally trained personnel tend to leave in 1 - 5 years more than the foreign-trained employees, and that those with both local and foreign trainings tend to stay on. The interpretation would be that those with very high qualifications join the organisation at very high levels where, as shown in Section 7.2.5, they are made very comfortable, and equipped with management courses. These "comforts" allow them extra resources and company facilities to launch their own private businesses.

Similarly, the fact that locally trained personnel tend to leave in 1 - 5 years and those with both local and foreign trainings tend to stay on, reflect the amount of "comforts" that are derived from the so-called foreign trainings (*)

The conclusion is that since the "managers" are employed straight from the market (without going through a build-up process) and they form a fair size of the organisation, the personnel policies in Nigeria are likely to encourage high labour turnover particularly in the management cadre. This would result in frequent changes of organisational policies which rob organisations of continuity of strategies.

A solution to this would seem to be a reduction in emphasis on high qualifications which tend to create a special class for the holders. This way, other "experienced" employees without university degrees would provide a challenge to degree holders who hitherto had been "over-protected". A second aspect of this over-protection is the allowances paid to those on foreign attachments. This aspect should be reduced (from the point of view of usage of resources) and more importantly, the amount of reduction be made available to every employee that would benefit from such trainings. In our opinion, it is the technicians who stand to gain more from overseas practical attachments.

7.3. Assessing the transfer of technology

7.3.1. Assessment by local technicians

In order to find how to improve technology transfer it would be helpful to assess how well it is transferred at present. One method is to seek the opinion of those doing so. For this reason the opinions of 68 persons concerned with transfer of technology in the P & T (Nigeria) are interesting. They were asked:-

> How effective are present efforts in Technology Transfer (TT)? The results of their responses were as follows:

(*) In Nigeria, an average manager on an overseas attachment is entitled to about ₦150 -a-day allowance (£120) apart from his basic salary. These allowances are paid in the currencies of the countries he/she is visiting.

Very satisfactory	0
Satisfactory	53
Unsatisfactory	15
Very unsatisfactory	0

The profile of those 15 persons critical of the effectiveness of technology transfer were:-

(i) Age 30 to 44

(ii) Training had been both local and foreign.

(iii) Length of service was over 5 years and none were graduates, but all had taken short courses.

(iv) The length of this training was between 3 months and 1 year and they thought that foreigners should go.

(v) Their employment status were: 9 in management
3 as foremen
and 3 as operatives

An interpretation of these results is that only employees that felt reasonably secure were willing to be critical. That is, men in the 30 - 44 age group, had 5 years or more service and were not due to retire soon. The fact that all those without foreign training felt that T.T. was satisfactory suggests that foreign training is necessary to provide some basis for assessment. Similarly some prior local experience and training was essential because only those with such experience recognise what could be achieved without imported technology. Probably those without early local experience tended to belittle what could be achieved by Nigerians themselves.

With this interpretation in mind the replies of everyone in the age group 30 - 44 with 5 years experience and local and foreign training were examined. There were 22 persons in this group.

The results of the analysis are given in Table 7.3.1.1.

Table 7.3.1.1. Some Characteristics of the 30 - 44 age group.

Education	T.T. Not effective	T.T. effective
Graduates	0	5*
Diploma holders	7	0
Lower qualifications	8	2
Status		
Management	9	2*
Foremen/Super	3	3
Operatives	3	2
Training - short courses		
Less than 3 months	0	6
3 months - 1 year	15	1*
Over 1 year	0	0

Only one reply out of the whole sample of 68 thought that foreigners should stay. This man has been*in the table above. He thought technology transfer was effective: he was a graduate, and had 3 - 12 months training locally, and was a manager.

This Table suggests that graduates with limited (less than 3 months) training will not be dissatisfied with technology transfer. These people are also less likely to be manager than diploma holders.

The tentative conclusion are that only 22% of all those concerned with technology transfer are likely to be critical of it. But if certain conditions are satisfied e.g. maturity (age 30-44), foreign training and early experience in Nigeria, together with substantial experience (5 years) and they are in a reasonable position to be critical, then there is a 68% chance that they will be.

Of the group (22) that may be critical, those without degrees but with diplomas and more training on short courses will be critical, whereas graduates and those with very little training will be non critical.

Thus the conclusion is that those with training and substantial experience in Nigeria and some training below university level abroad are likely to be critical. Those with degrees and/or less training in Nigeria are unlikely to be critical. This group are less likely to be managers than those who are critical.

If it is accepted that a willingness to be critical of current performance is the first step towards improvement, then the suggestion is that Nigeria has a substantial management problem as contended in Chapter II.

The key to improvement would seem to be more training to diploma level and some but not long training abroad after experience in Nigeria. Short (management) courses in Nigeria may also need to be accented.

7.3.2. Qualities of good managers in their working environments

As in 7.3.1., in order to improve the relation between the transferee and the transferer in creating an atmosphere of good cooperation (since it has been shown that joint ventures are more desirable for the transferee), it would be helpful to assess the quality of the current relation. The local personnel who work on technology with foreign nationals in the P & T Nigeria were therefore asked to react to the employment of foreign experts in the organisation.

The reactions varied from outright condemnation to polite opposition (to the employment of these foreign experts). A few thought the foreigners should stay to impart more technical knowledge on the local technicians, while some were unable to make up their minds. The results are provided in Table 7.3.2.1.

Table 7.3.2.1: Reactions to Employment of Foreign Personnel.

Age Group	Foreigners to STAY	Foreigners to Go	No reply
Below 30	0	3	8
30 - 45	4	16	2
45 and above	0	25	3
Qualifications			
University & Polytechnic qualifications	4	20	4
Trade Centre & others	0	24	9
Status			
Management	4	13	10
Supervisor/Foreman	0	20	3
Operators & Others	0	11	0

The Table suggests that the generality of the local technicians irrespective of the age group and qualifications would welcome the withdrawal of the foreigners. On basis of status, however, these rather hostile reactions are milder. The meaning of these results is that only those who don't feel too threathened by the presence of foreign workers are prepared to tolerate them. The remaining employees see the foreign workers as standing in their ways to higher promotions, and this is responsible for their ill-feelings against these foreigners. Other reasons adduced by the "aggrieved" local technicians centred on the fact that these "managerial" foreigners are merely administrators and that they are not involved in many practical operations, such that would allow transfer of knowledge and practical experience to the local technicians.

A few of those in the management group did not reply to the question. These refusals to answer the question could be because:

(a) they couldn't make up their minds;

(b) they appreciate the contributions of the foreigners but are not prepared to admit, for fear of hostility from their other "hostile" colleagues; or

(c) they don't see any good in the foreigners' stay, but are afraid of the reactions of these "administrative" foreigners who hold the key to their promotions.

Good management qualities include ability to assess situations correctly and courage to report these situations as assessed. Thus the conclusion is that about 40% of those involved with managing technological innovation in the P & T do not possess the adequate qualities of good managers. The situation is even worse if the managers are below 30 years.

For an improvement in the working relation between foreigners and local technicians, the answer seems to lie in

(a) either appointing the foreigners on consultancy basis (whereby they would have no direct control over the promotions of the local employees, i.e. line management)

(b) maintaining the current practice of direct foreign staff participation, but with the following modifications:

   (i) all employees at management level should be professionally capable of sharing practical experience with other employees;

   (ii) local employees at management level need more exposures to mature in their jobs, particularly when they are "underaged" (i.e. below 30). Local employees who have been in an organisation for quite a while and are newly appointed to management level at 45 are not likely to cooperate with their foreign colleagues because of the "frustrations" they must have suffered earlier.

Reaction of Local Employees to Foreign Employees

The fact that most of the 68 local 'technicians' were dissatisfied with the employment of foreigners suggested a 'hostile atmosphere' between the two parties, which would neither augur well for co-operation nor for good industrial performance.

The main reason given by these workers is that the foreigners' stay had prevented them (the local nationals) from taking total control of the business, (this is also the feeling of the generality of Nigerian workers). This led to the analysis of the employment of expatriates in the country over a period of time (See Table 7.3.2.2.)

A quick glance at the Table would suggest that whereas there had been an increase of about 62 per cent in the Senior Staff employment between March 1975 and November 1978, there had only been some 46 per cent increase in the expatriates quota of total employment over the same period. This would further suggest that the rate at which Nigerians are being appointed to managerial posts is higher than the rate at which expatriates are joining the pool, assumming all expatriates are appointed

Table 7.3.2.2.

Summary Total Employment.

	Mar75	Jul75	Nov75	Mar76	Jul76	Nov76	Mar77	Nov77	Mar77	Ju78	Nov 78
Expatriates % age of (U) Total Employment	2.8	2.8	2.6	2.9	2.8	2.3	3.0	2.7	3.4	3.9	4.1
Senior Staff (including Nigerians) (V) % age of Total Employment	10.3	10.1	10.2	9.5	10.5	9.7	10.4	11.4	15.1	15.2	16.7
Expatriates capture of Mgt. Posts (W) (U) as % age of (V)	27	28	26	31	27	24	29	24	23	26	25

Source: Expatriate Quota Employment. National Manpower Board, Fed.Min, of National Planning Lagos, 1980.

to Senior Staff positions, as indeed they are in Nigeria. Relating this to diffusion of technology, the role of a foreigner is that of a tutor, a trainer, or one that imparts knowledge. Once that job of training is done the trainees should be able to take over from the expatriates. One is not suggesting that there should be a constant decrease of foreigners (following successful trainings of the locals). On the contrary, there would even be increases in their number following introduction of more technologies. But while others are coming in there should be an evidence that some are going out of the country, if truly they had successfully diffused technological know-how through the importer's environment. This way there would be a state of equilibrium, and feelings would not run high.

Suppose x represents the no. of expatriates at time t_o,

y represents total Senior Staff (including Nigerians) at t_o,

a_1 represents the no. of expatriates that came in by t_1,

b_1 represents the no. of expatriates that went out by t_1.

Assuming all the posts vacated by these expatriates at t_1 are <u>ideally</u> occupied by the locals, then at time t_1 the no. of expatriates $= x + a_1 - b_1$

and the total no. of Senior Staff $= y + a_1 + b_1 + r_1$

where r_1 is the no. of Nigerians that got appointed to other Senior posts in addition to those posts vacated by departing expatriates.

Similarly, at time t_2 no. of expatriates $= x + a_1 - b_1 + a_2 - b_2$

and total no. of Senior appointments $= y + b_1 + a_1 + r_1 + b_2 + a_2 + r_2$

At time t_n therefore

No. of expatriates $= x + \sum_{i=1}^{n} a - \sum_{i=1}^{n} b$

and Total no. of Senior Posts = $y + \sum_{i=1}^{n} a + \sum_{i=1}^{n} bn + \sum_{i=1}^{n} r_n$

Relating this to Table 7.3.2.2.,

$$(U) = x + a - b \text{ (dropping the summation notations)}$$

and

$$(W) = \frac{x + a - b}{y + a + b + r}$$

It is correct to say that $\underline{r}$ takes care of any effects of labour turnover which might arise as a result of Senior Nigerians leaving their employments to form their own private companies. Ideally, such posts vacated by the Senior Nigerians will be taken up by other Nigerians. This assumption holds because there isn't, as yet, the situation where posts vacated by Senior Nigerians can not be filled by other Nigerians. Assuming that the change in expatriates' capture of Senior positions during the period under consideration is negligible (as indeed it was - See Table 7.3.2.2)

$$\text{Then } \frac{x}{y} = \frac{x + a - b}{y + a + b + r}$$

This is saying that the expatriates' capture at the beginning equals the expatriates' capture at the end.

Cross multiplying, we have

$$xy + xa + xb + xr = Xy + ya - yb$$

$$\therefore x(a + b + r) = y(a - b)$$

$$\therefore \frac{x}{y}(a + b + r) = a - b \text{ (dividing thru by } y\text{)}$$

But $\frac{x}{y} = \frac{25}{100}$ (See Table 7.3.2.2/Nov. 78)

(Any figure for that matter could be substituted from the Table)

$$\therefore \quad a + b + r = 4a - 4b$$

$$\therefore \quad 5b + r = 3a \quad \ldots\ldots\ldots (q)$$

For eqn (q) to hold, a must be greater than b. This therefore suggests that the rate at which expatriates are coming in is more than the rate at which they are leaving by a factor greater than 5/3. Little wonder then that tempers were running high.

Even if this is only one side of the story,* the analysis has shown that there is the problem of 'curing a hostile atmosphere' created by the rate of employment of expatriates, which has angered the local employees to an extent that the latter have failed to co-operate with the former in the use of foreign technology.

7.4. Economic Assessments of Industrial Performances.

The earlier part of this chapter had focused on benefits that are mainly technical oriented, e.g. increase in proportion of local technicians, ability to develop technology internally, etc, i.e. economic benefits that are not directly marketable.

This section assesses the performances of the industries, using factors that are profit oriented, i.e. economic factors. An indepth analysis of the economic performances of the industries is likely to reveal some management problems involved in utilising the available technology. To this end, the performances of fifteen major companies, distributed fairly evenly within the economy, were examined.

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* the other side might be that the expatriates have in fact not completed their training programs to the level at which they feel the trainees can take full control. In other words it might have been a situation where the trainees felt they had learnt and known all, when in actual fact, their perception of what they are learning (or have learnt) had affected how well they had learnt.

The type of analysis of the economic status of a firm (or financial statement) will depend upon the objectives of the person who is scrutinising them. For example a share-holder's interest lies only in the yield and safety of his capital. But management or anyone interested in the health of an enterprise as a whole has a much wider interest in the study of the financial statements. They are interested not only in the profitability of the business but also in the efficient utilisation of resources (i.e. fixed and current assets, men etc). For management and some other interested groups, the commonly accepted measures of overall performance are Return On Investment (R O I), and Assets Management Ratio (AMR). Another commonly accepted measure of performance is Productivity Margin (PM) (or as it is commonly known, profitability margin)*

ROI = $\dfrac{\text{Profit Before Tax}}{\text{Capital Employed}}$ (Table 7.4.2)

AMR = $\dfrac{\text{Sales}}{\text{Total Assets}}$ (Table 7.4.3)

PM = $\dfrac{\text{Profit Before Tax}}{\text{Sales (Turnover)}}$ (Table 7.4.4)

The companies are classified into four broad divisions: Manufacturing (M), Construction (C), Mining (MN), and Services (S). The companies within each class are further identified as to whether their operations require high technologies (1) or average (or relatively low) technologies (2) (See Appendix 7.7.3).

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* B.G. Shah; "Ratios: Tools of Financial Analysis in Economic Development Institute Course Notes, SEM IX/3; International Bank for Reconstruction and Development 1977 pp3 - 30.

Table 7.4.1. Profits (in Thousands of Nigerian Naira)

	77	78	79	80
C2	416	(8076)	(6425)	-
M 1	700	(1302)	(72)	(3692)
M 2	4254	3480	2732	3968
MN 2	7570	5954	10462	10517
S 1	(8500)	(9353)	(13128)	(18340)
S 2	754	415	860	1763

*Government - Subsidised

Table 7.4.2 Return on Capital (i.e. ROI).

	77	78	79	80
C 2	0.008			
M 1	0.014	(0.028)	(0.010)	(0.061)
M 2	0.139	0.057	0.042	0.008
MN 2	0.156	0.064	0.056	0.043
S 1	-	-	-	-
S 2	-	-	-	-

Table 7.4.3. Assets Management Ratios (A M R)

	77	78	79	80
C 2	1.63	-	-	-
M 1	7.495	7.845	8.865	4.305
M 2	1.605	1.513	1.393	1.523
MN 2	0.831	0.690	0.715	-
S 1	-	-	-	-
S 2	-	-	-	-

Table 7.4.4. Profitability Margins.

	77	78	79	80	
C 2	0.9	(20.2)	(60.9)	-	
M 1	0.45	(1.1)	(0.25)	(2.4)	* Govern-
M 2	12.100	9.867	11.4	7.4	ment
MN 2	28.1	15.6	17.4	31.4	Subsidi-
S 1	(100.6)	(43.875)	(41.300)	(42.4)	sed
S 2	8.2	4.5	7.9	16.3	

For instance, Aba Textiles Mills Ltd is in the manufacturing sector using average technology for its operations - it is classified as M2; Nigeria External Telecommunications is a service producing industry employing very high technology - it is classified as S1. The percentage share of the Federal government in the industries is also shown in the Appendix.

The main interest here is a comparison of performances between the industrial sectors, particularly with regards to usage of high technology or low - level technology.

As revealed by the figures in Appendix 7.7.3. the data are generally so varying that it is difficult to observe any definite pattern from the turnovers. Generally in government - owned (or highly subsidised) industries, the performances are not used for monetary assessments because they are tertiary and are mainly to produce services. Very often (if not always) they don't make any profits. With the exception of one or two companies on either side, these subsidised companies are shown by the data to have done very badly by way of profits. Perhaps these appalling performances can be traced to effects of bureaucracy, and not just due to the service-producing objectives.

The average performances of the industries according to their sectors and technology usages are shown in Tables. 7.4.1 - 7.4.4 (developed from Appendices 7.7.1 to 7.7.3.

Table 7.4.1. suggests that the mining industry has had a "field-day". This is expected. The Table also suggests that the manufacturing industry is likely to be more profitable than the other industries, excluding the mining industry, followed by the private service - producing industry, i.e. distribution and service sector.

Within the manufacturing industry, however, the Table suggests that companies using average technologies appear to perform better than those using high level technology.

In Table 7.4.2. a Return on Investment (R O I) of say 0.079 means ₦1 of Investment has attracted a profit of ₦0.08. Similarly, in Table 7.4.3., an Asset Management Ratio (AMR) of say 1.51 means that ₦1 asset yields N1.51 turnover, i.e. it indicates how effectively the assets have been utilised.

Table 7.4.2. supports the observations made from Table 7.4.1., and indicates general low returns on investments (or Capital).

Table 7.4.3. however shows that the Asset Management Ratios are very high compared with their corresponding Returns on Investments from Table 7.4.2. These disparties can only be a consequence of high overheads. A typical example of such high overheads is the Nigerian Airways with an overhead of N300 million in 1980.

Since the Asset Management Ratios of the manufacturing industry are much higher than those in the mining industry but with corresponding low return on capital, the inference is that manufacturing appears to attract high overheads.

Similarly, it is observed in Table 7.4.4. that industries in the '2' class, (i.e. those using low technology) have higher productivity or profitability margins than those employing high technology.

Going back to the disparity between return - on - capital and asset management ratios, Table 7.4.2. and 7.4.3. indicate that although high technology industies have high asset management ratios, their corresponding return on investments are low compared with the low technology industries (as a matter of fact, the return on investments of high technology industries are negative over the period under study).

The literature supports the explanation that high asset management ratios with corresponding low return on investments are direct consequences of high overheads. The conclusion therefore is that high technology attracts higher overheads than low technology. There is also the observation that industries using low technology are likely to be more profitable than those employing high technologies.

In a way this may have to do with differences in costs of technologies, i.e. high technologies cost much more than low-level technologies and therefore their percentage of profit over Capital is likely to be lower than those of low-level technologies where the capital is much smaller. All the same, this explanation does not impair the usefulness/importance of the observations.

The key to industrial development in developing countries would therefore seem to be in using average technologies, rather than very high technologies.

