

ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

SCHOOL OF INFORMATION STUDIES FOR AFRICA

**SCIENTIFIC AND TECHNOLOGICAL INFORMATION SUPPORT TO
INDUSTRIAL DEVELOPMENT IN KENYA WITH EMPHASIS ON
INTER-INSTITUTIONAL CC-OPERATION**

**A THESIS SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN
INFORMATION SCIENCE**

BY

JOHN KIPNGETICH CHEPKWONY

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JOHN KIPNGETICH CHEPKWONY

Approval by the board of Examiners:

Getachew Birru

Chairman, School Graduate Committee

A. Neelameghan

Advisor

G. Bhattacharyya

Advisor

Taye Tadesse

Examiner

S. Seetharama

Examiner

Examiner

Getachew Birru

[Signature]

G. Bhattacharyya

[Signature]

S. Seetharama

DECLARATION

The thesis is my original work and has not been presented
for a degree in any other university




(Signed)

John Kipngetich Chepkwony

31 May, 1993

The thesis has been submitted for examination with my
approval as a university advisor



(Signed)

Professor A. Neelameghan

31 May, 1993



(Signed)

Doctor G. Bhattacharrya

31 May, 1993

DEDICATION

To my wife Rhoda, and Daughter Petrica

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ABSTRACT

The importance of information in development has been accepted internationally. The present study examines the ways of providing scientific, technological and managerial information, necessary for industrial development in Kenya.

The document reviews the industrialization process in Kenya from the early part of this century and more particularly during the post-independence period. In this context, consideration has been given to: the structural adjustments programmes and policies adopted by the government, and the role of small scale industries in national economy. The institutions that support industrialization is also discussed.

Problems that hamper industrialization, such as, technology transfer methods and modalities adopted; lack of industrial information support systems; lack of appropriate policies; manpower, managerial and financial resources; inefficient co-ordination mechanism; and the complex patenting procedures, are reviewed.

Technology transfer to developing countries with emphasis on Kenya, is discussed and the impediments to

the process are mentioned. The deficiency of information support services in Kenya for efficient and effective transfer of technology to small enterprises in particular is pointed out.

The information needs of industries are discussed with due consideration of information for management, market information and financial information. Existing Information systems specifically to promote industrialization in Kenya include the Kenya Scientific Information, Documentation and Communication Centre (KENSIDOC), Kenya Industrial Research and Development Institute (KIRDI) library, Investment Promotion Centre (IPC) Information Centre, and the Ministry of Commerce and Industry library. Their activities are briefly reviewed.

The results of the study shows that the co-operation between the institutions responsible for the promotion of industrial development in Kenya is weak; and their linkages with the industries are also weak. The information systems set up to provide industrial information are not providing appropriate information services, such as, the current awareness services

(including selective dissemination of information), information analysis and consolidation, database services and translation services.

The Kenya Scientific Information, Documentation and Communication Centre (KENSIDOC) is seen to have a major role in the provision of scientific and technological and related information to the small enterprises and other organizations concerned with industrialization in the country. The study examines through systems analysis the features and factors of the Centre that need strengthening and enhancement to enable it perform its functions efficiently and effectively, and appropriate recommendations are made. A prototype database consisting of profiles of institutions, experts, research projects, information systems and bibliographic records, and another database of relevant national regulations (mainly industrial laws and regulations) has been created. The prototype database can be adapted by KENSIDOC and other information systems that provide information to entrepreneurs, researchers, government executives, etc. The thesis concludes with recommendations to assist in the promotion of industrial development in Kenya.

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LIST OF ABBREVIATIONS

- ADIPA - Association of Development Research and Training Institutes of Asia and the Pacific
- CBK - Central Bank of Kenya
- DFCK - Development Finance Company of Kenya
- EPZ - Export Processing Zone
- GDP - Gross Domestic Product
- GNP - Gross National Product
- ICCS - International Centre for Chemical Studies
- ICDC - Industrial and Commercial Development Corporation**
- IDC - Industrial Development Corporation
- ILO - International Labour Organisation
- IPC - Investment Promotion Centre
- IS - Import Substitution
- KARI - Kenya Agricultural Research Institute
- KBS - Kenya Bureau of Standards
- KEFRI - Kenya Forestry Research Institute
- KEMFRI - Kenya Marine and Fisheries Research Institute
- KEMRI - Kenya Medical Research Institute
- KENSIDOC - Kenya Scientific Information, Documentation and Communication Centre
- KETA - Kenya External Trade Authority**