7.5. Conclusion

In this chapter we have tried to substantiate a large range of issues that are frequently cited (but not proved) as barriers to technological innovation, in respect of management action or inaction. In doing so, we have focussed on the effects of past technologies on some industries by examining some measures of success of these industries, some of which are purely economic whilst others are related to technological growth. As said earlier, these measures mostly attest the efficiency of the working system of middle management in utilising technical and human resources to build virile organisations, with regards to technological innovation.

The results of the investigations have thus shown up why 'innovations had not taken place', or why the effects of technology had not been satisfactory in developing countries, considering the issue from the point of view of the practices of management (which in this case is mostly middle management).

Analysis of industrial performances has suggested these major issues, amongst other things that:

(i) There is underutilisation of resources in the industries of developing countries.

(ii) There are problems of internal managerial and operating systems, i.e. the internal working conditions are not conducive to high performance (this is reflected in the rapid increase in strikes and stoppages).

(iii) There had not been any expansion in the manufacturing industry. Since this is the sector of economy that had been able to develop some technology internally, its operation needs to be looked into, with a view to expanding it.

(iv) High technologies attract high overheads.

(v) The current training policies are likely to breed dissatisfaction in non-managers.

(vi) There are high management overheads in the industries.

(vii) There is a substantial management problem; i.e. those presently managing the technology do not possess adequate qualities of "good managers".

(viii) Companies using average technologies perform better economically than those using high level technology.

(ix) Technology grows with time.

(x) Technology is more likely to be managed successfully if the governments of both the transferee and the transferer are involved, i.e. joint ventures at governmental level are more desirable in developing countries.

7.6. Implications for Developing Countries.

Specifically, this study makes the following recommendations arising from the earlier conclusions, and other observations from the results:

1. Management of technology has so far been fairly successful with regards to internal transfer (i.e. from one institution to the other within the country). Most of these transfers are from the Manufacturing Sector. Those involved in the management of technology should therefore encourage the operations in that sector (*).
2. The study has indicated that joint ventures provide technological development for the transferee. This seems to contradict the earlier contention that joint ventures are not good for developing countries. But the findings here have been strengthened by the chi-square test which validates the hypothesis that

   > "the chances of successfully managing technology in developing countries vary according to the type of ownership".

   Specifically, the chances of success are higher when the governments of the transferee and the transferer are both involved (**).
3. Arising from these observations is the inference that if technological independence is the main aspirations of developing countries then management of technology should be undertaken through joint ventures, and efforts should be directed more to the Manufacturing Sector.

(*) In Section 7.2.1. it was observed that the sector had not generated enough demand for extra technicians. An increase in the operations of this sector would in itself generate more demand for technicians.

(**) The home government should increase its participation in establishing more technology - oriented industries by virtue of its resources. The Japanese experience is relevant here: After the initial impetus to import technology and establish more industries, the Japanese government left private companies to carry on the task of importing and managing new technologies in Japanese industries. (Oldman, 1967). The government, however, seemed to be aware of the need to create an indigenous Japanese scientific and technological capacity.

4. For both good management and technical developments, local trainings are more desirable. These trainings should generally be between 3 - 6 months. When occasions warrant, the local trainings could be supplemented by seminars and overseas attachments for more practical experiences. There is possibly a need to review the training system (e.g. methods, contents, and timing).

5. The study has shown that technology grows with time and, on the average, it requires about six years for its effect to be noticeable in terms of absorption or ability to demonstrate technical ingenuity. Managers of technology in developing countries should, therefore, learn to be patient and to grow technically with time. A rush to develop technically "overnight" is probably responsible for the major problems encountered in managing technology in developing countries.

6. It was shown that there is a fair chance to develop and transfer some form of technology in private firms operating with foreign partners. The least chances seem to be in indigenous industries and in subsidiaries of foreign companies. The most plausible reason for these situations is the amount of research and development done by the individual firms. Perhaps the solution to this would be in making R & D compulsory, both at the national level and at industrial level. As of now, only in private firms with foreign partners do you have some reasonable level of R & D.

7. The Biblical teaching holds here: "..... he that sows much shall reap much ......". Investments in training seem to yield good dividends in form of ability to develop and transfer technology. Firms should therefore be encouraged to spend more on training their staff by giving the firms more incentives, e.g. tax relief on training expenditure, especially in the manufacturing and construction sectors.

(Notably, Subsidiaries of foreign companies and those with some touch of foreign ownership are particularly guilty of giving very short trainings to their technical staff). At Present, about 79 percent (45/57) of the industries spend less than 5% of their revenue on training. About 44 percent actually spend less than 1 % of their revenues for this purpose. In most advanced countries with technological success, investments in training is about 6 - 10 per cent of the total revenue. The findings of this chapter have validated the proposition of positive relationship between technological success and training investments in Nigerian industrial settings. It is hoped that this would act as a booster and induce the industries to make higher training investments. The government again has a leading role to play in this case. The Western World's practice of regularly making large sums of money available for training is an example worth emulating.

8. The strong correlation between R & D and success with technology has been stressed quite positively. At present only the manufacturing sector seems to take any appreciable interest in R & D. If compulsory R & D won't work, perhaps the industries (particularly the other Sectors) can be induced into it, again through tax incentives on research bills.

9. A high percentage of the industries are in the Construction sector, possibly because of the huge contracts given by the various governments (States and Federal) as a result of the oil boom. A very high proportion of the foreign firms are in the construction and distribution services. One is not arguing that these sectors are not important for national development, but general industrialisation is a shorter and more positive route to this goal (e.g. via manufacturing). Foreign firms should therefore be encouraged to invest in other sectors, (e.g. manufactures) other than construction and distribution services.

10. While one is not against University education in developing Countries, it would appear as if what is needed is professional trainings at Trade Centres and Polytechnics. For one reason, those with these trainings tend to stay longer on their jobs. For another reason (as shown under "assessment by local technicians") they tend to have the willingness to be critical of current performance, and if this quality is accepted as the first step towards improvement, then this group is likely to contribute more to technological improvements. Perhaps the educational curricula ought to be examined in line with those of the old Trade Centres. The employment policies which favour academic qualifications also need reviewing.

11. Those who have the ultimate responsibilities of managing technology in developing countries should not be less than 30 years (preferably, they should be between 30 - 44 years old), and should be professionally capable of providing good technical leadership.

12. As for the foreign experts, they should either be appointed on consultancy basis, (whereby they would have no direct control over the promotions of the local technicians). Alternatively, they could be allowed direct participating employment but in fewer numbers, making sure that they can share their practical technical experience with other technical employees.

13. Since there are evidences that industries employing low technology perform better economically than those using high technology, and that high technology attracts high overheads, the key to industrial improvement would seem to be in using average technology, rather than very high technology. For another reason, the local technicians would be more capable of understanding the working of an average technology, and be able to apply and maintain it.

Appendix 7.7.1.

in '000s of ₦ (₦1 = £0.79)		Annual TURNOVER				PROFIT Before Tax				
Name of Company	Group	1977	78	79	80	77	78	79	80	Fed.Govt. % Share
Aba Textiles Mills Ltd.	M 2	5407	9225	10479	10244	1233	1320	2139	986	70
Flour Mills Ltd.	M 2	122425	128924	127004	147037	12772	14511	11755	13227	12
Dunlop Industries Ltd.	M 2	40690	45675	45373	51138	1248	1805	2051	1817	33
Nigerian Sugar Co. Bacita	M 2	11717	8491	8868	10006	1763	(3716)	(5016)	(158)	19
Road Construction of Nigeria	C 2	46583	40021	10549	-	416	(8076)	(6425)	-	60
Peugeot Automobile of Nigeria	M1	214754	166648	228706	374943	1047	869	1989	(1522)	35
Volkswagen of Nigeria	M 1	94912	128827	155922	113485	352	(3473)	(2132)	(5862)	35
West African Portland Cement, Ewekoro	MN2	29577	51607	74760	25434	7902	9252	18600	10517	16.6
Nigerian Cement Factory Nkalagu	MN2	24525	19911	23402	-	7238	2655	2324	-	10.72
Nigerian External Telecomm.	S 1	22033	33286	26630	31748	6913	8512	8618	7372	100
Nigerian Airways Ltd.	S 1	58279	84836	111433	126887	2878	(221)	(2893)	(17704)	100
Nigerian Railways	S 1	28195	30216	35735	43541	(43436)	(44468)	(57001)	(62380)	100
National Shrimpo Nig. Ltd.	S 1	123	2302	224	1826	(352)	(1235)	(1235)	(648)	51
Tourist Co.	S 2	7648	9809	10908	10838	1002	920	860	1763	100
British American Insurance	S 2	18826	23002	28121	-	506	(90)	0	-	49

Appendix 7.7.2.

(in '000s Of N)

Name of Co.	Total Capital Employed 1977	1978	79	80	Total Assets during the year 77	78	79	80	Return of Capital or ROI (Profit/Capital 77	78	79	80	Assets Mgt. Ratio or Assets Turnover (Turnover/Assets) 77	78	79	80	Gro-up
Aba Textile Mills Ltd.	16250	16243	16243	16243	7162	7076	6933	6562	0.07	60.08	10.13	20.06	10.76	1.30	1.51	1.56	M2
Flour Mills	37111	53244	53235	57000	25970	41241	42715	44670	0.34	40.27	30.22	10.23	23.30	2.42	2.39	2.58	M2
Dunlop Industries Ltd	35285	38883	42462	43101	23719	24257	37378	36969	0.03	50.04	60.04	80.04	21.72	1.88	1.21	1.38	M2
Nig. Sugar Co. Bacita	18855	21641	21667	16312	18326	19007	19280	17612	0.09	30.17	20.23	20.01	00.64	0.45	0.46	0.57	M2
Road Construction of Nigeria	50639	-	-	-	28549	-	-	-	0.00	8 -	-	-	1.63	-	-	-	C2
Peugeot Automobile of Nigeria	46965	84873	123524	127944	26168	36792	47174	53772	0.02	20.01	20.01	60.01	28.21	4.53	4.85	2.11	M1
Volkswagen of Nig.Ltd	57995	52189	61189	53422	13992	11544	12108	17472	0.00	60.06	70.03	50.11	06.78	11.16	12.88	6.50	M1
West African Portland Cement Ewekoro	190519	232205	383200	247032	147649	159181	158896	164862	0.04	10.04	00.04	90.04	30.20	0.32	0.47	0.15	MN2
Nig. Cement Factory Nkalagu	26691	30255	33841	35883	16819	18722	24319	23028	0.27	10.08	80.06	9 -	1.46	1.06	0.96	-	MN2
Nig. External Telec.																	S1
Nig. Airways Ltd.	171322	255313			51024	64858			0.01	70.00	1		1.14	1.31			S1
Nigerian Railways																	S1
National Shrimpo Nig. Ltd.																	S1
Tourist Co.	25015	27256	27440		23324	24541	24595	-	0.04	00.03	40.03	1 -	0.32	0.40	0.44	-	S2
British American Insurance																	S2

Appendix 7.7.3.

Productivity (or Profitability) Margin of Nigerian Companies.

Productivity Margin (i.e. Profit/Turnover) % / Name of Company	1977	78	79	80	Group	Group average over the 4 years.
Aba Textile Mills Ltd.	22.8	14.3	20.4	9.6	M 2	
Flour Mills Ltd.	10.4	11.3	9.3	9.0	M 2	
Dunlop Industries Ltd.	3.1	4.0	4.5	3.6	M 2	10.19
Nigerian Sugar Co., Bacita	15.1	(43.8)	(56.6)	(1.6)	M 2	2.21
Road Construction of Nigeria	0.9	(20.2)	(60.9)	-	C 2	
Peugeot Automibile of Nigeria	0.5	0.5	0.9	(0.4)	M 1	
Volkswagon of Nigerian Ltd.	0.4	(2.7)	(1.4)	(5.2)	M 1	0.93
West African Portland Cement Ewekoro	26.7	17.9	24.9	41.4	MN2	
Nigerian Cement Factory Nkalagu	29.5	13.3	9.9	-	MN2	23.37
Nigerian External Telecommunication	31.4	25.6	32.4	23.2	S 1	
Nigerian Airways Ltd	4.9	(0.3)	(2.6)	(14.0)	S 1	12.58
Nigerian Railways	(154.1)	(147.2)	(159.5)	(143.3)	S 2*	
National Shrimpco Nig. Ltd.	(284.6)	(53.6)	(551.3)	(35.5)	S 1*	
Tourist Co.	13.1	9.4	7.9	16.3	S 2	
British American Insurance	2.7	(0.4)	0.0	-	S 2	7.00

Chapter VIII

Study of Acquisition of Innovation in Developed Countries

8. Study of Acquisition of Innovation in Developed Countries

8.1. Introduction

Previous work suggest that problems of Technology Transfer in U.K. and Nigeria may be grouped as in Table 8.1.1. The incidence of management and Managerial problems are similar in developed and developing countries. The incidence of Technological know-how problems are also similar. Problems of Capital are also similar and surprisingly are of less importance in both developed and developing countries.

But Market factors and societal problems have very different incidence. If, however, Market factors, Capital and Societal factors are grouped into a single "Environmental" factor then the results of previous work indicate that the problems affecting successful transfer in the U.K. and Nigeria are surprisingly similar See Table 8.1.2.

Clearly the "environmental" problems are very different in developed and developing countries; these socio-cultural problems would demand different actions for solutions. We shall therefore not attempt to see how problems of environment are solved in developed countries. This piece of study will, instead, concentrate on how management problems and problems of physical technology and technological know-how are tackled in developed countries.

To this end, a questionnaire was designed to gather useful information about management's choice of methods of acquiring technology and the factors that affect their preference of methods. The questionnaire was administered on 14 selected U.K. companies, so that the information gathered can be compared or contrasted with the procedures of Chapter V.

8.2. Methodology - Explaining the Questionnaire

The questionnaires were administered personally on managers of technology (or those who had been highly involved in technology usage). The face-to-face comments of the respondents went a long way to supplement their responses to the questions in the questionnaires.

The questionnaire is divided into 5 sections:

Difficulties of Technology Transfer as Seen by U.K. (Transferer) and Nigerian (Transferee)

Table 8.1.1.

Type of Problems	Developed Countries (Transferer)		Developing Countries (Transferee)	
	As a percentage of total	Ranking	As a percentage	Ranking
Management (Managerial)	29.7	1	28.0	2
Market Factors	28.3	2	12.1	4
Capital	9.0	4	5.6	5
Te-chnology and its Know-How	27.5	3	21.1	3
Societal	5.5	5	33.2	1

Table 8.1.2.

Type of Problems	Developed Countries		Developing Countries	
	As a percentage of total	Ranking	As a percentage of total	Ranking
Management	29.7	2	28.0	2
Technology	27.5	3	21.1	3
Environment	42.8	1	50.9	1

A. Methods of acquiring technology, stating

   (i) which methods are preferred by the firm

   (ii) which methods are commonly (mostly) used, and

   (iii) which methods are preferred by the respondents personally.

B. Factors that affect preference of methods- these factors will be appreciated by developing countries in developing their policies on acquisition of technology.

C. This section looks into how U.K. firms (and other European firms) view

   (i) the duties of operative or midle management in relation to technological innovation.

   (ii) focus of technological development (bearing Chapter II in mind)

   (iii) degree of importance attached to research and development.

   (iv) the focus of company objectives

   (v) the orientation of innovations and

   (vi) ways and means of co-ordinating activities involved in innovative processes.

D. Training factors:- how much is invested in training technical personnel, the length of training, the type of training, location and timing; and what sort of trainers are involved in these trainings.

E. This last section examines the operative arangements in terms of percentage of personnel involved in production to total staff, and the ratio of managers to production staff; and the last part assesses the firms as to their hierarchical placings in innovation and their respective successes in the field.

8.3.0 Results and Observations

As expected from exercises of this nature, responses were not obtained to some of the items on the questionnaire because the respondents felt such items of information were 'confidential' to the firms, and in some cases, because the repondents were not prepared to offer their personal views for fear of 'contradicting the company policies openly'. However, a fair deal of information was obtained from a fairly wide spectrum of industries, ranging from phamaceuticals through canning industries to heavy engineering firms and telecommunications. See Table 8.3.1. and Table 8.3.2.

(i) Co.	(ii) Type of Company	(iii) Scale of Technology Employed	(iv) Priorities	(v) Methods Actually Used	(vi) Method(s) preferred by Co.	(vii) Personal Preference of Respondent	(viii) Respondent(s)	(ix) Profile of Respondent	(x) Very Outstanding Factors for differences between (v) and (vi)
(i)	Pharmaceutical	High	1st	4	2	1	Production Manager	Chemist	Inadequate research facilities; cost of research and inadequate trained staff
			2nd	3	1	2			
			3rd	2	6	6			
(ii)	Boiler Manufactures	High	1st	2	2	2	(a) Managing Director	Engineer (with Sales & Marketing)	The Co. believes in research thru Universities but lacks the funds to back its desires
			2nd	4	1	1	(b) Marketing Director	Long Service	
			3rd	5	6	4	(c) Chief Engineer	Physicist	
(iii)	Computer Manufacturer	High	1st	2	2	2	(a) Production Mgr.	Engineer	Take-over bids or interests so as to be perpetual pace-setter. ←* Factor for difference between (vi) and (vii)
			2nd	1	1	1	(b) Chief Systems Co-ordinator	Electronics	
			3rd	6	6	5			
(iv)	Communications (Electronics)	High	1st	2	2	2	(a) Deputy M.D	Physicist	
			2nd	1	1	1			
			3rd	6	6	6	(b) Production Mgr.	Engineer	
(v)	Steel Industry	High	1st	2	1	2	(a) Deputy Director (Engineering)	Chemical Engineer	
			2nd	1	2	1			
			3rd	6	6	6	(b) Production Mgr	Chemical Engineer	
(vi)	Pharmaceutical	Medium	1st	4	2	2	Production Mgr	Chemist	
			2nd	3	3	1			
			3rd	2	4	6			
(vii)	Chemical Engineering	Medium	1st	4	2	1	Works Manager	Chemical Engineer	Limited Own Research
			2nd	3	1	2			
			3rd	2	6	6			
(viii)	Canning Industry	Medium	1st	2	-	-	Works Manager	Production Engineer	
			2nd	3	-	-			
			3rd	5	-	-			
(ix)	Glass Industry	Medium	1st	2	1	-	(a) Deputy Managing Director	Marketing	Lack of funds, and time factor
			2nd	4	2	-			
			3rd	1	5	-	(b) Works Manager	Chemical Engineer	
(x)	Electrical Manufacturer	Medium	1st	2	-	-	Managing Director	Physicist	
			2nd	3	-	-			
			3rd	1	-	-			
(xi)	Components Integration	Medium	1st	2	-	-	Production Mgr.	Physicist	
			2nd	1	-	-			
			3rd	4	-	-			
(xii)	Foundry	Medium	1st	2	-	-	Chief Engineer	Engineer	
			2nd	6	-	-			
			3rd	3	-	-			
(xiii)	Steel & Metal Works	Low	1st	3	3	3	Managing Director	Marketing	
			2nd	-	-	-			
			3rd	-	-	-			
(xiv)	Prototype Engineering	Low	1st	3	2	6	(a) Chief Engineer	Engineer/Bus. Admin.	Time factor for development, easier to copy from others and innovate on their products.
			2nd	2	5	2			
			3rd	6	6	5	(b) Production Mgr.	Physics engineering	

KEY:

Methods

1. By Own Research
2. In-house development
3. Importing other people's machinery i.e. Turnkey
4. By Know-how license or Patent Agreement
5. Cooperative programme with external manufacturers
6. By flow of books, journals, etc.

Table 8-3.1. Analysis of Methods of Acquiring Technology

Co.	Assessment of Innovation	Organisational Success	Percentage of technical personnel to total staff.	Ratio of Managers to operatives	Focus of Technology Development: Product as a Unit	Stages of Product	Rate of Innovation	Individual Personnel	The Department	Organisation at a Unit	Orientation of Technological Innovation: Improved Techniques	Physical Results	Human Relations	Coordination of Innovation falls on: Individual Deptal Managers	Heads of Processes	The Planning Dept	Others e.g. Development Committee	Investment in Training: Financial	Length of Training	Training by Company Instructors	Timing of Trainings: Pre Installation	In parallel with Installation	Post-Installation
(i)	3	3	3	2	1	3	1	ϕ	2	3^{o}	3	3	1^{n}	2	3^{P}	3	ϕ	2	2	2	1	3	2
(ii)	3	3	3	3	3^{TE}	3	2	1	1	1	3	3	2	ϕ	ϕ	2^{m}	3^{C}	2	2	2	1	3	3*
(iii)	3	3	3	2	3^{TE}	3	3^{L}	1	1	1	3	3		1	1	3	ϕ	3	3	3	1	3	2
(iv)	4	4	4	3	1	3	3	1	1	1	3	3		2	ϕ	3	ϕ	3	3	–			
(v)	3	3	3	2	1	3				3^{o}	3	3	2	3^{T}	3^{P}	3	ϕ	–	–	3	3*	2	1
(vi)	2	3	1	2	2	2	1	1	2	2	3	3	1	3	2	1	ϕ	1	1	1	2**	2	1
(vii)	3	3	3	3	3	2					3	3											
(viii)	3	4	3	3	3	3	3^{S}			2	3	3	ϕ					–	–	2	–	2	–
(ix)	3	3	3	3	3	3	2	1	1	1	3	3	1		3								
(x)	3	3	4	3	3	3	3^{L}				3	3	3^{A}										
(xi)	4	4	4	4	3^{D}	3					3	3			3^{H}								
(xii)	3	3	4	3	3	3					3	3	2^{A}				3^{I}	3	3	2	1	3	1
(xiii)	1	1	4	2	3^{F}	3	1	1	1	3^{o}	2	3	2^{A}	3	$ϕ^{E}$	1		1	1	2	–	2	2
(xiv)	3	3	4	1	3	3	1	1	1	1	2	3	2^{A}	ϕ	3	1	ϕ	3	2	2	–	2	–

KEY:

Assessment of Innovation	Organisational Success	Percentage of technical personnel	Ratio of Managers to operatives	Focus / Orientation / Coordination	Investment in Training	Timing of Trainings
4 - Pace-Setter 3 - Leader 2 - Follower 1 - Floppy	4 - V. Successful 3 - Successful 2 - Average 1 - Floppy	4 - Very High 3 - High 2 - Low 1 - Very Low	4 - Very Low 3 - Low 2 - High 1 - Very High	3 - Very Import 2 - Important 1 - Not Important ϕ - Not Considered	4 - Very High/Long (Over 15%) 3 - High/Long (6-15%) 2 - Low/Short (1-5%) 1 - Very Low/Short (Less than 1%)	3 - Highly Used 2 - Averagely Used 1 - Seldomly Used

C - development Committee
m - principally marketing dept
s - to improve qualities and satisfy customers
A - afraid of industrial actions
D - believes in diversification
n - no strikes or stoppages for the past 10 yrs.
o - believes that a healthy organisation would lead to good production
L - to maintain its lead in new products
I - control rests on one individual (the dir of Coordinator) N.B. It is a small company
T - Consortium of Control Team.
P - To do paperwork and overall supervision
H - a hierarchical sort of arrangements
F - the main focus
E - Doesnt exist
TE - There is a Testing dept to integrate the different components
P - the operation of the Co. (Pharmaceu) demands that each process is right, hence heads of processes are responsible for coordination

Time factor is always an importan consideration

* Wanted experienced personnel

** A copy-cat compan

Table 8.3.2: Analysis of How U.K. Companies Organise for Technological Innovation

The resulting data could be analysed in so many different ways, but we have chosen to group the 14 firms into three categories, viz,

(a) those involved in high technology in terms of investments in technology and the complexities of operations

(b) those using medium technology, and

(c) relatively small companies using low technology in their operations.

These results and observaions will be discussed on a general basis and then in details for specific firms.

8.3.1. Methods of Acquiring Technology

8.3.1.1. Actual Usage

Referring to Table 8.3.3. it shows that in-house development of ideas obtained from outside seems to be the most popular method in the U.K. It would appear to be that most of the basic researches are done in the universities and other research institutions. Table 8.3.1 shows that in all firms using high or medium technology, it is only in the two pharmaceutical firms and one other chemical engineering company that in-house development is not the top method used. Firms in the U.K. largely do not practice 'turnkey' acquisition; those that import foreign machines mostly use these machines to manufacture their own products and these are if, and only if, they are 'compelled' to obtain such machines from outside. This method of acquiring technology seems to be favoured mostly by companies using medium or low-level technology. See Table 8.3.1.

Acquisition of 'foreign' technology by know-how licensing and/or patent agreements is fairly popular, possibly because it ensures good advice from the author(s), and secondly because it is time-saving. This is the method mostly favoured by pharmaceutical industries and other firms which are highly involved in some form of chemistry. Still referring to Table 8.3.3., it appears that U.K. firms do not primarily acquire their technology through own research. Those that are subsidiaries of larger firms depend on their parent companies for their research and

Table. 8.3.3. <u>Comparison of Methods of Acquiring Technology (Actual Usage)</u>

Acquisition Methods	No. that made it 1st Choice	No. that made it 2nd Choice	No. that made it 3rd Choice	Rank<3rd or No Reply
By Own Research	-	4	2	8
In-house development of ideas obtained from outside	9	1	3	1
Importing other people's machinery (i.e. TurnKey)	2	5	1	6
By Know-how license or patent agreements	3	2	1	8
Co-operative programme - external manufacturers	-	-	2	12
By flow of books, journals, etc	-	1	4	9

development. This is not to say that U.K. firms do not do their own research at all. What we are saying is that some constraining factors seem to have relegated this method of acquiring technology to some lower position than first or second place.

Acquisition by flow of books and journals are not very popular throughout the spectrum of the 14 industries; this is probably because although it allows exchange of information, ideas obtained from such sources are too scanty to be developed with minimum resources, particularly time. Co-operative programmes between industries are far-fetched and when they occur, are mainly through mergers.

8.3.1.2. Company Preference

From Table 8.3.4. the observation is that most firms prefer to acquire their technology by in-house development of ideas obtained from outside. Except in one steel industry, companies using high technology would prefer to obtain ideas from outside and develop them, as opposed to the one steel industry which would prefer to do its own basic research. Similarly, in industries using medium technology, only a glass industry would prefer to do its own research instead of developing other people's ideas in-house: the reason for this is that the company wants to be a leader amongst the glass industries.

Acquisition by own basic research would appeal to many firms if the facilities and resources were available. Although it was observed from Table 8.3.3. that U.K. firms largely do not acquire their technology through books and journals, Table 8.3.4. suggests that a lot more of the firms would have preferred to use this method if the information were detailed enough. This method of acquiring technology is similar to in-house development.

If U.K. firms have the choice, they will not import other people's technology on turnkey basis, nor acquire through licensing or patent agreements; co-operative programmes with other manufacturer's do not seem to gain much respect either, except with the intentions of taking over such companies.

Table 8.3.4. <u>Comparison of Methods of Acquiring Technology (Company Preference)</u>

Acquisition Methods	No.that made it 1st Choice	No.that made it 2nd Choice	No.that made it 3rd Choice	RAnk < 3rd or No Reply
By Own Research	2	5	-	7
In-house development of ideas obtained from outside	7	2	1	4
Importing other people's machinery (i.e. TurnKey)	1	1	-	12
By Know-how license or patent agreements	-	-	1	13
Co-operative programme - external manufacturers	-	1	1	12
By flow of books, journals, etc	-	-	6	8

8.3.1.3. <u>Personal Preference of Respondents</u>

The respondents were highly placed personnel (in their respective industries) who have been involved in the management of their industrial technology. Responses were scanty in industries using medium and low technology, for reasons stated in Section 8.3.0.

However, Table 8.3.1 shows that there are no major differences between methods preferred by companies and the personal preferences of the respondents, except for some ordering of preferences. In the computer manufacturing company where the third personal preference of the respondents is by co-operative programme as opposed to flow of books and journals desired by the company, the difference is due to the interests of the respondents in take-over bids so that the company can be a perpetual pace-setter in computer industry. In the pharmaceutical company where the methods preferred by the company differ from the personal preferences of the Production Manager, the differences reflect the background and interest of the Manager who is a Chemist and would like to be involved in more research and exchange of ideas and findings through books and journals.

The inference from these observations is that highly placed personnel seem to be able to have their personal technological interests adopted by their respective industries. Perhaps, there would have been more differences between company-preferred methods and personal preferences if the respondents had been drawn from lower the ladder. A fair deduction from this might be that the <u>choice of methods of acquiring technology in U.K. companies rests solely with top management</u>.

8.3.1.4. <u>Differences between Methods preferred by Companies and Methods Actually Used.</u>

As would be observed from Tables 8.3.1. to 8.3.4, there are differences between actual methods used in acquiring technology in the U.K. and the methods the firms would have preferred to employ. Table 8.3.5. shows in general how certain factors affect company preference of methods of acquiring technology, while Table 8.3.1. shows which of these factors force these differences in specific firms.

Table 8.3.5. The Top Eleven (11) Factors which affect preference of methods of acquiring technology

FACTORS	Very Important	Important	Not Important	Not Considered	No Reply
Overall Cost	14	-	-	-	-
Availability of enough development staff	8	2	4	-	-
Overall Time	10	-	3	-	1
Method guarantees the use of market research findings	4	3	1	1	6
Ready stock of trained specialists for the work	7	2	4	1	-
Availability of recruited personnel to handle operation	3	4	2	-	5
Availability of Own Research	3	3	-	1	7
Problems of training	7	4	2	-	1
Difficulty in co-ordinating innovation ideas and efforts	3	1	2	8	-
Non-availability of development staff	3	-	1	-	8
Good control over the operations	3	-	-	9	2

Table 8.3.6.1.

Methods Preferred	Methods Actually Used.					
	1	2	3	4	5	6
1		✓✓				
2		✓✓✓	✓	✓✓✓		
3			✓			
4						
5						
6						

Methods of Acquiring Technology: First Preference Against Top Usage by the Companies.

Table 8.3.6.1. is extracted from Table 8.3.1. and it shows how the first preferred methods relate to the methods mostly used by the companies. Going by the first choices, what seems to be happening is that some firms would prefer to do own research and development but for lack of funds to prosecute such ventures they tend to 'settle' for in-house development of ideas obtained from outside. Most firms seem content with letting other people bother with basic research while they develop these ideas in-house. Where there are no sufficient ideas to be developed in-house, they tend to supplement their technology acquisition largely through licensing and, to a lesser degree, by importing other people's machinery (i.e. turnkey). Companies using medium technology seem to exhibit more differences between actual and preferred methods than high-technology or low-technology industries (going by first choices) Going by second choices, the picture is illustrated by Table 8.3.6.2. The picture that emerges is that many companies would prefer to do their own basic research if the resources were available. Some companies in the high-technology group have managed to implement their desire for own research, while others (distributed fairly evenly over the three categories) have to acquire their technology by turnkey and licensing.

Table 8.3.6.2.

2nd Best Method Preferred	2nd Best Methods Actually Used					
	1	2	3	4	5	6
1	✓✓		✓✓	✓		
2	✓			✓		
3			✓			
4						
5		✓				
6						

Table 8.3.6.3.

3rd Best Method Preferred	3rd Best Methods Actually Used					
	1	2	3	4	5	6
1						
2						
3						
4		✓				
5	✓					
6		✓✓			✓	✓✓✓✓

Going by third choices, Table 8.3.6.3. shows that in the absence of own research and/or in-house development, many U.K. companies would want to acquire their technology through exchange of information in books and journals. Some actually adopt this method (notably the high-technology companies), while a few (scattered over the three categories) seemed to have succeeded in developing, in-house, ideas from other sources.

Summarising, it would seem that high-technology industries in U.K. have succeeded more than the other two groups, in actually adopting the methods that they prefer to use. In general, however, the observation is that some constraining factors do force industries to adopt methods of acquiring technology other than those they would have preferred to use. Amongst these constraining factors are cost, non-availability of recruited personnel to handle operations and inadequate research facilities. Other constraining factors include (as shown in Tables 8.3.1. and 8.3.5.) guarantee of the use of market research findings, cost and time of training personnel, difficulty in co-ordinating the large variety of innovative activities and ability to control the operations.

8.3.2. Organising for Innovation

Earlier work has suggested that innovation is not just one simple act; rather it involves related creative activity in the areas of discovering new phenomenon, invention, developing a new product or a manufacturing process, creating new capital and consumer markets and developing a virile organisation to achieve these. This section therefore attempts to see how firms in developed countries (principally, U.K.) organise their activities towards successful innovative processes. The tool for gathering the information was the questionnaire administered on the firms (See Section 8.2).

8.3.2.1. Focus of Technology Development

From Tables 8.3.2 and 8.3.7.1., it is observed that consderable attention is focused on ensuring that technological innovation is broken into autonomous stages, and that each stage is properly or successfully prosecuted. It is only in the medium-technology group that two isolated companies (one pharmaceutical and one chemical engineering) do not seem to pay as much attention, as the others, to the individual stages of their processes. The general belief of U.K. firms is that if each stage is got right, then the chances of success of the whole project are high.

TABLE 8.3.7.1. Company's Outlook of Technological Innovations

	Very Important	Important	Not Important	Not Considered	No Reply
Manager's function as perceived by the Company					
Initiate Programmes	-	-	4	8	2
Direct the people	10	4	-	-	-
Control Operations	14	-	-	-	-
Contribute ideas	-	1	8	5	-
Others	-	-	-	14	-
The Focus of technology					
The process as a unit	10	1	3	-	-
Stages of project or product	12	2	-	-	-
Rate of Innovation	4	2	4	-	4
Individual personnel	-	-	7	1	6
The departments	-	2	6	-	6
Organisation as a unit	3	2	5	-	4
Objectives of research and development					
Repairs (correcting operational defficiencies)	7	1	5	1	-
Short-Term improvments	6	5	2	1	-
Long-Term Benefits	6	1	4	3	-
The Objectives of the Company					
To make money (i.e. profits)	11	3	-	-	-
To provide services	3	6	3	2	-
To develop new products (innovations)	11	1	2	-	-
To provide employments	-	1	2	8	3

Orientation of technological innovations					
Towards Improved Techniques	10	2	-	-	-
" Physical Results	14	-	-	-	-
" Humanm Relations	1	5	3	1	4
" Others (Specify)	-	-	-	-	14
Co-ordination of innovative process as the responsibility of					
Individual departmental Managers	3*	2	1	2	6
Heads of Processes	5	1	1	3	4
The planning department	3	1	3	1	6
Others (e.g. Development Committee)	2*	-	-	6	6

* They form Development Committee

In addition to ensuring the success of the individual stages, the firms also strive to co-ordinate the various activities so that the process as a whole is successful. In the boiler and computer manaufacturing firms co-ordination of the various stages is the responsibility of the Testing Departments; the department integrates the different components of the process. In the Steel and Metal Works firm, the success of the final output is the main concern and therefore much effort is geared towards that.

Although in general, the firms would want to innovate, the observation is that the main focus is not necessarily how rapidly they can come up with new products; they seem satisfied if they can "Keep the customer satisfied". However, some firms, notably in the electronics industry want to be in the fore-front, and therefore direct major attention towards rate of innovation.

Generally, the focus of U.K. industries is not on the organisation as a unit, although some (about 37%) believe that if the organisation is 'healthy' then production will be high. These firms therefore direct a lot of energy towards ensuring a virile organisation. Such firms are fairly distributed over the generality of the industries.

It will be observed that the boiler and the computer manufacturing firms are very similar in their focus of technology development, and the pharmaceutical firms have very differnet bearings from the generality of the industries, and even from one another. The explanation lies in the fact that one is multinational while the other is a subsidiary of a U.S. company, as opposed to other (mostly) nationalised and private companies (See Table 8.3.2).

8.3.2.2 Orientation of Technological Innovation

Tables 8.3.2. and 8.3.7.1. show that all the companies, except the low-technology one, aim their technological innovation at achieving improved techniques for their operations. The two exceptions to this general observation are merely interested in their final outputs and bother very little about modernising their techniques. As was observed from the detailed questionnaires (but not observable from either of the tables) the main objective of these two companies is to make money.

As expected, all the firms are interested in good physical results from their operations.

Responses to 'human relations' showed that although this does not take top priority, it certainly agitates the mind of some industries. About 60 per cent of those that responded to this issue aim at incorporating industrial relations into their programmes for innovation, so as to avoid disruption of processes due to strikes and stoppages. It would appear to be that the chances of strikes and stoppages taking place are higher in low-technology industries.

8.3.2.3. Co-ordination of Activities of Innovation

The tables indicate that high-technology industries co-ordinate their activities strictly by having a planning department (in the boiler industry, it is a marketing department), supplementing the efforts of the planning department with meetings of heads of processes where the paperwork is done. Medium and low-technology industries seem to favour having their activities co-ordinated by heads of processes and by individual departmental managers in that order. The explanation for these situations is that the operations of high-technology industries are much too complex to be handled by 'part-timers', hence the creation of full-time planning departments. On the other hand, the operations of the medium and low-technology industries do not require a full-time department, but can be handled by heads of departments or heads of processes, individually or collectively. In some cases a consortium of control teams or development committee is formed for purposes of co-ordinating the innovative activities.

Lessons for developing countries.

Summarising, although there are slight variations here and there, the following general observations are made:

(i) For successful innovation, processes are decomposed into autonomous stages, ensuring that each stage is successfully executed. In addition, attention is paid to the integration of the different stages of the processes to produce a good final output.

(ii) Generally, there is no mad rush for new inventions except for those who want to be perpetual pace-setters. Rather, effort is made at consolidating and improving on current techniques and products "to satisfy the customer".

(iii) Although the industries strive to maintain virile organisations, technoogical innovation is not designed around the organisation, rather it is aimed at producing improved techniques for improved products.

(iv) Industrial unrest is "arrested" by incorporating human relations in innovative programmes.

(v) There are different ways of co-ordinating innovative activities,

(v) There are different ways of co-ordinating innovative activities, but the most popular methods seem to be, having a planning department that integrates the various activities, and forming a consortium of heads of departments and/or heads of individual processes.

8.3.2.4. Training Programmes

From Tables 8.3.2. and 8.4.7.2. it is observed that industries with high technology invest a fair amount of their turnover in training technical personnel involved in production, (some spend between 1-5%, others between 6-15%). Only two isolated companies (one each from the other categories of firms) do not invest that much in their training programmes. In general, about 50% of the respondents spend 6-15% of their investments on training. So, in total, 75 per cent of the respondents spend at least one per cent of their turnover on training their technical personnel.

Similarly, it appears that only industries in high-technology can afford to give trainings lasting 6-12 months to their technical personnel. Others give trainings ranging from 3 to 6 months.