KETRI	- Kenya Trypanomiasis Research Institute
KIE	- Kenya Industrial Estates
KIPO	- Kenya Industrial Property Office
KIRDI	- Kenya Industrial Research and Development Institute
KITI	- Kenya Institute of Industrial Training
KNAAAS	- Kenya National Academy of Applied Arts and Sciences
KPTC	- Kenya Posts and Telecommunication
KTDC	- Kenya Tourist Development Corporation
MIS	- Management Information System
NCST	- National Council for Science and Technology
OAU	- Organization of African Unity
PDS	- Product-Distribution System
PTA	- Preferential Trade Area
R&D	- Research and Development
SEFCO	- Small Enterprises Finance Company Ltd
SSI	- Small Scale Industries
S&T	- Science and Technology
UK	- United Kingdom
UNCTAD	- United Nations Conference on Trade and Development
UNDP	- United Nations Educational, Scientific and Cultural Organization

- UNIDO - United Nations Industrial Development
Organization
- UNISIST - United Nations Information Systems in
Science and Technology

CHAPTER ONE

INTRODUCTION

1.1 PROBLEM DEFINITION AND JUSTIFICATION FOR THE STUDY

1.1.1 African Economy

The status of the economy of African countries, especially Sub-Saharan Africa (SSA) is very low: substantial proportion of the population of these countries live below the subsistence level (see Appendix 1). At present, there is a serious economic crisis as pointed out by financial international bodies and aid agencies, such as, the World Bank and International Monetary Fund (IMF). These institutions have recommended various structural and stabilization adjustments to the economy of African countries, including Kenya. The adjustments encompass demand management policies which control domestic budgetary trends and improve the balance of payments. Exchange rate devaluation, real wage reductions, and positive interest rate realization are some of the measures introduced to redress macro-economic imbalances.

The fact that the global economy is an open system makes it difficult to establish the exact cause of particular economic problems facing the continent. What is noticeable, however, is a persistent lack of technological advancement a pre-condition for economic development. Even in structures where the scientific and technological potential of a country is high and its endogenous scientific development already tuned to national priorities, a good part of the technology used is of foreign origin.

Many African countries are poor, with growth rates far below the world average; or to be more accurate, they are adversely affected by the growing inequality of world's growth. Without showing a complete statistical account of the present state of the African economies, it is pertinent to point to the main features of each national economy. These are the weakness of agricultural production and even more of the industrial production, the very inadequate food production in some countries, and the glaring lack of technical means of production or of exploiting national resources. In 1979 the national income per head in nearly 35 countries of Africa and its outlying islands was less than US \$ 500 (OAU 1982), and in ten richest countries of the world over US \$ 10,000. The economic crisis of the African countries can further

be elaborated by their GDPs as shown in Appendix 1. The negative rates of the growth of GDP for most of the African countries is something to worry about.

The evolution of African economies in the last three decades has been marked by rapid shifts influenced by internal and external factors. The traditional economies that characterized the pre-colonial period are being transformed by the introduction of new economic activities and forms of social organization. These irreversible changes play a significant role in influencing the current situation in Africa. This, however, does not mean the economic situation in Africa can be blamed on one primary factor. Far from it. The economic conditions are partly a result of the complex interplay between the initial conditions and other factors that have emerged during the post-colonial period.

Access to technology as well as its effective transfer and diffusion are critical problems in the structural changes taking place in Developing Countries (DCs), including Africa. Usually one or two constraining factors are identified as the major impediments to the development of effective transfer and diffusion of technological know-how. In delineating these factors,

political instability and the low levels of education and skill are mentioned as the primary causes. Socio-cultural and geographical factors also have been frequently cited. A factor which is not always cited is the national policies and strategies applied.

1.1.2 Science and Technology support to Industrialization in Africa

Regarding industrialization, UNIDO classifies countries in four major categories:

- a) the industrialized countries in which industry accounts for more than 30 percent of the GNP;
- b) semi-industrialized countries in which industry accounts for between 20 and 30 percent of the GNP;
- c) countries in the course of industrialization, in which industry accounts for between 10 and 20 percent of the GNP; and
- d) non-industrialized countries, in which industry accounts for less than 10 percent of the GNP.