Surprisingly, although training is widely given, using their own company instructors, this method does not occupy the first place in the minds of at least 86 per cent of the respondents. It would appear that the industries favour employing august lecturers (e.g personnel with technical know-how from other firms or the Universities) to teach the company instructors who in turn pass the knowledge and/or know-how to the technical personnel, mostly on-the-job; this is more common in high-technology industries. Perhaps, this is ajudged the 'best' way of complementing their in-house expertise. Authors of particular technologies are seldom invited as technical trainers. There are few occasions when technical personnel receive some training outside the organisation, but such training is restricted mainly to within the U.K. i.e. foreign training is very seldom undertaken.

Trainings appear to be geared more towards day-to-day operations and short-term improvements than long-term benefits. Most firms favour giving on-the-job trainings i.e. in parallel with 'installation' of the technology. There is an isolated case of the steel industry where pre-installation trainings are favoured. The explanation for this is that the industry is happier to entrust its operations to "experienced men". Similarly, the boiler company is the odd-one out that highly favours post-installation trainings. It is the industry that seems to be too concerned about time factor.

Table 8.4.7.2. Training Factors

	Very Considerable	Considerable	Not Considerable	minimal	No Reply
Investments in Training	-	4	2	2	6
Usual length of Training	-	3	3	2	6
Types of Trainings					
Training for day-to-day operations	-	5	3	-	6
Trainings for short-term improvements	-	4	4	-	6
Trainings for long-term plans	-	-	4	4	6
Timing of Trainings					
Pre-installation	-	1	-	6	6
In parallel with installation	-	5	3	-	6
Post installation	-	1	2	2	6
Types of Trainers					
August lecturers (from other firms, Universities, etc)	-	4	2	2	6
Manufacturers of particular technology	-	-	2	6	6
Company training instructors	-	2	6	1	5
Training Locations					
On-the-job trainings	-	5	3	-	6
Outside trainings (local, i.e. within the country)	-	1	2	2	9
Foreign trainings (i.e. abroad)	-	1	-	1	12

8.3.3. Operative Arrangements and Assessment of Innovation

From Tables 8.4.3. and 8.4.7.3. it is observed that the percentage of production personnel to total staff in technology oriented firms in the U.K. are very high. About half of the respondents engage over 50% of their staff in Technical Production, while the other half of the respondents engage between 26-50% of their total staff in similar positions. The strength of technical personnel to total staff is hardly ever less than 25% in any of the companies.

The ratio of managers to operatives in most U.K. companies seem to be between 1:20 and 1:50. Differences in the ratios are largely due to the type of operations the firms are engaged in. For instance, in Pharmaceutical Companies the ratio appears to be about 1:20 mostly, while in engineering companies the ratio is much smaller, i.e. in the order of about 1:50.

Most of the companies studied in this aspect of the research are 'leaders' in the hierarchy of innovative processes. A few of them are even pace-setters and almost all of them are successful or very successful in the field of innovation. (from Table 8.3.2.). Generally, it can be said that the industries are successful in terms of organisation and innovation. However, there are two or three firms on either side of such a broad assessment: the communication (electronics) firm, the canning industry and the component-integrating company are seen as very successful: the pharmaceutical company (with medium technology) and the steel and metal works are seen as not very successful and floppy, respectively. In addition to the general observations already made, the following specific observations are made about these individual firms:

The Communication (Electronis) firm.

The firm is assessed as a pace-setter in innovation and very successful as an organisation. Its percentage of technical personnel to total staff is very high (over 50%) and the ratio of managers to operatives is low (1:50). It pays more attention to individual success of innovative stages than to the project as a whole. It believes in rapid rate of innovating its techniques of operation as well as the products. Co-ordination of innovative processes is handled by a Planning Department.

The firm invests considerably (about 6-15% of its turnover) in its training programmes for technical personnel, and trainings last between 6-12 months. It is the only company whose three methods of acquiring technology (i.e. methods actually used, company-preferred methods and personal preferences of respondents) have the same incidence, both in type and ordering viz: in-house development, own research and by flow of books and journals.

Table 8.4.7.3. Operative Arrangements and Assessment of Innovation

	Very High	High	Low	Very Low
Operative Arrangements	(Over 50%)	(26-50%)	(10-25%)	(Under 10%)
Percentage of production personnel to total staff	6	7	-	1
Ration of managers to operatives	1:5	1:20	1:50	1:100
	1	5	7	1
Assessment of innovation	Very Successful (Pace-setter)	Successful (Leader)	Average (Follower)	Floppy (Just in trade)
Hierarchy in innovative processes	2	10	1	1
Success in field of innovations	3	10	-	1

The Canning Industry

The industry is a leader in innovation, and has been assessed as very successful in its operations. Its ratio of managers to operatives is low (1:50) and the percentage of technical personnel to total staff is fairly high (between 26%-50%). Its interests lies mainly in 'new innovations' so as to improve qualities and satisfy customers. Focus of technology is equally on stages of innovation as it is on the whole innovative project as a unit. Just as in the Communication firm, its first priority is to acquire technology through in-house developments. However, its second and third choices are quite different from those of the communication firm.

Components-Integrating Company

This is another outstanding company in terms of position in hirerarchy in innovation and success of operations. The ratio of managers to operatives is very low indeed (1:100) and the percentage of technical personnel to total staff is very high (over 50%). The Company believes in diversification, and focuses equally on the stages of a process and the whole process as a unit through detailed planning activities which are co-ordinated by heads of individual processes. The decision-making mechanism governing co-ordinations in this company obeys a sort of hierarchical structure, i.e. co-ordination of activities is achieved at the process-head level by series of lesser co-ordinators at lesser levels. Although it is not shown in Table 8.3.2., a recheck at the company indicates that trainings last between 6 and 12 months and total investments in training programmes range between 6% and 15% of the Company's turnover. Its method of acquiring technology are mostly by in-house development and through own research. Occasionally, know-how licensings are obtained to supplement the two previous methods.

Pharmaceutical Industry (with medium Technology)

The industry is fairly successful as an organisation but it is a "copy-cat" and therefore a follower in innovation. The ratio of managers to production operatives is high (1:20) and the percentage of production personnel to total staff is very low (under 10%). Not much attention is paid to either the stages of the processes or the processes as units, because these processes have been found operational from where they were copied. Co-ordination of activities is mainly by individual departmental managers. Investments in training programmes are very low (less than 1% of turnover), and trainings are usually under 3 months.

Table 8

Type of Technology	Company	Assessment in Innovation	Success in Operations	Ration of Manager to Operatives
High technology	Electronics	Pace-setter	Very Successful	Low
Medium "	Canning	Leader	Very Successful	Low
Medium "	Components Integrating	Pace-Setter	Very Successful	Very Low
Medium "	Pharmaceutical	Follower	Successful	High
Low "	Steel & Metal Works	Floppy	Floppy	High

Steel and Metal Works

This is a small company employing about 80 personnel. It is floppy in terms of operational success and equally floppy in innovative processes. Because of the nature of its operations, percentage of technical operatives to total staff is very high and the ratio of managers to operatives is equally high (1:20). Although attention is paid to the individual stages of a process, the main focus of the company is the success of the process as a unit. The company believes that " a healthy organisation as a unit would lead to good production" and, therefore, its focus of technology is towards a virile organisation. The company is not very interested in improved techniques but concerns itself mainly with physical outputs. Control of co-ordination of activities rests with one individual (the chief Co-ordinator). Financial investments in training programmes are very low indeed (under 1% of turnover) and trainings are usually under three months.

From these observations about the industries that 'deviate from the general pattern' is extracted Table 8.

From this table, there appears to be a relationship between three factors, i.e. when the ratio of managers to operatives is low, the organisation is very successful in its operations and also in its innovative processes. Conversely, where the ratio of managers to operatives ishigh, innovative process is not always successful. Similar tables can be extracted to show the profile of these companies in terms of financial investments in training programmes for production personnel and length of trainings.

8.4. Conclusion

This comparative study of technological practices in some British industries has some implications for developing countries (allowing for variations in environmental factors). These implications arise from

(a) observations made from the generality of the industries studied, and

(b) observations made from the specific "five industries" studied.

The suggestions thereof are as follows:

(i) the profile of technologically-successful industries is likely to be as follows:-

- ratio of managers to technical (or production) operatives are low (between 1:50 and 1:100,depending on the type of operation).

- the industry pays good attention to the individual stages of the process, and ensures good integration of the various stages to build into a wholistic process
- Co-ordination (or integration) of component processes are better left to a distint full-time Planning Department or, in industries of complex operations, to heads of individual processes who form part of a consortium of control team.
- financial investments in training programmes for technical personnel are considerable (not les than 5% of company's annual turnover)
- trainings for technical personnel are normally between 6 and 12 months, in parallel with the 'installation' of the new technology
- methods of acquiring technology are mainly by in-house development and through own research.

(ii) industries operatiing with medium technology appear to be more successful than those with high technology or low technology, in that order

(iii) focus of technology development should be on consolidating and improving on current obtains, rather than 'vainly reaching for the sky' in new inventions.

(iv) industrial unrest is "arrested" by incorporating human relations in innovative programmes.

ORGANISING FOR, AND UTILISATION OF, NEW TECHNOLOGIES IN DEVELOPED COUNTRIES - THE BRITISH TELECOM AND KELLERING AIRPLANE COMPANY OF U.S.

9.1. Introduction.

9.2. The British Telecommunication

- 9.2.1. Methods of acquiring technologies
- 9.2.2. Factors affecting preference of methods of acquiring technologies
- 9.2.3. Procedures adopted in procuring technologies
- 9.2.4. Company's Outlook to technological innovation
- 9.2.5. Organising for effective utilisation of technologies
  - 9.2.5.1. Trainings in general
  - 9.2.5.2. Trainings for technical operators.
  - 9.2.5.3. Management trainings.
- 9.2.6. Operative arrangements
- 9.2.7. Observations - strengths and Pitfalls.

9.3. PLESSEY

- 9.3.1. Methods of acquiring technology
- 9.3.2. Factors affecting preference of methods
- 9.3.3. Company's Outlook to technological innovation
- 9.3.4. Organising for effective utilisation of technologies
  - 9.3.4.1. Trainings
  - 9.3.4.2. Operative arrangements
- 9.3.5. Ways of reducing technical problems

9.4. Management by Solving Problems.

9.5. Kellering Airplane Company of the U.S.A.

- 9.1. Procedures adopted in procuring technologies
- 9.2. Observations

9.6. Recommendations

9.6.1. Recommendations from observations

9.6.1.3 Model of solving problems relating to technological innovations

9.6.1.2. Organising for effective utilisation of technologies

9.6.1.4. Systematic procedures for predicting and solving problems

9.6.1.1. Procedures for procuring (foreign) technologies

9.6.2. Suggestions by Companies understudied

9.6.2.1. Procurement

9.6.2.2. Organising for Innovation

9.7. Conclusion.

9.1. Introduction

This chapter focuses on how British Telecommunications and Kellering Airplane Company (which are highly technical-oriented) have organised for, acquired, and utilised new (and atimes, foreign foreign) technologies. The study adopts 2 approaches:

(1) administering questionaires, personally, on some selected personnel who have been involved in the management of technological innovations. The questionaires covered the same aspects of the subject as did the previous study in chapter XIII, viz:

- (i) methods of acquiring technologies
- (ii) factors affecting preference of methods of acquiring technologies
- (iii) company's outlook to technological innovation
- (iv) training factors for technological development
- (v) operative arangements (for effective utilisation of acquired technologies).

(2) carrying out interviews with others (who also have been - and still are - involved in management of technological innovation) on various aspects of the subject. These interviews, atimes supplemented by case studies,covered the following main areas:

- (i) procedures adopted in acquiring foreign (and atimes, local) technologies.
- (ii) organising for effective utilisation of technologies (acquired and/or self-developed),
- (iii) trainings for technical operations (including development of management skills),and operative
- (iv) operative marrangements.

Finally, the study collates its findings, culminating in a model which describes how British Telecommunications (in particular) tackles, solves or avoids problems which otherwise would have impeded its programmes of technological innovations.

9.2. The British Telecom.

9.2.1. Methods of acquiring technologies.

British Telecom wants to remain a pace-setter in its field of operation and would therefore prefer to do its own research for new technologies. It would also prefer to engage in cooperative programmes with other (outside) manufacturers. Seminars and conferences are considered important as well as licensing - (in case of licensing, it is the company that sells its know-how mostly, rather than buying from outside). The Company would very rarely want to buy any finished products from outside manufacurers in a turnkey form.

In practice the company does its research and develops a prototype copy of the new product in-house. Specifications of the desired product are then given to external manufacturers because

(i) the company would want to concentrate on research for new technology and the in-house development of prototype products arising from the research.

(ii) the company lacks manufacturing capabilities for all the products arising from its reserach. The personal preferences of respondents (i.e. personnel involved in the management of technological innovation) agree with company - preferred (and also company - used) methods because, in the words of one of the respondents,
"one tends to follow the working of the organisation, and because of the past success, one tends to 'agree' with past practices".

9.2.2. Factors affecting preference of methods of acquiring technologies.

According to the company there are 3 groups of factors that affect its preference of methods: group A are positive assets which are very important; group B are demanding variables (of less importance to the survival of the company); and group C are those factors which hardly bother the company because ' the system of operation takes care of them very successfully'.

Group A: Time; Very low turnover in the R & D team; strong marketing team; Constant availability of researches; Abundant development staff for in-house production of prototype technologies (but not for mass production); and Exchange of ideas through conferences and seminars.

Group B:
- Difficulty of coordinating innovation ideas
- Cost (of little importance because there are always enough resources since the company is itself successful and because the government can and will (almost certainly) always come to its aid).

- Restrictions imposed by suppliers (again, this is not of any major effect on the company because British Telecom always tries (and most often succeeds in) negotiating from a position of power).

Group C .

- Stock of trained specialists
- Problem of trainings
- Shortage of degree - level engineers
- (Never in) shortage of development staff.

9.2.3. Procedures adopted in acquiring technologies

Figure 9.2.1. shows the procedures adopted by British Telecom in acquiring new technologies. The figure is shown in a linear fashion for the sake of clarity. In practice, a few iterations do occur.

(1) Research and Development.

The Market Research Team is to

(i) create awareness of what products are possible and useful; extra ideas are obtained from conferences, in addition to those supplied by the Technical Development Division (Research & Development Team)

(ii) give information about the claims and capabilities of different manufacturers.

Together, they combine to give rise to prototype products. In future, the R & D Team may operate with the economic objective of selling knowledge to industrial concerns - on a very large scale.

(2) Tenders.

Once the R & D team has produced the prototype product, the Tenders Committee invites tenders from external manufacturers.. The high-powered committee usually comprises

(i) An adviser, e.g. of the status of a General Manager, e.g. Head of Telegraph and Telex Switching Division

(ii) Representatives of Procurement Executives

(iii) Representatives of the Development Team

(iv) The Maintenance Dept. (e.g. its General Manager).

After scrutiny and pruny the Tenders Committee selects a few manufacturers, sends specifications to them and invites them for round-the-table talks during which questions relating to the new technology are asked and answered by both parties .

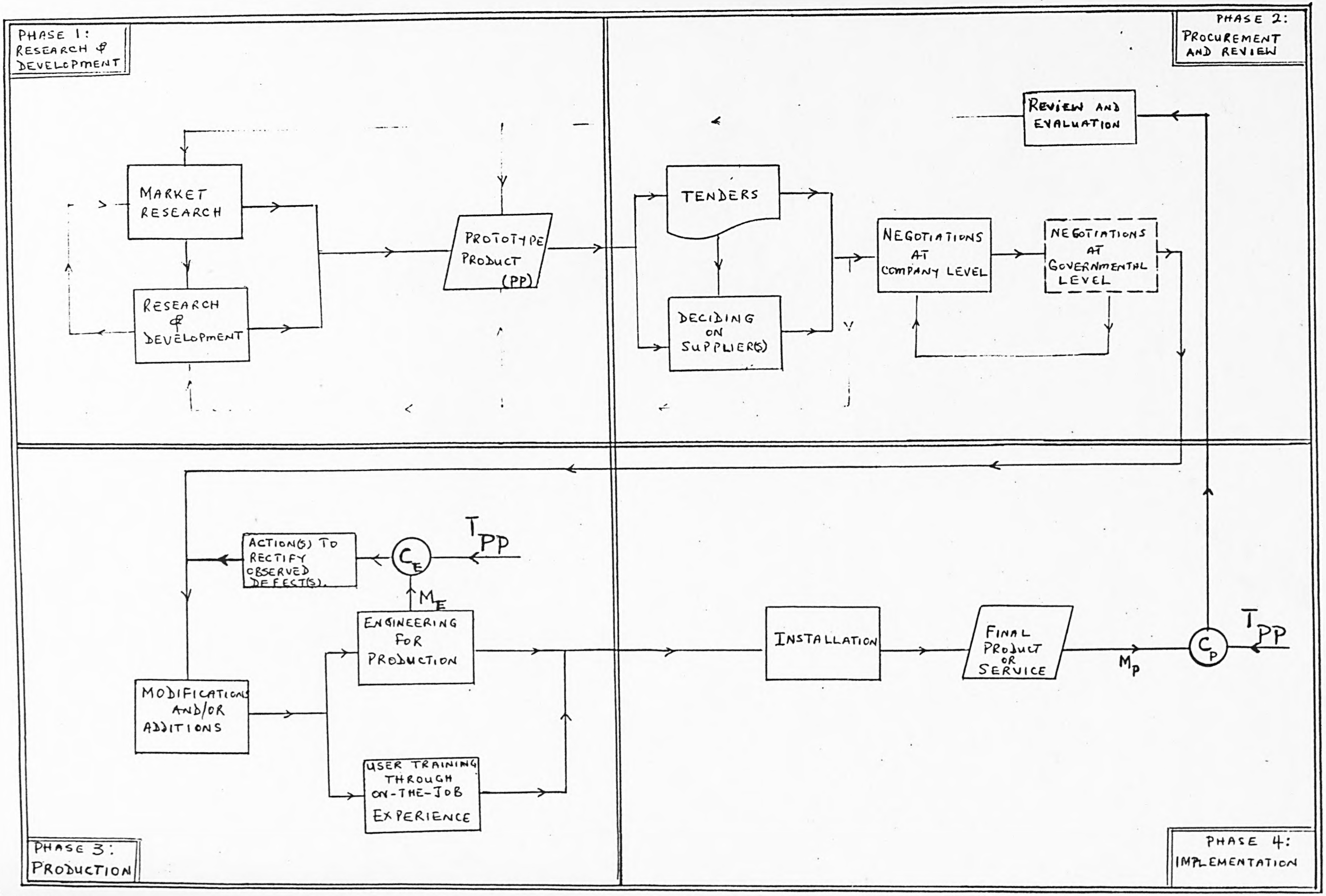

Fig 9.2.1. Model of Procedures Adopted by BRITISH TELECOM in Acquiring Technology.

Normal flow of procedures
Possible iteration in procedures
M – denotes measured output as an input to comparison unit
T – denotes objective as an input to comparison unit

* These talks allow

(i) British Telecom to ascertain the experience and capabilities of the manufacturer, and

(ii) the manufacturer to ask questions about the specifications (earlier sent to him by British Telecom).

All discussions and agreements reached at this level would form part of the final agreements during 'proper negotiations'. From the list of invited manufacturers, a final choice is made of the manufacturer(s) to produce the technology.

(3) Negotiations at Company Level

Terms of negotiations are the usual ramifications, i.e. quality, delivery dates, testing, payments,etc. At times, negotiations are through third parties instead of dealing directly with the manufacturer, e.g. dealing with ITT through acredited representatives like GEC or PLESSEY.

(4) Negotiations at governmental level

Government policies previously dictated which Companies British Telecom could contract business to: PLESSEY, GEC, STC (a subsidiary of ITT) and PYE/TMC (a subsidiary of Phillips in Holland).

(Technologies from these companies were allowed to be brought and adopted to suit British Telecom). They kept a tight control over the choice of technology suppliers to British Telecom.

However, about a year ago (i.e late 1981) the government policies were relaxed and British Telecom was given a free hand to negotiate with any manufacturer(s) that it considered appropriate for its business.

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* The Contract Board would have to approve the choice of tenderers and the final choice of manufacturer(s). The Board consits of the following bodies:
  - Development group, i.e. the market research team, and the R & D team
  - Planning Division
  - Engineering, i.e. Maintenance
  - Services (people to sell and demonstrate the product to the customers)
  - Software specialists
  - Procurement Executives, i.e. the Contract Department which will take care of the legal aspects of the contract.

The Department of Industries, the Foreign Office and the Treasury now only come into the negotiation machinery if the contract were 'big' and won by a foreign company, in which case some 'political games' may have to be played. Terms of negotiations may then include balance of payment, exchange of exports, and political allying.

The Department of Industries gives the final approval for the technology if it conforms to standards approved by the Secretary of State.

(5) Manufacturing

A small team is sent by British Telecom to the manufacturer's site at a very early stage to monitor the product development and other activities of the manufacturer, especially in software technologies.. Members of the team are drawn from 3 groups

(i) Engineers from the Development Department to monitor the technical processes

(ii) Representative of the Quality Assurance Dept. to ascertain the technical qualities of the product, and

(iii) Procurement Executives to ensure that the contract terms of the project are adhered to. The team is usually headed by a personnel of the status of an Executive Engineer. This sort of arrangement has the additional advantage of the team growing to be knoledgeable about the product. A side function of the team leader is that he acts as the Public Relation Officer (PRO) for British Telecom to the manufacturer. The team produces report(s) at various stages.

(6) Testing.

The project team at the manufacturer's site engages in an on - going testing programme, ensuring that each stage of product development satisfies British Telecom's requirements and specifications. The final product is again tested (as a unit) by the engineers and the Quality Assurance Group. The same process is repeated at the site of British Telecom.

(7) Installation (or Implementation)

The installation of the new technology is done by the Maintenance Department of British Telecom, monitored by representatives of the manufacturer(s). The arrangement allows the local personnel to gain experiance on the workings of the new technology.

(8) Review and Evaluation

The Quality Assurance Department evaluates the whole project and at the end, if all parties are satisfied, then payment is made. Again, at the end if additional units of the technology are (later) required and requested by British Telecom, the Technical Development Department is no longer involved, the process is handled solely by the technical division ofthe Procurement department (i.e. Contract dept.). If the Contract department runs into any problem over the issue, advice can always be obtained from the Technical Development Department.

9.2.4. Company's Outlook to technological innovation

The following observations describe the company's outlook to technological innovation: -Company objectives (which are)

(i) to make money,

(ii) provide good services through improved products.

- Technological innovations are oriented towards physical results. Efforts are mostly geared towards

(i) Development ofnew techniques (and therefore products) for customers

(ii) Planning of operations; coordination of innovation is the responsibility of the Planning department.

(iii) Acquisition of new technologies to aid (i) above

- Focus of technology development is mostly on the stages of the project, arising from the belief that if the individual components are good, then the product as a unit will be o.k.
- Objectives of R& D are mainly for long - term break-throughs which would invariably afford short-term improvements.
- The company believes in the development of individual personnel through very thorough annual appraisal exercises, i.e. there is an in-built human management system.
- Management trainings cover a wide spectrum of functions such that would enable a manager to perform a variety of duties.

9.2.5. Organising for effective utilisation of technologies

The company organises for utilisation of technologies mainly by providing trainings for its personnel. There are 3 types of trainings: general trainings for all new personnel, trainings for the technical personnel, special trainings for management skills.

1. General trainings: Trainings are continuous i.e. before the job, further trainings on the job, and trainings for further developments. Length of trainings before a personnel is considered very fit for his job is about 12 months.

2. Technical trainings: Trainings are directed mainly towards day-to-day operations and short-term improvements. Trainings are mostly pre-installations and in parallel with installations

- they are almost always by the Company's own instructors
- trainings are largely conducted at the company's training schools and augmented by on-the-job trainings.

There are 4 modules of training for technical operations:

(i) training module on hardware, usually at the training school in Stone

(ii) Software support module - to update technical capabilities on software aspects of a project

(iii) Repairs trainings, and

(iv) Informal trainings - to tune the techician into getting involved in, and committed to, the problems of the operation.

Trainings are focussed mainly on 3 aspects of the company's operations:

(i) Appreciation - lasting few days, but might run into 1 - 2 weeks depending on the complexity of the project

(ii) Simple Diagnostic - about 8 weeks.

(iii) Maintenance (or technician's trainings, as they are called) - lasting between 16 - 20 weeks

Therefore minimum trainings for technical operations run between 25 and 30 weeks.

3. Management trainings. A new engineering graduate joins British Telecom's management at an Assistant Engineer's level. Because his job demands social contacts with customers (as well as with other workers, mainly operatives) he is given management courses as he progresses through the ranks of the set-up, so as to develop his management skills.

The figure below illustrates the module of management trainings.

Snr. Engineer

↑ 2 mgt courses

Engineer

↑ 2 mgt courses.

Asst. Engineer

Each course is, on the average, of a duration of a month (4 weeks) in one year. This suggests that each management personnel must have received a minimum of 16 weeks management trainings before he becomes a Senior Engineer. Depending on the performance of each individual 'manager', specialist courses may also be given during this period, thereby increasing the total management trainings to about 20 weeks. Alternatively, if the performance is not very brilliant, the specialist course is postponed till the 'manager' becomes a full engineer. This period of waiting is called 'the educational period' and it is about 12 months, after which he is thought of as being capable of 'contributing ideas'.

9.2.6. Operative Arrangements.

For effective utilisation of technology, British Telecom operates under some guidlines which breed good planning and control of technical operations.

1. Planning: Jobs are always broken down into MODULES, and there are softwares to keep records of codes that have been written for each module for purposes of integration and testing.
2. Control:-

- There are monitoring systems that keep records of the performance of each module, giving warnings in times of operational mishaps especially concerning problems of meeting target dates.
- ratio of managers/supervisors to operative staff varies according to the sector of operation but mostly range between 1:20 for R & D and 1 : 50 for fault rectifications.
- percentage of personnel (with technical trainings) that assist in technical production is over 50%.

9.2.7. Observations.

Arising from the activities of the company are 2 sets of observations: the first set being from the procedures adopted in acquiring technologies, while the second set relates to the company's outlook to, and preparations for, utilisation of technologies including the operative arrangements.

1. Observations from the Procedures

Strengths

- The procedures exhibit a mixture of all the six methods of transfer in varying degrees; in other words, it combines the strengths of the individual methods.
- The main strength of this 'comprehensive method' of transfer lies in the fact that the company is ready to exchange ideas with other parties in similar operations (mainly through a strong and virile R & D team), and to test and develop (in-house) the ideas so obtained.
- The procedures ensure that proper records of activities are kept i.e. the procedures generate benefits of keeping records of past performances (which is 'handed down' from generation to generation).
- The involvement of the government does not allow 'loose' negotiations since payments are left to the Treasury on the express recommendation of the company that it is satisfied with the final product. The involvement of the Department of Industries also ensures high standard of safety requirements.
- Committees are high-powered, knowledged in and conversant with the technical demands of the project; the committees are also small and therefore manageable and effectively functional.
- British Telecom is able to utilise the technology effectively because it was involved in the development of the technology, as well as its installation.
- Quality is assured because the production was monitored by the Company throughout the process.

Pitfalls

However, the following pitfalls are observed from the set of procedures:

- They make the company depend on other firms for the production of its technology, i.e. there is no self-sufficiency in the true sense.

- If the expectations of the recipient are too high (as is often the case with British Telecom) the project may undergo many requests for modifications, and these requests usually create 'sour atmosphere' between the production personnel (of the Manufacturer) and the monitoring team (of the recipient). Secondly, these requests could lead to target dates not being met.

2. Other observations

- British Telecom expends efforts on the planning and control of its operations.
- Technological innovations are oriented towards physical results for long-term break-throughs that would invariably effect short-term improvements.
- Focus of technology development is mostly on the stages of the project.
- Attention is paid to human development, i.e. the system incorporates human management
- Training programmes are well defined and planned (both before, during and after installation of the technology).
- ratio of managers/supervisors to operatives allows for proper supervision of job, and avoids management overheads
- the high proportion of technical personnel to other non-technical staff reflects and supports the technical demands of company's operations.

9.3. PLESSEY - A supplier of Technology to British Telecom.

9.3.1. Methods of acquiring technologies

Plessey would prefer to acquire its technologies via the following methods in this order: by own research; in-house development of ideas obtained from books, journals, conferences and seminars; Know-how licensing through cooperative programmes with external manufacturers; and very minimally by importing other people's machinery in a turnkey form.

But because of practical constraints (e.g. lack of resources) Plessey adopts the above methods in the following order: Know-how licensing, through cooperative programmes with other manufacturers, in-house development of ideas obtained from own research and from flow of books, journals, seminars and conferences; and minimally by importing turnkey machines.

9.3.2. Factors Affecting preference of methods

The company's choice(s) of methods of acquiring technology are influenced by factors identical to those of the British Telecom: Group A are considered as being major ; Group B are less pressing, while Group C are easily taken care of.

Group A.

- Availability of relevant research
- Availability of enough development staff
- Does method assure good advice?
- Overall cost
- Availability of recruitable personnel to handle operations
- Effects of external environment, especially late deliveries during tight schedules.

Group B.

- Availability of own research
- Shortage of degree level engineers
- Overall time
- Ready stock of trained specialists
- Problems of training
- Problems of control over the operations

Group C

- Exchange of research findings and ideas with other research bodies
- Necessity to employ outside contractors for market research
- Guarantee of market reserach findings

9.3.3. Company's Outlook to technological innovation

- The company's objectives are principally to make money, by providing good services through the development of new products and to stay in business; it is not bothered about providing employments because 'the company is not built for social purposes, nor is it an employment agency'
- Technological innovations are oriented towards physical results i.e. (i) to reduce costs and (ii) to improve products
- The objectives of remedial work are mainly for long-term breakthroughs.
- The focus of development of technology is on the product as a unit (in the belief that the stages of the project are properly taken care of); development of technology also takes great cognizance of the development of individual personnel "to ensure that skilled personnel have the right motivation and attitude".

- Coordination of innovation processes is handled by two bodies whose memberships overlap:- a Planning Department and the Technical Directors.

9.3.4. Organising for effective utilisation of technologies

1. Trainings.
   - Trainings are mainly geared towards long-term plans and short-term improvements, and not necessary for day-to-day operations
   - Trainings are mostly practical in nature, and normally by company's training instructors.

- Management trainings are broadly of 3 types:

(i) Short induction trainings (about 4 wks) for new graduates.

(ii) On-the-job trainings (about 12 months) "before he can make contributions".

(iii) Seminars and other short management courses are on ad-hoc basis and are left to individuals to attend what trainings they think are useful for them.

2. Operative arrangements
   - percentage of personnel (with technical training) that assist in technical production is about 25%; (this is lower than for British Telecom because of the strict nature of specialisation that the jobs demand)
   - ratio of manager/supervisors to operative staff in areas concerned with technological innovations is about 1:20 (this ensures effective supervision).

9.3.5. Methods of reducing (or minimising) technical problems.

The main emphasis lies on how to predict (or foresee) these problems before they arise *

The practical method of predicting problems is by thorough mechanical designs and production engineering:

1. Projects are broken down into definite and manageable stages and each stage is checked by**

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* Two bodies are charged with these responsibilities.
(i) Business Planning:- to look into future and predict the shape of business in, say, 5 years time.
(They produce Business Plans.
(ii) Market Research Department:- charged to come up with improved techniques, e.g. level of automation.

** Great effort is directed towards individual components, validating them through practical testings and softwares, e.g. "Firmware" (a system halfway between software and hardware) checks Read-only-Memories (Rom), and allows the products to be modified as development goes on.

(a) Logic equations, e.g. Boolean algebra, so that the logic conforms with some mathematical equations.

(b) Bread-board-system i.e. circuits are wired together and ideas are tested

(c) Printed Wiring Assembly (depending on circuit complexities).

2. Electronic Board for Integrating Testings:
This involves special softwares e.g. Firmware, Maintenance Control Sub-System, Management Statistics Sub-System and Call Processing Sub-System, as used in System - X Exchange.

3. Environmental Tests to certify circuitory and product behaviours (and other characteristics) under different conditions, e.g. temperature and humidity under storage and operating conditions.

4. Cyclic Testings for reliability purposes. Usually, on the average, Integrating testings take about 2 years to be completed and certified o.k.
Because of the intensity of effort and the thoroughness with which the testings are done, the compnay claims about 95% success rate in predicting, and therefore averting, its technological problems. **

5. Customers' Tests - to confirm that the product conforms with requirements. (Quality Control procedures are used to ensure good quality)

9.4 <u>Management by Problem Solving</u>

The research draws its interest from the strong belief that if managers of technology transfer can be helped to vitualise the problems involved, then they are likely to reduce the effects of these problems on technology transfer.

This belief is borne out of the principle of 'management by Problem Solving' which involves management's ability to 'foresee' problems and plan to avoid them, or to recognise problems when they arise and take actions to solve them. The level of management success in these tasks would depend very much on its perception of, and hence its attitude to, the organisation (or the system). See Figure 1.5.2.

** Designs are made to give less scope for errors.

In other words, the function of managing an organisation (or a system) successfully draws heavily on the attitude(s) of the manager(s). Therefore, an analysis of management problems in a system is, in the main, a study of how management perceives the system and its attitude to the system. These two variables are behavioural in nature.

This principle was one leading tool employed to examine the model of activities of both British Telecom and PLESSEY in averting and Solving their problems of technological innovation. Figure 9.4.1. presents the findings.

9.5.1. Procedures Adopted in Acquiring Technology: The Case of Bayerishe Mashinen Werke GmbH (BMW) (transferer,) and Kellering Airplane Company (transferee).

In order to appreciate more fully the strengths and pitfalls of the procedures adopted in transfering technology into Nigeria (See ChapterV), this exercise was undertaken to see how similar practices compare with, or differ from one another. Realising the pitfalls observed in chapter V, the venture chosen for this aspect of study was such that would highlight how the observed pitfalls are prevented or taken care of. To this end, focus was made on how suppliers are chosen and how negotiations are made (and compared with British Telecom's practices).

Background

The two companies concerned in this study are Bayerish Mashinen Werke GmbH of Germany and Kellering Airplane Company of the United States. The former had established itself as a reliable supplier of several NATO subcontracts, and is located in the small town of Anderbach in Germany. Kellering, on the other hand, was one of the world's largest airplane makers and the most scientifically advanced aerospace organisation. Kellering wanted a supplier of some parts of its aeroplanes and in doing so, it adopted the following procedures:

1. Deciding on Technology Supplier/Tenders

(i) Kellering executives visited BMW to inspect its plant; they informally questioned BMW as to their ability to handle the project. Specifically, Kellering was more concerned about BMW's previous experience, competence and familiarity with similar projects.

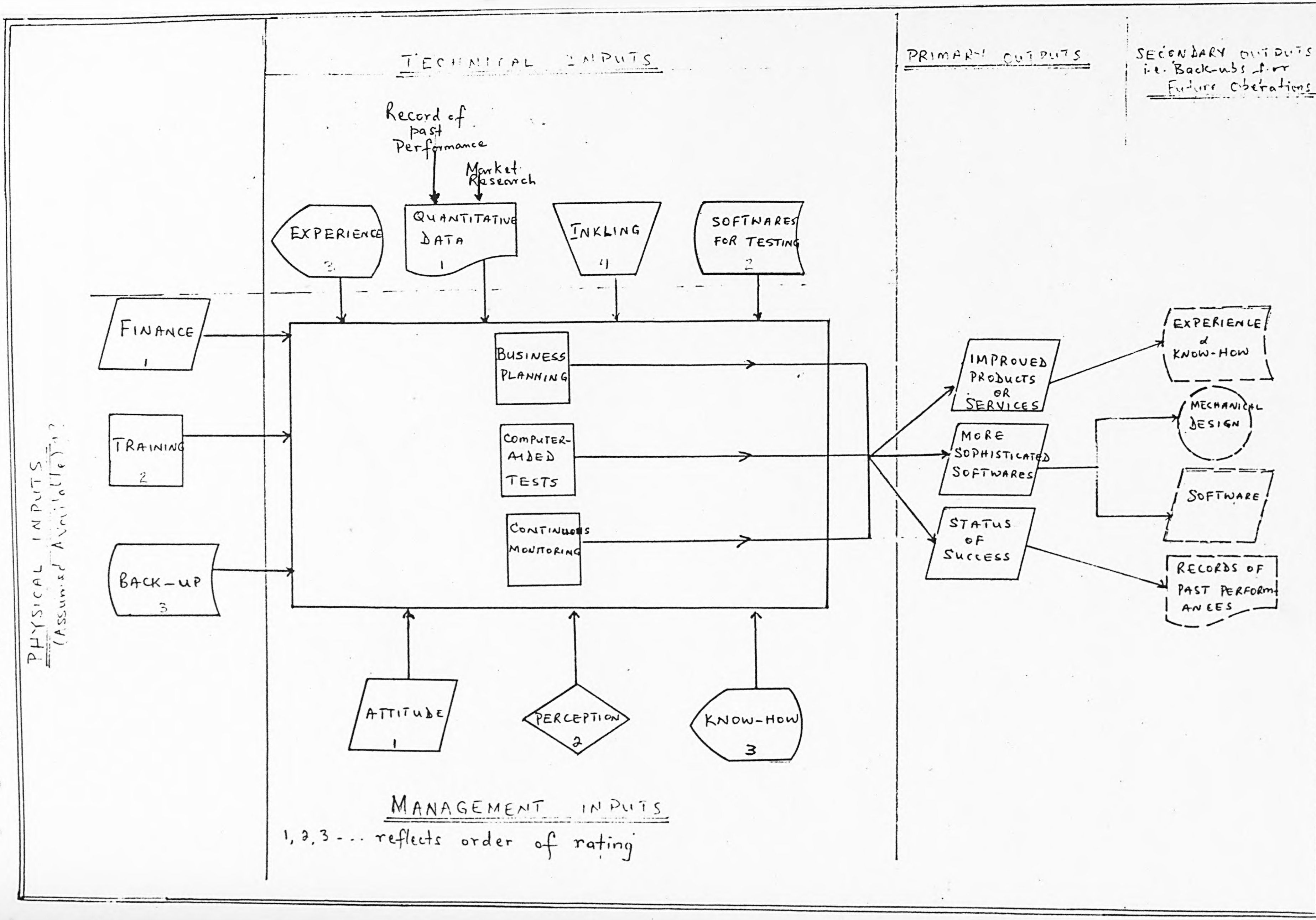

Figure 9.4.1. Model of Variables employed by British Telecom and PLESSEY in averting and solving problems of Technological Innovation

(ii) After satisfying itself that BMW was capable of handling the project, Kellering invited BMW to submit a bid in favour of a portion of the project in which Kellering felt BMW was competent (and not necessarily for the whole project).