By the above standards, in 1977 no African country was industrialized, 16 countries were in the course of industrialization, 21 were non-industrialized and the rest semi-industrialized (OAU 1982). But even this

comprehensive definition of industrialization is unsound, as it relates to the national production of each country, and does not specify the composition of the industry. In fact very few African countries are in the course of coherent integrated industrialization; and where the take-off stage is reached, it is by industries whose production factors (equipment, machines and technology) are imported and hardly affect other sectors of the national economy, being concerned principally with assembly or industries linked with foreign companies exploiting natural resources (OAU 1982).

Industrialization and technological development are now the major strategies for economic development in all African countries. The African governments have realized that probably the only way to increase their Gross National Product (GNP), alleviate poverty, and reduce dependence on the developed countries is to apply science and technology know-how to industrial development. They have, therefore, accorded a major role to industrialization in their development plans, and the period 1980-1990 was proclaimed by the countries as the "Industrial Development Decade in Africa".

The industrialization of Africa in general, and of each country, constitutes a fundamental option in the total range of activities aimed at freeing Africa from underdevelopment and economic dependence. The integrated economic and social development of Africa demands the creation of an industrial base designed to meet the interests of the country, strengthened by complementary activities at the sub-regional and regional levels. Industrialization of this kind will contribute, inter alia, to:

- a) the satisfaction of basic needs of the population;
- b) the exploitation of local natural resources;
- c) the creation of jobs;
- d) the establishment of a base for developing other sectors;
- e) the creation of the basis for assimilating and promoting technological progress; and
- f) the modernisation of society.

The need for science and technology in development has been a subject of discussion at various levels of government in many countries in Africa for the last two decades. Despite the increasing awareness on the role of

science and technology for development, African countries do not invest much in research and development and in training of the skilled manpower to sustain scientific creativity and technological innovation. Table 1.1 shows that from 1970, Africa has always spent less than 0.4 percent of her GNP on research and development, compared to an average of 2.11 percent in America and 1.75 in Europe. In absolute terms, Africa spends a mere 0.66 percent of total research and development expenditure of the countries shown in the table, compared to 40.1 percent in USA and 40.3 percent in Europe.

Table 1.1 - Research and Development Expenditure

Continent	1970		1980	
	US \$ Million	As % of GNP	US \$ Million	As % of GNP
Africa	188	0.34	1,156	0.36
America	28,118	2.28	70,391	1.94
Asia	4,572	0.99	31,230	1.08
Europe	15,739	1.70	70,649	1.79
Oceania	497	1.10	1,953	1.11
Total	49,114	2.04	175,379	1.78

source: UNESCO, 1989.

The awareness of the importance of science and technology for development has led to the establishment of institutional framework to facilitate transfer of

technology from industrialized countries to Africa. Many countries in Africa developed modern scientific and technological institutions but failed to establish an indigenous scientific base. As a result, the contribution of the institutions has almost always been below expectations in terms of enhancing the social and economic development. This has forced African countries to rely on the importation of turn-key industrial projects that are based on technologies that may not be appropriate to local conditions.

The experience of the industrialized countries has shown that there is an inseparable linkage between institutions set up to exploit the potential of science and technology and industry. The development of institutions for generating technical change in agriculture and industry was not based on replicating "wholesale" models from other countries, but on choosing, adapting and modifying the systems to fit in the existing local environments.

The lack of contact between scientific and technological institutions and the productive sector in Africa has been explained by historical factors. Firstly, most African countries inherited a skewed education system which was mainly aimed at producing technocrats

and bureaucrats to service the administrative set-up of the colonial governments. The education system, thus, never incorporated the practical orientation needed to make the work of scientists and engineers relevant to the needs of the indigenous agricultural and industrial sectors. Secondly, as African countries became independent, many new governments saw industrialization as an indispensable strategy to accelerate economic change and development and reduce dependence on the developed world. Most African countries pursued the import-substitution industrialization strategy with the objective of locally producing finished consumer goods to compete and displace expensive imports. This industrialization strategy necessitated heavy importation of machinery, equipment and high level management and technical personnel. There was no motivation for entrepreneurs to look for local inputs.