(iii) A set of drawings and specifications were provided BMW by Kellering.

2. Negotiations

(i) During negotiations, Kellering would not accept any escalation clause by BMW that might result in cost increase averaging above 6.0% per year. Because of this 'impasse' BMW made an estimate of future cost increases instead, and included this in their estimate for contigencies.

(ii) Kellering insisted on several features of the contract, e.g. one such aspect was the provision for value engineering which provided for a 50% - 50% sharing between Kellering and BMW of all savings accuring from the application of value engineering principles to the work under the contract.

(iii) Delivery requirements were clearly and explicitly established by the contract; it also contained progress reporting (using, in this case, Gantt - type charts). These charts showed both the actual and planned performances - side by side - and were forwarded to both the Kellering Headquarters and Kellering Project Team based in Germany (the seat of BMW).

(iv) Kellering had included a clause in the contract giving them the right to audit BMW's books where they pertained to the contract.

3. Manufacturing.

(i) In addition to the previous inspection of BMW's plant by Kellering executives, Kellering sent its engineers to briefly inspect BMW's facilities before the project was started. It is worth noting that the Sales Manager and the Production Manager of Kellering (the team heads) have engineering degrees. They both have had years of experience in countries outside their home country.

(ii) For implementation (or adaption) of the designs, the specifications from Kellering were translated into the manufacturer's language to remove communication difficulties; in addition technical experts (who also acted as translators) were stationed in Anderbach, i.e. at the manufacturer's plant. These technical experts are also to provide assistance if difficulties were encountered by BMW.

4. Quality Control

(i) Prior to the mandatory quality control and ispection by the U.S. Federal Agency, Kellering established its own Quality Control Department at BMW's plant; this department was completely independent of other functional departments and reported directly to the president of Kellering. It provided resident inspectors at the plants of its supplier (or transferer). In addition, there was a special group of Kellering personnel assigned to expedite deliveries of materials or parts needed in manufacturing, i.e. spare parts department as distinct from Spare parts stores.

(ii) For quality control and inspection there was the requirement for approval by the U.S. Federal Agency which had to approve all designs and finished or manufactured products coming into the U.S.

9.5.2 Observations

(i) Activities concerning the project were highly co-ordinated because
- there were clear lines of authorities and very little bureaucratic practices
- there was a foreign office of the company established at the supplier's (or transferer's) base to advise the transferers and to monitor the projects which the transferer might be handling for the transferee.

(ii) The procedure allow the transferee to verify the claims of the manufacturers against their capabilities, experience and competence through physical visitation to the plants thereby ensuring that whoever wins the contract has the required resources and would do a good job.

(iii) The procedures also safeguard Kellering's interest particularly during negotiations with particular reference to the following:
- indemity against excessive cost increases
- right to audit the manufacturer's account, and
- provision of value engineering.

(iv) Those who had to make decisions were technically qualified, capable and experienced and were well equipped to offer technological leadership to other personnel.

(v) The managers kept data on the performance of the manufacturer because they recognised the usefulness of such data in future dealings.

(vi) The involvement of the Federal government of the recipient supplements the efforts of the recipient to ensure quality control of the finished products.

(vii) The procedures are very similar indeed to those adopted by IBM (Greenock) in Scotland and British Telecom in acquiring 'foreign' technology.

9.6. Recommendations

There are 2 sets of recommendations to be made:

(A) those emerging from the observations of the various studies, and

(B) the suggestions (made specifically by the companies under-studied) for developing countries.

A. Recommendations from the observations.

i. Procedures for procuring (foreign) technologies

1. There should be clear lines of authorities and very little bureaucratic practices.
2. The procedures should ensure an exchange of ideas with other bodies through a strong and virile R & D team, particularly by establishing foreign offices to advise on competent technology authors and to monitor projects (when they are being done) to ensure good quality of finished products.
3. The procedures should be able to verify the claims of manufacturers against their capabilities, experience and competence through physical visitation.
4. The procedures should make it mandatory for proper records of activities to be kept, in other words, generate benefits of keeping records of past performances.
5. Those who have to make decisions should be technically qualified, capable and experienced and well versed in the art/science of negotiations of technology-oriented projects.
6. The procedures (through the tender system) should allow the transferee to negotiate from positions of power. Terms of agreements should be clearly and explicity established by the contract.

7. Committees should be high-powered and knowledgeable in the technical demands; their sizes should be small (manageable) to be effectively functional.
8. The procedures should ensure active participation of the transferee at a very early stage of the development to enable him utilise the technology when it is completed.
9. The involvement of the transferee's government (if it is a big project) gives negotiations a better bite and ensures high standards of safety requirements.

(ii) <u>Organising for effective utilisation of (acquired) technologies</u>

1. Technological innovations should be oriented towards physical results, and efforts geared towards planning and coordination of activities.
2. Projects should be broken down into definite and manageable stages, and each stage properly executed.
3. There should be an in-built human management system to bring the best out of individual personnel, thereby reducing industrial unrests.
4. Management should have technological leadership to offer the operative personnel.
5. Trainings for operatives should be continuos, geared towards day-to-day operations and short-term improvements. They should mostly be on the job (comprising of pre-installation and in-parallel-with-installation trainings)
6. Management and other specialised trainings should be available to managers from time to time to enable them develop new skills in tackling the problems involved in managing technological innovations.
7. High management overheads should be avoided by adopting the following:
   - appropriate supervision: ratio of managers/supervisors to operative staff should be between 1:20 and 1 : 50 depending on the complexity of the operation
   - percentage of personnel involved in technical production of total staff should not be below 25%

(iii) Model of Solving problems relating to technological innovations.

Figure 9.6.1. is a recommended model for averting, tackling, or solving problems involved in managing technological innovations in relation to the classifications of chapter IV.

For management personnel in particular, the following variables are required in forecasting and solving the problems, assuming the adequate resources are available:

1. Attitude:- this breeds commitment to, and sense of responsibility for, the problems. It is the "variable that determines everything" in the sense that it affects the degree of sensitivity and helps the manager to "develop some empathy for the problem in order to get somewhere".
2. Perception:- the manager's understanding of the problem and his approach to utilising the resources available. Even if the manager is himself not technically competent his attitude to, and perception of, the problem would enable him to "use other people's Know-how to solve the problem.
3. Know-how:- the better if the manager is personally capable of effecting a solution to the problem, given the available resources.

(iv) Systematic procedures for predicting (and solving problems (which are specifically technical)

The forecasting of problems through series of testings should absorb between 20% - 30% of total efforts from design to production. This forecasting exercise is considered a very important aspect of successful technological development, (possibly much more important than formally recognising and rectifying the problems) because the rigorous tests reduce very drastically (if not eliminate completely) future technical problems.

Ratio of importance of forecasting and averting problems before they arise to recognising and solving the problems when they arise is about 100 : 1

	INTERNAL	EXTERNAL
TECHNICAL	1. Continuous technical trainings 2. Development of a system to predict problems, eg. STEM of British Telecom 3. Monitoring System of performance, i.e. Control 4. Quality Assurance System	1. Good procedures for acquiring technologies 2. Quality Assurance System
ADMINISTRATIVE	1. Good records of past activities, i.e. an efficient Information System 2. Well-defined operational arrangements	1. Easy accessibility to the government or its agents like Ministries of Industries and Finance or Central Bank
PERSONNEL	1. Management Trainings 2. Open Reporting System 3. Informal Trainings	1. Constant Publication of reports 2, Open Tenders

Figure 9.6.1. Model of Required Variables to avert, tackle or solve problems of managing technological innovations

The procedures below are recommended:

1. Listing all sorts of possible problems (a sort of brain-storming): from experience, past records or inkling.
2. Desk running to solve these problems, using not in any order, the following tools:
   - (i) Circuit diagrams
   - (ii) Test Bed(s) - this shows up solutions almost immediately e.g. by simulating the problems
   - (iii) Going through records for past solutions to similar problems.
3. The technology should be built around softwares and/or other computer-controlled systems which allow continuous monitoring of performances and constant comparison of results with expectations. These systems should be quantifiable and able to give warnings when problems arise.
4. There should always be Back-up Services to fall on when problems arise, e.g. during financial and training problems.

B. <u>Recommendations for developing countries (by the Companies understudied)</u>

It was observed that top-management were cautious (almost reluctant) to volunteer comments on the issue of how to help management solve problems of technological innovation in developing countries.

The caution or reluctance was an attempt not to be discourteous. On the contrary, middle management were more forth coming. However, the following suggestions were made:

(i) <u>Procurement</u>

1. Developing countries should be <u>able to define what they want</u>. i.e. ability to write or prepare system definitions as a basis for inviting tenders, by adopting the following procedures.

Initial request for proposals
(i.e. rough proposal of requirements)

↓ Sifting through

Better ideas that lead to a shorter list
of candidates to submit actual tender documents

↓ Bilateral Consultations.

Actual Supplier

The services of consultants can be employed in this task; the consultants can be either some external manufacturers, consultancy firms versed in similar projects, or international bodies reputed for such job.

2. Managers of technology should have appropriate understanding and experience on the technical demands of various technologies in parallel with (1) above.
This can be achieved through the literature and
   (a) Short visits to manufacturers in other countries
   (b) Attachments, and
   (c) Courses run on procurement techniques.
3. Managers should be versed (trained) in techniques for evaluating tenders and other similar activities.
4. They should be conversant with the process of analysing and specifying detailed costs concretely, e.g. marginal costs for failed items, etc. These detailed costs should always be available, especially during negotiations.
5. Evolution - ensuring that the desired product is compatible with the next generation of products from the manufacturer so that the finished product for the transferee does not become obsolete in a very short time.

(ii) Organising for Innovation

"Training is the Keyword and the centre nerve of preparations (or organising) for innovation".

1. The right Kind of people with the right kind of training, education and skill should be employed; where there are deffiencies, they should be corrected by providing the necessary variables.
2. Management and other technical personnel should keep up-to-date with latest developments through seminars, conferences and journals, etc.
3. The activities of CCITT in Geneva should be constantly monitored (if it is impossible to participate) for purposes of keeping abreast of new techniques and other research findings.
4. It must be ensured that innovation is cost effective, i.e. value for money, particularly in relation to the nation's requirements.
   For instance, although Satelites are prestigeous technologies, they are not of common-place usage in Britain because of little geographical spread i.e. there is no need for them as there are in the much larger United States.

5. Develop relationship with well-known technology suppliers e.g. for purposes of advice and preferential supply under easy terms.
6. Stimulate people to have creative ideas, particularly in specialised fields so as to "come to the frontline" too.
7. Efforts should be focussed on application areas rather than abstract technology.
8. Avoid having too many managers to supervise workmen i.e. management overhead; also avoid having low-calibre of managers because this is as bad as having no supervision for the workmen.
9. Maintain a realistic relationship in business so as to avoid situations where businesses become 'social gatherings'; this tends to make one 'loose speed'. The thyme is/should be "Business is business".
10. Where applicable, matrix organisation should be employed; in other words, fitting arrangement of organisation to fit a particular job, as opposed to fitting a job to fixed organisational arrangements.

	Dept 1	Dept 2	Dept 3	Dept 4	Dept N
Project 1	-	-	-	-	-
Project 2	-	-	-	-	-
Project X	-	-	-	-	-

Conclusion:

The outputs of the chapter are practical illustrations of how industries in developed countries have averted, tackled, or solved problems involved in the management of technology transfer (and innovation) that are similar to those of developing countries. The outputs constitute, individually and collectively, attempts to improve the management of technology transfer (and innovation) by/in developing countries.

In very broad terms, these outputs are:

1. A model of some requirements and the procedures to be adopted by developing countries in procuring technologies. Some of the requirements are:
   (i) ability to define national requirements properly and prepare system definitions as a basis for inviting tenders.

(ii) knowledge of evaluating tenders and other activities.

(iii) preparing detailed costs to make efforts cost-effective

(iv) ensuring that decisons are made by competent personnel, i.e. those with vast knowledge and experience of a particular aspect of the subject.

2. A set of variables (and their arrangements) required to organise or prepare for acquisition and utilisation of technology.

   (i) Trainings - both formal and infromal; technical and management

   (ii) Planning - ability to concentrate on special areas, i.e. separation of stages of project.

   (iii) Monitoring activities (research findings, application developments, and new products) of other (especially well-established) technology authors.

   (iv) (Investment in) Research and Development.

   (v) Stimulating people to be creative, especially in specialised fields.

   (vi) Developing good relationship with well-known technology authors/suppliers

   (vii) Focussing attention on application areas, rather than on abstract technology.

3. Operative arrangements for effective utilisation of the acquired technologies.

   (i) Ratio of managers/supervisors to operative staff should be between 1 : 20 and 1 : 50 (depending on the complexities of the operations) to avoid management overhead.

   (ii) Percentage of technical personnel that assist in production, to total staff should not be lower than 25% at the very minimum; a percentage of 50 is likely to produce good results.

   (iii) Good record keeping to facilitate an evaluation system comprising two sub-systems:

      (a) a monitoring sub-system that measures performances and compares outputs with desired targets (or objectives).

(b) a <u>control</u> sub-system that gives warnings of impending danger(s) resulting from activities going out of control; these warnings should allow enough time for corrective actions to be taken.

(iv) A human management system that would encourage the development of technical skill of individuals and provide job satisfaction. This has the benefit of arresting industrial unrest.

Chapter 10 CONCLUSION

10.0. Introduction

Following the repeated comments in the foregoing chapters on one or another of the many barriers to innovation, this chapter tries to have all these points brought together and summarised in one place. Chapter II, in the discussion of innovation perceptions, introduced how management can be helped to arrive at objectives and policies that would result in 'appropriate' innovative practices, within the demands of the environment in which the innovation is to operate. Chapter III aimed at reducing problems of decisions on choice of method and/or kind of technology transfer desired. Chapters IV and VI separated the problems of managing technology into those of acquisition, operative arrangements, organisational structures, human management, and provision of infrastructures, which, individually or in some combinations, represent problems of government, top management and middle management (or Supervisory management). Chapter V discussed procedural problems, and Chapter VII examined the problems that arose from the actions and/or inactions of middle management mainly. Chapter VIII-IX (comparative studies), looked at how similar problems to those identified in chapters IV, V and VI have been tackled in the U.K.

The resultant of these is that, in the main, this chapter makes certain recommendations to reduce the problems of managing technological innovation in developing countries, adopting three strategies: first, it suggests a procedural model for the acquisition of foreign technology; secondly, it discusses the diffusion of the acquired technology and its Know-how; and thirdly, it draws some lessons from the practices observed in developed countries.

Finally, the chapter states some of the problems the researcher has worked closely with, which have forced some limitations on some of the findings of the study. Consequently, certain recommendations are made for possibilities of further research to complement the results of the study for practical purposes.

10.1. Research Findings and their respective Recommendations.

The findings come under four types:

(a) procedural errors (particularly in methods of acquisition),
(b) planning/operative problems,
(c) problems of the three tiers of management,

(d) problems of technological Know-how.

(a) Procedural errors

(i) That certain methods of transfer offer greater chances of success than others. For instance, analyses of the methods of acquisition suggested that Joint_Ventures method does not offer much to the aspirations of developing countries. But the findings in later chapters (See Ch. V) showed that this is the most widely adopted method in Nigeria. This contradiction in what is 'ideal' and what 'obtains' in a developing country has called for a modification of the existing arrangements for acquiring technology. The suggested arrangement provides for a 'go-between' for the transferee and the transferer such that the go-between who understands the cultural requirements of both parties provides the transferee with an operational system which the latter will reconstruct by itself to obtain the process and procedures that are suitable for its requirements.

(ii) That the transferee is being made to go through too many rigorous procedures, actions that are likely to discourage prospective industrialists (transferees).

(iii) The rules and regulations governing the procedures of transfer are too stringent with the likely event that the number and variety of technological projects will be drastically affected.

(iv) The administrative procedures involve too many paperwork and show over-centralisation of activities, resulting in bottlenecks.

(b) Planning/Operative Problems.

(i) That there are problems of awareness, definition of needs and setting of objectives.

(ii) That government and top management have problems of choice of technology due to lack of understanding of what innovation is.

(iii) That there are problems of appreciating and providing the infrastructures that favour successful technological development. Consequently, a comprehensive model of innovative process was developed, breaking it into its basic structures (or components) and identifying the focal point of each major activity, thus making the process easier to understand.

(iv) That internal problems are more numerous than problems external to an organisation.

(v) That these internal problems stem mostly from administrative systems, from personnel, and from technical factors, in that order.

Some remedial actions have been suggested to direct efforts at solving both internal and external problems, but with more emphasis on solving internal problems.

Analysis of industrial performances suggested

(vi) That the internal working conditions are not conducive to high performance (reflected in the rapid increase in strikes and stoppages)

(vii) That there is underutilisation of resources in the industries of developing countries.

(viii) That high technologies attract high overheads.

(ix) That there are high management overheads in the industries.

(x) That companies using average technologies perform better economically than those using high level technologies.

(xi) That there is a substantial management problem, i.e. those presently managing the technology do not possess the qualities of 'good' managers.

(xii) That the chances of success-fully managing technology in developing countries vary according to the type of ownership, e.g.

(xiii) That technology is more likely to be managed successfully if the governments of both the transferee and the transferer are involved, i.e. joint operations at governmental level.

(xiv) That local trainings are more desirable for technical development; occasionally these local trainings could be supplemented with seminars and overseas attachments for more practical experience.

(xv) That those who have the ultimate responsibilities of managing technology in developing countries should not be less than 30 years (preferably, they should be between 30-40 years old), and should be professionally capable of providing good technical leadership.

(c) <u>Ascertain functions of different levels of management</u>

(i) That middle (or operative) management have <u>problems of organisational structure</u>, problems of <u>planning</u> and reducing iterations of activities involved in technological innovation. The first two problems arise from lack of knowledge of the workings of the technology (i.e. the processes demanded by the method(s)), while the third problem is related mainly to procedures involved in self-developed technolgies, and to a large extent, the processes of utilising acquired technologies effectively.

(ii) That top management and government have problems of choosing development projects.

(iii) That the three tiers of management have problems in making the society appreciate the dignity of labour and self - reliance.

(iv) That morale, which is a very important ingredient of success) is lacking in local techniques, due mainly to management's sociological diligence. While middle management is advised to take remedial actions to reduce the deficiencies in its formal and informal administrative systems, the government and top management should strive to improve their political and social relations with external agencies and the society at large respectively.

(v) That there is lack of essential means of providing services (resulting in low quality of services provided). Remedial actions should therefore be taken by top management and the government to provide and/or modify the tools (and methods) employed in providing services. (For detailed and specific recommendations, See Chapter IV).

(vi) That in total, problems of managing technological innovation in Nigeria are more related to middle management than top management or the government, in that order.

(d) Problems of technological Know-how.

(i) That it is useful to prior-assess a project by probabilities (or chances) of success, rather than relying solely on post-exercise appraisals.

(ii) That good training and investments in research and development are two major ingredients for technological know-how; in particular, developing countries need to concentrate on professional trainings.

(iii) That the probabilities of obtaining good results from local trainings given to technicians and middle managers (i.e transferees) are high, (5/7).

General Concluding Remarks

The research has discussed technology as an agent of national development, a belief which has spurred the third world into great investments in technology. The resultant, however, is that while there are evidences of economic growth in Nigeria, the social benefits derived from past technologies are not very apparent. This is probably a direct consequence of selecting or favouring projects along economic lines, and paying little attention to the social benefits (which have been shown to be more numerous than the economic benefits).

Other focuses of developing countries (with regards to technological innovation) should include:-

(i) competence to reduce technological dependence on others (i.e. self-reliance)

(ii) awareness (which allows the recognition of certain problems)

(iii) economic stability, and

(iv) civilisation of the society at large.

Consequently developing countries must develop a policy which would enable them adopt a strategy in line with their requirements, borrowing experiences from those factors (that are relevant to their socio-cultural environment) which have aided technological development so much in advanced countries.

10.2.0. Recommendations to reduce problems of managing innovation.

Indeed, a complete analysis of problems of innovation requires an integration of understandings from the perspective of practically every discipline. To a large extent, each country and each innovative situation represent a unique configuration of elements related to each other and to each of these disciplines.

Therefore the recommendations offered here can only be a very tentative guide, perhaps suggesting to the innovation director the types of problems he, as the manager, should look for and guard against. These recommendations are based on anthropology, i.e. regarding action of man (in this case, management) as the central figure rather than money (or other resources) as in economics. The much larger task of finding complete solutions to the problems of innovation and of guiding the innovator to specific practical steps, based on all the disciplines, need to be tackled essentially and progressively in future works.

The first set of recommendations is aimed at reducing procedural problems in acquiring foreign technology. The second set discusses how technology and its know-how are best passed from the authors to those that would apply them. The third set of recommendations is drawn from the experiences of developed countries who had had, and tackled, similar problems.

9.2.1. Procedural Model for Acquiring Foreign Technology

10.2.1. Procedural Model for Acquiring Foreign Technology

This procedural model (suggested for the acquisition of foreign technology) is based on the combination of the research findings and the experiences of some developed countries.

Figure 10.2.1. divides the model (which incorporates iterations) into 4 phases: Phase I is constant Research and Development, Phase II is Decision and Approval to set up a Technology, Phase III is Procurement of the Technology, and Phase IV is Implementation of the Technology.

The participants to be involved in the model are shown in Figure 10.2.2.

Functions to be performed in phase I by a central body* include:

1. To compile societal problems and needs based on continuous 'market research'.
2. To liaise between society and industry so as to guide industries to researches that would contribute to the requirements of the society.
3. To coordinate researches between all research institutions, (industrial or technological or academic)
4. To monitor and compile international researches that are of interest to the country, through the personnel in its offices; this may involve subsequent modifications and/or further development of imported ideas and semi-developed concepts.
5. To advise on past and current researches at national and international levels.

This Central R & D body should be jointly financed by the government, industries and the banks. This will promote a strong cooperation between the industries and the government which invariably will spill over to the universities.

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* Currently, there is no central coordinating body and therefore these functions are missing. The Office of Industrial Research, Oshodi, in Lagos, is charged with the responsibility of ordering government interests in its industrial projects. These projects not only exclude outside industrial and academic projects, but they focus mainly on industrial interest at the expense of basic researches that would provide and ensure the social needs. The Central Bank of Nigeria, the Nigerian Institute of Social and Economic Research, and some other interested bodies attempt to liaise between the society and the industries, but only haphazardly for all they are capable of doing.

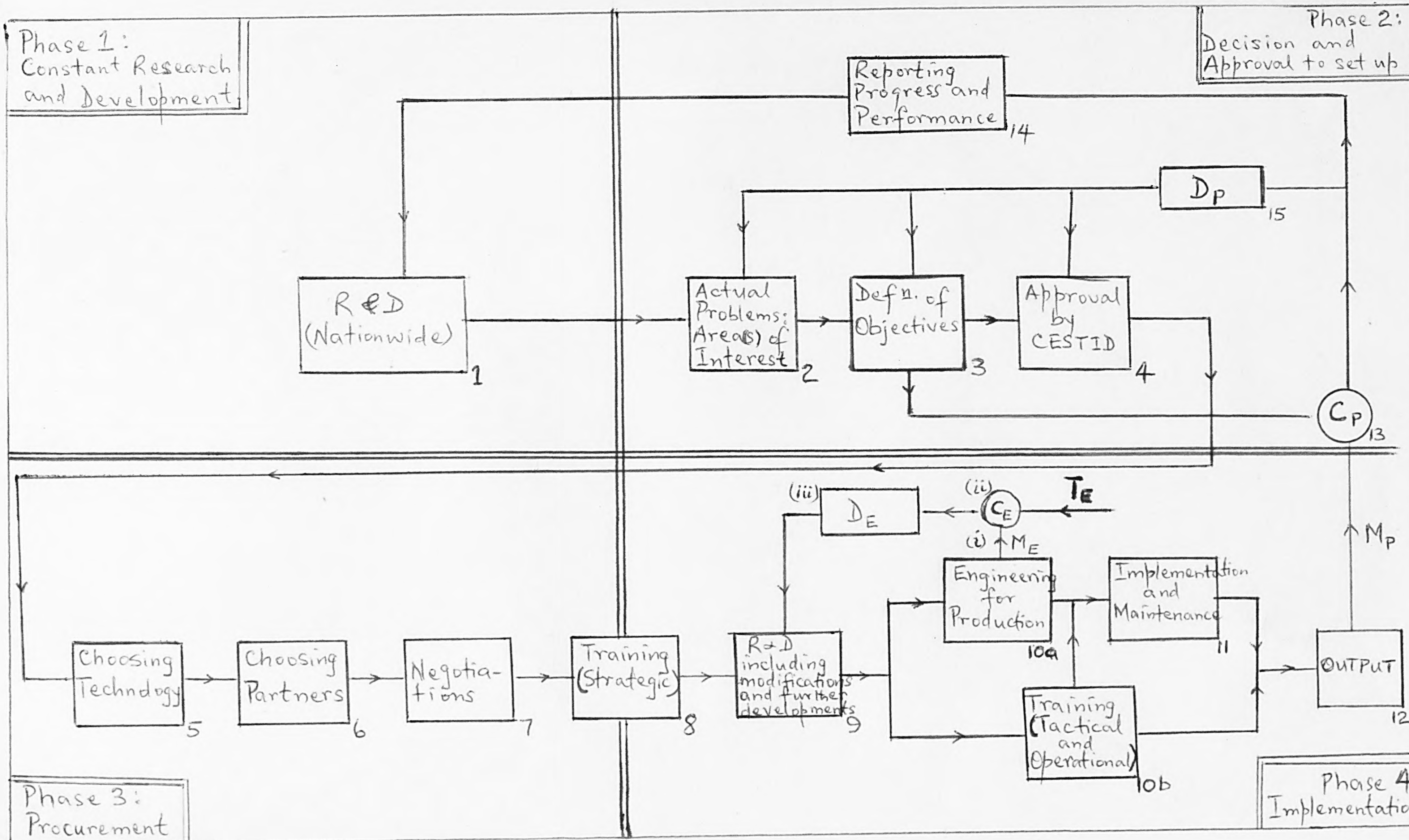


Fig. 10.2.1. Suggested Model of Technology Transfer Process into Developing Countries.

*(The participants involved and their interactions are as shown in Fig. 10.2.2.)

Participants Involved in Transfer of Technology, and their Interactions

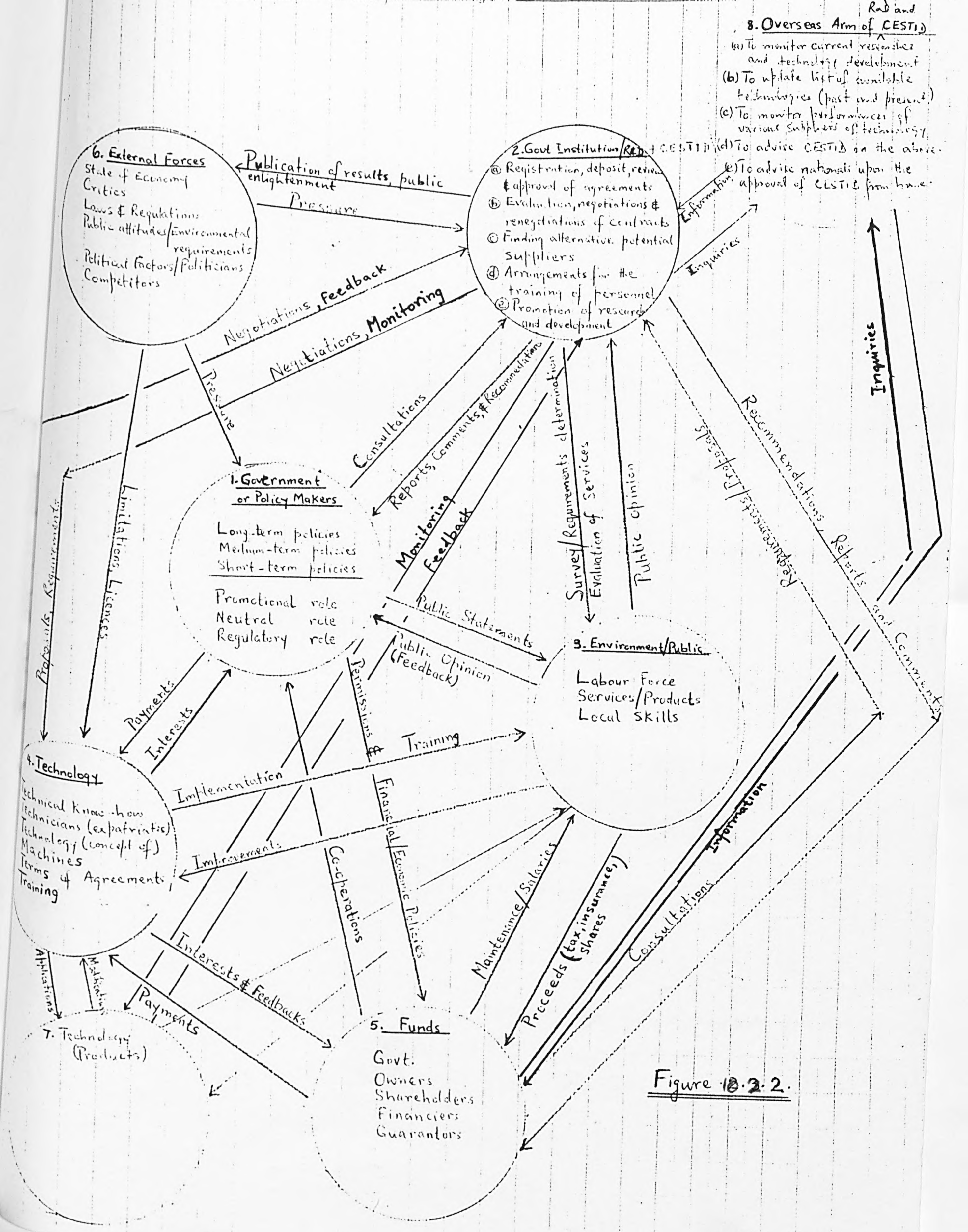


Figure 10.2.2.

For international technologies, the R & D body will have several employees assigned for several years to all major developed countries (such as the U.K., U.S.S.R., other countries in Europe, Japan, U.S.A., etc) to keep an eye on current and relevant researches going on, the methods, and their relative costs and chances of success. This group of personnel is shown in circle (8) in Fig. 10.2.2. This overseas group will constantly be vigil on the development of old and new technologies in the market.

For fast exchange of information between the R & D body and the overseas group, there should be various provisions of working telex, telephones, and computers (equipped with video systems).

The present bodies of Business Advisory Committee (BAB) and Nigerian Office of Industrial Property (NOIP) should be merged into one body, say the Committee for Economic, Social, Technological and Industrial Development of Nigeria (CESTID) as in phase II of the model. This arrangement will remove the current duplication of functions by the two bodies, as well as shorten the approval-seeking time of the enterpreneur. By keeping in touch with home R & D body and the Overseas arm of the body, CESTID can keep records of successful and unsuccessful technologies, as well as record of foreign authors. These up-to-date items of information will be useful in advising prospective industrialists who seek approval to set up, particularly on choice of technology, the suppliers and methods of negotiation (as indicated in phase III of the model). Registration of the industrial enterprise will also be the function of CESTID.

Phase IV is the implementation of the technology and was expanded in Figure 2.3.7. It has an in-built control mechanism which allows evaluation of outputs by comparing them with pre-defined objectives and taking corrective actions. In the model,

T - denotes objective as an input to the comparison unit.

M - denotes measured output as an input to comparison unit.

C - denotes a comparison unit for output (performance) and objective (target)

D - denotes action to align outputs and objectives if there are differencies between T and M (E or P).

E - represents interim output obtained from pilot tests

P - represents final output ready for evaluation

As would be observed from the model, CESTID has been charged with the responsibility of monitoring performances of implemented technologies, as well as instructing corrective actions to appropriate bodies such that would allow defined level of objectives to be met. This is done in phase IV, but because it relates to CESTID, it is shown in phase II simply to show who does it.

Strategic training should be an on-going process, and for any particular project, it should start right after all negotiations have been reached, i.e. before any further modifications or developments to the 'imported' technology. Tactical and operational trainings are advised to be in parallel with testing and implementation. This will allow the local nationals to gain on-the-job experiences and should therefore be able to maintain the system, after the departure of the foreign supplier. In certain cases, the trainings may come before actual implementation if the objective is for the 'locals' to install the technology on their own.

The Strength of the Model.

Various advantages that this model enjoys over the current procedures have been mentioned here and there in the discussions: these arrangements would reduce very drastically the effects of the pitfalls of the current model. In particular the following benefits will ensue:-

1. International Research and development activities are easily monitored and kept up-to-date. Local research and development are also monitored and well coordinated.
2. Public needs are ascertained, and local researches tuned in these directions.
3. CESTID avoids duplication of functions by BAB and NOIP.
4 By involving CESTID at the early stage, the industrialist is likely to reduce the number of iterations that currently occur in phase III.
5. Because the industrialist will deal with only CESTID instead of BAB and NOIP as in current practice, the rigours he will go through and the time he waits for approval will be drastically reduced.
6. Joint financing by government, industries and banks will foster greater cooperation between the bodies.
7. Paperworks are likely to be reduced.

8. The in-built control mechanism will enhance the achievement of desired level of objectives, since deviations between outputs and objectives are detected regularly and corrective actions are taken immediately after.

9. The training arrangements will allow the local nationals to be able to maintain the system, thereby achieving some level of self-reliance.

10. Finally, but surely not the least important, the first three phases of the model can be run concurrently (if need be) because there is a central body (CESTID) in the three phases. Since the central body (CESTID) has international representatives who are conversant with the operational demands of foreign technologies as well as the cultural requirements of the transferee, this arrangement will

    (a) remove the problems of communications between the transferee and the transferer especially over the cultures and the styles of management, and

    (b) minimise direct conflicts of interests between the transferee and the transferer

Lastly, phase IV allows good planning and sequencing of events, as well as easy linkages between the various activities.

10.2.2. Towards Better Diffusion of Technology and its Know-how

Diffusion is here defined as the passing (or passage) of technology, its know-how, new techniques and products from the innovators to those that would apply these elements. Simply put, it is the process by which an innovation is spread through communication channels (e.g. through trainings) to members of a social system (for example, firms in an industry) over time. In order to influence the diffusion process positively, the following factors are recommended to be examined critically:

(i) Calibre of trainees
(ii) Types of trainings
(iii) Quantity (or Mix) of trainings
(iv) Timing of trainings, and
(v) Seqence of trainings.

10.2.2.1. Calibre of trainees.

The profile of those likely to be good managers of technological innovation (as contained in the findings of chapter VII) are:

(i) Age : 30 - 44 years

(ii) Education : Formal degree not necessary (but would be useful)

(iii) Training: (i.e. previous exposures)both local and foreign

(iv) Experience: Not less than 5 years of working

10.2.2.2. Types of trainings.

Figure 10.2.3. is a recommended model for effective diffusion of technology. Its focus is the types of trainings to be given to technical managers (and other technical personnel). The upper segment of the model represents the inventor's environment (where the major activities (from research through development, engineering to marketing and sales take place) while the lower portion represents the environment of the user of the new system. However, Marketing and Sales could be done in either environment. The frontier between the two environments represents the mechanisms of procuring the new technique or system: these include licensing, patency, aids, purchases, other agreements, etc. Occasionally, training is supplemented by some more advance courses (usually through attachments) in the inventor's environment. Trainings at environment (a) are often of practical nature, whereas trainings at (b) would be both theoretical and practical.

The arrangements shown in (b) indicate trainings done in parallel with installation and operations, after which the trainees are able to carry out maintenance of the system after it has been installed and made operational.

Trainings should be of three main types:-

(i) Trainings for operations,

(ii) Tactical trainings, and

(iii) Strategic trainings

and should contain the following elements:

(a) Knowledge of the work

(b) Knowledge of responsibilities

(c) Skill in instructing

(d) Skill in leading

(e) Skill in improving methods

(f) Skill in marketing

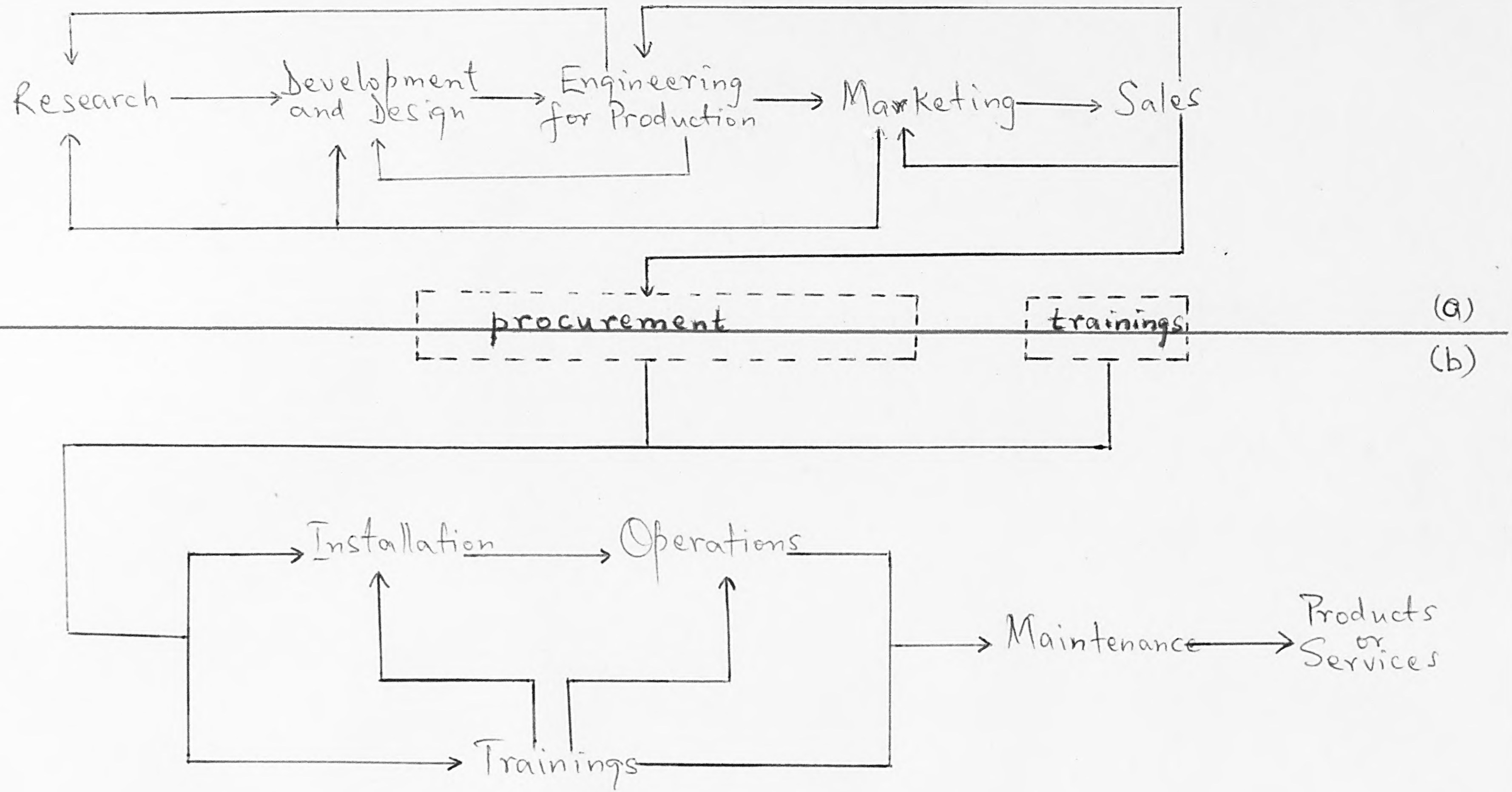


Figure 10.2.3. A Linear Model of Diffusion of Technology

If the middle management (particularly in developing countries) possess the foregoings, the problems arising from operating systems, managerial systems, lack of technical know-how and part of problems arising from bad management (i.e. societal interface) that were identified in chapter VI will be reduced.