1.1.3 Kenyan Economy

The development of the Kenyan economy since 1963 was satisfactory in most of its dimensions during the first decade. Nevertheless, the international shocks of the 1970s such as the oil price rise, the collapse of the East African Community and in addition, the high rate of

population growth imposed serious pressures upon the Kenyan economic structure. In an effort to return to a stable growth path, Kenya has addressed, and will continue to address, the potential of agriculture, the investment environment, the efficiency of Government's use of resources and the major welfare distribution characteristics (Kenya Development Plan 1989-1993).

A look at the major contributions to GDP in 1983 and projection of 1988 reveals the situation of Kenyan economy as shown in Table 1.2. Agriculture with its contribution to GDP of Kf 938.85 million is the leading sector, followed by Government services with a contribution of Kf 459.89 million, the third being the manufacturing sector with a contribution of Kf 373.09 million. Kenya, like other developing countries has been in a situation of deteriorating terms of trade for raw materials, and, therefore, aspires to transform its agricultural economic base to an industrial one. Both agriculture and manufacturing sectors are controlled by the application and/or use of science and technology. The contributions to GDP could be higher if the transfer of technology was given due consideration.

Kenya has concentrated its scientific and technological efforts on research (R&D) institutions in the biological fields. Relatively little attention has been paid to installing an institutional mechanism for

Table 1.2 - Gross Domestic Product (Constant 1982 Prices)
Kf Million & Percentages

	Actualt 1983	Projected 1988	Target 1993	Annual Growth Rate 1983-88	Annual Growth Rate 1988-93
Traditional Economy	170.48	207.13	246.72	4.0	3.6
Monetary Economy					
1. Agriculture	938.85	1,059.85	1,323.29	2.5	4.5
2. Forestry	21.56	30.16	44.31	6.9	8.0
3. Fishing	10.59	15.10	21.18	7.4	7.0
4. Mining & Qarring	6.42	9.43	13.85	8.0	8.0
5. Manufacturing	373.09	479.94	653.24	5.2	6.4
6. Building & Constrction	105.44	111.60	138.81	1.1	4.5
7. Electricity & Water	47.42	63.33	88.82	6.0	7.0
8. Trade, Restaur- ants & Hotels	295.14	417.21	585.16	7.2	7.0
9. Transport, Sto- rage & Communi- cations	193.23	228.43	301.38	3.4	5.7
10 Finance & Insurance	214.39	270.61	352.34	4.8	5.4
11 Ownership of Dwellings	129.63	136.49	161.33	1.0	3.4
12 Other Services	65.65	94.90	140.73	7.6	8.2
13 Domestic Services	34.88	51.64	77.24	8.2	8.4
14 Government Services	459.89	586.69	748.78	5.0	5.0
Total Monetary Economy	2,896.16	3,555.37	4,650.50	4.2	5.5
Total Traditional & Monetary	3,066.64	3,762.50	4,897.23	4.2	5.4
Population (Mn)	18.75	22.66	27.21	3.8	3.7
GDP per capita (Kf)	163.55	166.04	179.98	0.4	1.6

Source: Kenya Development Plan, 1989-1993

effective transfer and absorption of foreign technology, and for commercialization of results from indigenous R&D institutions.

1.1.4 Industrial performance in Kenya

Although Kenya is one of the more industrialized countries in Eastern and Central Africa, the rate and pattern of industrial growth in the last two decades has not been satisfactory. The share of the manufacturing sector to the country's Gross Domestic Product (GDP) increased from 9.4 to 13.5 percent between 1963 and 1973 but declined sharply in the second decade. For instance, the real growth rate of the manufacturing sector for the period 1976-83 was 7.3 percent per annum, and only 3.5 percent for the period 1980-83 (Ikiara 1986).

Kenya's industrialization process has been disappointing in many other ways. It created too few jobs as compared to the growth of population; many industries tended to use inappropriate capital-intensive technologies; the manufacturing sector continues to depend heavily on imported equipment and raw materials thus aggravating balance of payment problems; the sector has not developed extensive linkages with the rest of the economy; production of consumer goods has been unduly

emphasised at the expense of capital and intermediate goods. Moreover, indigenous Kenyans do not yet control a significant proportion of manufacturing sector and manufactured exports form only a small part of the country's total exports. There is also over-investment in some sectors while other sectors suffer from under-investment (Ikiara 1986).

The weaknesses in Kenya's industrialization have persisted during the last twenty years despite considerable direct and indirect involvement of the government. The government established institutions to provide development finance for industrial enterprises, to promote participation of indigenous entrepreneurs and to provide support services such as Research and Development. The government has also created infrastructure to increase national capacity in vital areas like electricity generation, transport and communication and formation of the necessary manpower skills.

Kenya has tried to harness science and technology for development. This is evidenced by an impressive array of scientific institutions, an appropriately geared educational system, and a commendable allocation of GDP for R&D. The 1987/88 R&D expenditures represented 0.73%

of the GDP for that year (Muturi 1989). A range of researches are being undertaken in research institutes and universities. Kenya has six public research institutes organized under the ministry of Research, Technical Training and Technology. There are also various state corporations and other parastatal organizations which have scientific and technological research branches, some of them having full-fledged scientific research establishments. The four public universities (namely, University of Nairobi, Kenyatta University, Moi University and Egerton University) and private universities are by their respective charters expected to carry out research in an atmosphere of intellectual freedom. There also exist substantial research efforts in the private sector and various non-governmental organizations. The main coordinating body between public and private sector in science and technology policy issues is the National Council for Science and Technology (NCST).

1.1.5 Specific Problem

Kenyan policies and strategies have not clearly stressed the importance of industrial information as a prerequisite to industrial development. Industries established, continue with old technologies for lack of

information about new technologies, hence, the low quality of Kenyan products in some instances. Most of the technologies used are imported and not much emphasis has been put to promote indigenous technologies. Potential entrepreneurs' willingness to invest in industrial projects is low and this could be attributed to the lack of relevant industrial information.

Information required could be financial, market, managerial, scientific, technical, etc. National research institutes and universities undertake research, year after year; in some instances coming up with new technologies which could be applied to local projects. It is not uncommon to find completed research projects (technically and economically viable), in research institutes, universities and other scientific bodies, which are not disseminated or communicated to potential users. This problem has necessitated the undertaking of the present study.

1.1.6 Possible solutions

Several possible solutions exist for the promotion of industrialization in Kenya. The major ones are:

- a. Application of policies and strategies that favour industrialization.
- b. Improvement of information systems and services that support industrialization.
- c. **Strengthening of the inter-institutional cooperation among the various institutions that support industrialization. The interrelationship between the various institutions is closely associated with the flow of information, knowledge and other resources such as finance. Information flow is important because the process of technological innovation is largely adaptive and involves learning and numerous adjustments both in the technology and the related organizational aspects. Thus institutional organization is an integral part of the process of innovation and economic change.**

1.2 OBJECTIVES OF THE SYUDY

The broad objective of this study is to identify mechanisms that facilitate the flow of scientific and technological information from the generators such as research institutes, universities, Government ministries and departments, parastatals, and other scientific and technological institutions, from within the country and from abroad, to the potential users in industry. The specific objectives are:-

- a) To identify scientific and technological information systems and/or services that exist in industries, research institutes, universities, government ministries and departments, parastatals and other scientific and technological institutions.
- b) To examine existing types of co-operation between industries, research institutes and universities, Government ministries and departments, parastatals, and other scientific and technological institutions.
- c) To examine the scientific and technological information flow patterns between the various institutions that support industrialization.

- d) To identify impediments to the flow of scientific and technological information, especially of indigenous technologies.
- e) To examine information support needs of technology management, especially imported technology.
- f) To suggest practical recommendations and possible solutions that could improve the flow of scientific and technological information.
- g) To develop prototype databases of scientific and technological information.

1.3 SIGNIFICANCE OF THE STUDY

The significance of the study arises from the fact that it addresses ways of enhancing industrialization in Kenya, especially the provision of appropriate information to industrialists and potential industrialists. Man requires information to be able to **manipulate the factors of production, i.e. land, labour and capital resources** into productive use. It has become an essential instrument for development. The capacity to generate, process, store, transmit and utilize productive information will determine the social and economic development of a country. In countries like Japan, USA and Britain, the timely availability and accessibility of

information has been a major impetus in the rapid development of their economies. In all aspects of development, the planners, policy makers and implementors require to have relevant, timely and reliable information. Enhancement of industrialization can lead to economic growth, reduction of unemployment, increase in income per capita, etc.

The results of the study will be made available to the National Council for Science and Technology (NCST), an institution that is charged with the advisory role on all matters of science and technology, hence would be communicated and/or disseminated to the relevant users. The following categories of persons are expected to benefit from the results of the research: Industrialists (and other entrepreneurs), researchers, academicians, administrators, planners, policy makers, and others concerned with industrial development in Kenya.