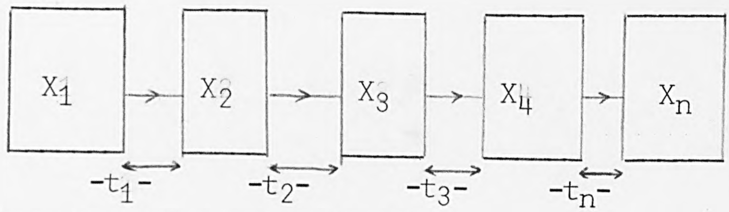
10.2.2.3. Quantity (or Mix) of trainings.

(i) It is suggested that managers require between 200 and 600 man-hours training. These hours could be spread over two to three (2-3) years, aimed at producing persons with new ideas to introduce original innovations.

(ii) On the average, a quantum of about 300 hours of management training is necessary to get a strategic effect.

(iii) Tactical training (designed for securing results quickly especially under immediate pressure) can not be very long because of the urgency involved. Sabbatical Leave Programmes of six (6) months to twelve (12) months duration should enable one to become immersed in an active atmosphere and to draw on the extensive resources of the new community. Alternatively, a total of 400-1200 man-hours might be required, divided into blocks and spread over one to two years. Each block of training (x) should not be less than two weeks and the periods (or breaks) between the blocks (t) should not be longer then three (3) months, as illustrated below:-

Blocks



The following constraints are suggested:

(a) $X_i \geqslant$ 2 weeks

(b) $t_i \leqslant$ 3 months

(c) $$12 \text{ months} \leqslant \left[\sum_{i=1}^{i=n} x_i + \sum_{i=1}^{i=n} t_i\right] \leqslant 24 \text{ months}$$

(d) $400 \text{ man-hours} \leq \Sigma y \leq 1200 \text{ man-hours}$

(where y = hours of physical learning).

(iv) Operational training (geared towards keeping the current operations going) should consist of short courses of two to ten (2 - 10) days duration for quick familiarisation with a specific topic.

(v) The relative investment in tactical and strategic trainings should be about 4 to 1, i.e. from 80% to 20% of the total training effort in tactical training and the balance in strategic training, depending on the requirements of the situation.

10.2.2.4. Timing of trainings.

(i) Operational trainings should normally be in parallel with implementation and should be on-the-job.

(ii) Tactical trainings could also be given at this point in time and could be on-the-job, and in some cases, before or after implementation.

(iii) Strategic trainings should take place before implementation (like the Iron and Steel Industry in Nigeria); occasionally, they could take place after the physical installations and operations. Strategic training before implementation provides a pool of planners of tactical trainings, while strategic training after implementation ensures innovations for improving the implemented technology.

10.2.2.5 Sequence of trainings.

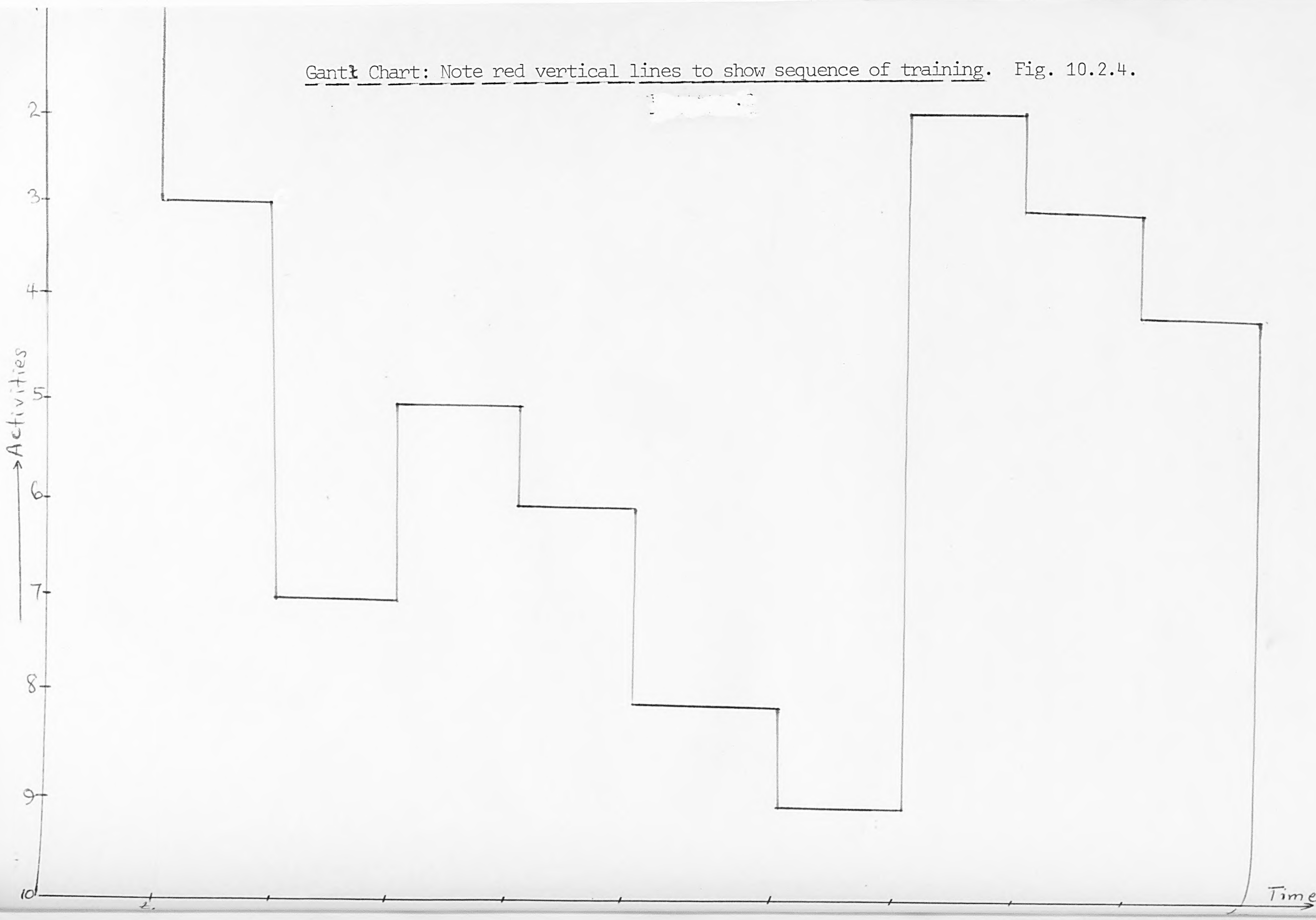
When the content and objectives of training have been agreed, the training programme itself can be drawn up. The two most important decisions to be taken are those about sequence and pace. Sequence is affected by the 'immediate needs' of the organisation while the pace has to be related to the objectives of the training which set the target of when the man should be available, and also the capacity of the trainee.

Figure 10.2.4. reflects the importance attached to overcoming problems of operating procedures before say marketing or skill in planning. To overcome immediate problems of technical operations, the schedule would concentrate on step 8 as well as allowing some activities in

KEY: to Fig. 10.2.4.

1. Knowledge of the organisation of the industry (i.e. Induction Training) to know the organisational structure of the company, the output required, the machines used and the materials needed and available, including rules and regulations.
2. Knowledge of responsibilities: to know the Administrative procedures.
3. Knowledge of operating procedures: to possess the essential skills of producing output)(s) from input(s).
4. Skill in leading: Leadership training,including ability to transfer knowledge and dexterity to employees, and reducing the probability of human problems developing.
5. Skill in planning: ability to organise resources (time, money, men, materials, etc).
6. Production management: the application of (5) above, ensuring the maximum utilisation of the planned resources.
7. Marketing: technique of gathering, updating and understanding information for purposes of having knowledge of the consumer's behaviour, to ensure that the right (desired) product is produced; ability to communicate with the outside environment after understanding the relationship between the industry and the external environment.
8. Production Control:skill in recognising and bringing about improvements in the use of time, space, men, materials and machines, particularly if the system goes wrong.
9. Finance: Cash flows, budgetting, accounts, financial appraisals, sources of funds and ability to raise same.
10. Successful Manager ready to "work"

Gantt Chart: Note red vertical lines to show sequence of training. Fig. 10.2.4.



steps 4 and 5. A whole series of different arrangements can be derived and applied from this model (depending on the pressing need(s) of the industry), thereby increasing the probability of success of the rest of the exercise.

The estimates of t_1, t_2, t_3, ...t_n in Table 10.2.5. bear in mind the constraints contained in Section 10.2.2.3. but in actual practice, would vary according to the objectives of the training and other prevailing factors in the industry and its enviroment.

Table 10.2.5. <u>Estimates of Duration of Training Blocks (in Weeks)</u>

t_i	Activity to be Undertaken	Suggested Duration	t_i	Activity to be Undertaken	Suggested Duration
t_i	Induction Training	$\frac{1}{2}$ - 1	t_6	Production control	2 - 4
t_2	Operating Procedures	3 - 4	t_7	Finance and Accounting	2 - 4
t_3	Marketing	3 - 6	t_8	Administrative procedures	4 - 6
t_4	Skill in Planning	2 - 4	t_9	Advanced (or new) Operative procedures	3 - 4
t_5	Production Management	2 - 4	t_{10}	Leadership training	Indefinite: until he leaves the organisation

The essence of putting (4) last is to avoid the trainee going through the course with the explicit and pompous belief that he is everything of a leader, and belongs only to a special part of the oragnisation. This is particularly true of developing countries where leadership is synonymous with being a <u>father</u> in an African context: the father's word is final and can not be wrong.

The estimates reflect the importance of knowledge of operating procedures because technology-related problems are severe in developing countries (See result of the P & T exercise). Attention is also paid to planning and production management: these are aimed at solving problems relating to system of operation.

A balance is struck for marketing (as it is important in the West, but not very important in developing countries - there is ready market for almost any product).

As for knowledge of responsibilities, this should be in-built in almost all the other activities.

10.2.3. Making Available Technology Effective

The responsibility of ensuring that the diffused (or available) technology is utilised to the maximum benefit of the 'benefactor' lies with the manager. The most desired output of the technology may well be its application to predict, avoid and/or solve the problems of the larger society. This optimum demand from the usage of technology calls for three important variables from the manager(s). viz. his perception of societal problems, his attitude to the problems and his know-how to tackle these problems, in that order, as contained in part of the recommendations of chapter VIII. These suggestions may be very pertinent (and therefore valuable) to Nigerian situation because an investigation conducted between January and June, 1983 revealed that Nigerian managers believe very strongly ONLY in a manager's individual know-how to tackle problems, and that his perception and attitude are 'only academic', or are at best of minimal importance.

10.3.0. Difficulties of Research and Limitations of Findings

As in most ventures some difficulties were encountered during the period of this research. As expected, the most outstanding were lack of finance and 'enough' time to enlarge the scope of the research to cover many countries in greater details. Complementing these difficulties was lack of adequate facilities to gather some much - needed data from different points in developing countries.

Consequently, the study reduced its scope of operations, thereby covering few developing countries in general and Nigeria in very great details. The rationale behind this is that these few countries chosen for the study (in particular, Nigeria) are good representations of the developing world. Invariably, such types of reduction in the scope of coverage tend to affect the degree of acceptance of the results; but when these results are viewed in light of the constraints then the scale of acceptance should not suffer serious set-backs. Some of the research problems are enumerated below.

10.3.1. Research Problems.

(i) The greatest difficulty in assessing technology in Nigeria is non-availability of data, and when the data is available, its reliability is questionable. A typical example is the output (or Turnovers) of companies discussed in Section 7.4. where for a certain company, its output for four (4) successive years were given as N95m, N28m, N155m and N113m (N1 = £0.80). This set of figures looked suspicious and was thought to demand a recheck; the recheck produced N128m for the second year instead of the original N28m. There were other examples during the data collection.

It is probably unkind to present the case this way (that is, as if no data is ever correct), but the seriousness or consequences of incorrect data cannot be overemphasised. This error of commission is probably more harmful than total lack of data, as it can lead to wrong decisions being made. If there are no data at all, then judgement is simply left to intution (this is a case of "the better of two evils").

(ii) There was, generally, lack of cooperation from those involved in managing technology in supplying much needed data especially to researchers from universities. There may be the need to protect some industrial confidential records or information, but there is a greater need for cooperation between the industries, government agencies and the universities in exchaning data and knowledge to arrive at the common goal of technological development.

This lack of cooperation is attributable to two variables

(a) Bureaucracy - " I do not have the authority to relaease such data. You will have to go to my boss for permission". These were typical responses from the respondents during data gathering.

(b) Conflict among, and lack of co-ordination of, people in different roles; the effects of which split over to, and hampered research studies.

(iii) A difficulty may be a delay of information, as indeed it was in this study. The postal system in the country is so terribly bad that a letter posted from Ibadan to Lagos (a distance less than 80 miles) will take between 1 - 2 weeks to arrive at the destination. Unfortunately, the process of data gathering could not be quickened by using the telephone because that, too, just won't work. And so, most of the data had to be gathered by making very long journeys to the sources, hoping and praying that the data would be available and the people in charge would be willing to release such data.

10.3.2. <u>Effects of the Research Problems on the Findings</u>.

(i) Difficulties of finding reliable aevidence of what happened inadvertently limit the validity of many project evaluations and, at the same time, the validity of synthetic studies such as this one. The usefulness of monitoring the results (and accurately too) of an innovation is not only to inform others. It is also useful to inform oneself in order that:

(a) more information be available to improve the project in its next phase

(b) the innovation can be compared to other possible options and

(c) that decisions can be made on the extension or generalisation of the innovation to other settings.

In developing countries where resources are scarce and procedural infrastructure limited in its capacity, these three functions, in particular the last two, are especially crucial.

(ii) Havelock and Huberman (1) showed that poor interpersonal relations in developing countries (i.e. poor climate for sharing ideas openly) are barriers to innovation with a loading (degree of relationship) of 0.59. If lack of cooperation in supplying data can affect innovation in its entirety by as much a loading as 0.59 then it is reasonable to infer that the same factor might affect the validity of the data (when supplied) by a much higher degree.

(iii) The costs, strains and stresses of the long journeys made to the sources of the data reduced the coverage of the research. A much larger sample than the one obtained might have increased the confidence of the results-

10.3.3. Possibilities for Further Research.

(i) Many categories of problems of technological change have been looked into, viz. Economic (2,3), Financial (4) Employment and and Unemployment (5,6) and Choice (7), in developing countries Others were oriented to Legislation and Accounting. But there hadn't been any research(es) oriented towards the management aspect of technological innovation indeveloping countries. There are, therefore, the needs for more, much more research into the problems of technological management. This research is perhaps more a plea for further research than anything else.

(ii) An attempt was made in chapter VII to study the effects of labour turnover in the P & T (Nigeria). Unfortunately, the records of those who have left the organisation were not made available to the author. It is recommended that a further research is undertaken to study the records of past personnel so as to have a meaningful correlation between length of service and other factors, e.g. labour turnover.

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(2) Strassman, W.P.; Technological Change and Economic Development: The Manufacturing Experience of Puerto Rico; Ithaca, Cornell University Press, 1968

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(6) Technological Development and Unemployment (Nairobi);Univ., Institute for Development Studies (1974) 29 pages.

(7) Technological Development Centre of Japan; Technological Choice in Thai Sericulture/Katsuo Otsuka (Tokyo). (1979).

(iii) Also in Chapter VII, we attempted to study the development of technical staff in relation to the total staff of the companies understudied. It would be interesting to see how different companies faired in their proportions of technical staff, (as opposed to know how the companies are lumped together in Table 7.2.2.)

(iv) It would be valuable if there are evicences (through) research) to show the desirability or otherwise for companies to do their own research and development, rather than having it done for them by the universities (See Table 7.2.3.2.).

(v) In Chapter II, we suggested that ~~ehe~~ the 'best' model of the innovative process and hence most successful way of understanding the innovative process is itself an open question and is a potentially valuable research project.

(vi) In one of the recommendations to reduce problems of technology transfer (See Section 10.2.2.2.) we suggested '~~better~~' 'better' trainings for innovative managers. In order to enjoy the full benefit of such trainings a further research is ~~necessary~~ necessary to determine the right mix of training blocks.

(vii) In addition, it would be very useful if a research project is undertaken using, say, Q-theory to see if the time spent by expatriates in teaching the local personnel can be reduced, paying special attention to any possible omissions of Section 10.2.2.1.

(viii) Finally, the table below shows the inclination of enterpreneurs in relation to what sectors of the economy they operate in.

Sector Ownership	Manufacturing	Distribution Services	Educat-ional Services	Construc-tion	Consul-tancy	Others	Total
Indigenious (Private)	-	-	-	9	-	-	9
Indigenous (Govt)	6	4	5	-	4	-	19
Joint Ventures	12	7		5	-	-	24
Subs. of Foreign Partners	-	3	-	6	-	4	13
Others	4	-	-	4	3		11
Total	22	14	5	24	7	4	76

Source: Questionaire for Chapter VII. (Question 4 VS. Question 3).

Indigenous private investors seem to be interested mainly, if not only, in the Construction Sector. This is where the major contracts are awarded. The private enterpreneurs have not taken any active part in the manufacturing Sector, which has proved to be the most promising sector (See Section 7.22.). The government has tried to have a hand in almost all the Sectors - this is commendable and infact, the efforts seem to be evenly distributed.

The Joint Ventures seem to be mainly interested in the Manufacturing and Distributive trades, and don't seem to be interested in Consultancy business. It is only in the Construction Sector that you find that everybody participates except the government, and conversely, nobody takes any interest in the educational services except the government.

It will therefore be desirable for a further research to look into those factors that will encourage operations in all sectors in fair proportions but with the manufacturing and educational services having larger shares.