1.4 SCOPE AND LIMITATIONS OF THE STUDY

The scope of this study is confined to the role of information support in enhancing industrialization in Kenya. It deals with industrial information (especially scientific and technical information), its flow patterns in institutions that support industrialization.

The study covers institutions, policies and strategies that support industrialization. technology transfer and information needs of entrepreneurs and industrialists. The study is limited to scientific institutions such as research institutes, universities, parastatals, government ministries and departments, and other scientific and technological institutions; although in some cases it has been necessary to include the financial institutions. The consideration of technology transfer has been limited to that in developing countries with emphasis on Kenya.

1.5 DEFINITIONS OF TERMS

The following working definitions are used in this document (the first four are as defined in the Main Working Document of UNISIST II - 1979):-

- a) "Information" - is the content or message of a written or oral communication or discourse.
- b) "Scientific information" - is information arising from or pertaining to research activities, usually in the natural and social sciences. The research may be basic or applied; it may be exploratory, observational or experimental.

- c) "Technology" - is scientific, engineering, managerial and other knowledge necessary to produce the goods and services needed by society.
- d) "Technological information" - is information pertaining to technology.
- e) "Industrial information" - is information given to industry for the purposes of enhancing industrial development.

1.6 ORGANIZATION OF THE TEXT

Chapter two deals with the methodology of the study; and chapter three deals with the review of industrialization in Kenya. Chapter four deals with the institutions that support industrialization; and in chapter five the information needs of small scale enterprises are discussed, while chapter six discusses technology transfer mechanisms.

Chapter seven deals with the mechanisms that facilitate the flow of information for industrial development in Kenya. In chapter eight the results of the interviews are discussed, while chapter nine deals with system analysis and recommendations. In chapter ten the KENSIDOC information services and prototype databases are discussed; and chapter eleven concludes with recommendations.

CHAPTER TWO

METHODOLOGY

In order to achieve the objectives of the study, a combination of literature survey, and survey by interview has been used. A systems analysis has also been carried out in one of the information systems that support industrialization in Kenya. A prototype database on industrial information has also been developed by the investigator.

2.1 INTERVIEW METHOD

The interview method has been used to obtain relevant information from some universities, research institutes, government ministries and departments, parastatals, other scientific and technological institutes and organizations, and industries. The method involves literature review whereby the investigator has first sought to know (from the available literature) about the institutions he has been planning to visit. The Central Bureau of statistics (CBS) has been very helpful to the researcher as it has provided preliminary information on the institutions the researcher has been planning to visit. In the case of industries, the

following checklist of questions has been used to obtain information for the study. Some items of information have been obtained directly from the CBS statistical data and got confirmed by the institutions; while the other items of information have been obtained from the personnel in different institutions who have been interviewed during the course of discussion.

- a) Date of establishment of the industry
- b) Raw materials used and their source
- c) Products produced
- d) Scientific and technological information systems/services present in the industry
- e) Channels or means of obtaining information on new technologies
- f) What co-operation exists between the industry and other institutions (mainly universities and research institutes)
- g) Scientific and technological problems faced by the industry
- h) What do the interviewee and/or industry feels it to be the major hindrances to industrialization in Kenya
- i) Any other information that the interviewee is in a position to contribute to the subject of the study.

In the case of universities, research institutes, government ministries and departments, parastatals and other scientific and technological institutions, the following checklist of questions have been administered the same way as that of industries:-

- a) Date of establishment of the institution
- b) Institution's field of specialization
- c) Institution's fields of research
- d) **Scientific and technological information systems/services in the institution**
- e) Co-operation that exists between the institution and other institutions
- f) Channels or means of disseminating research results to users
- g) Scientific and technological problems faced by the institution
- h) What do the interviewee and/or the institution feels it to be the major hindrances to **industrialization in Kenya**
- i) Any other information that the interviewee is in a position to contribute to the subject of the study.

2.2 LITERATURE SURVEY

Published as well as unpublished literature have been searched in university libraries, government ministries (or Departments), other scientific and technological institutions, and individuals; and reviews on topics related to the objectives of the study, such as the following have been prepared:-

- a) African and Kenyan economy
- b) Science and technology for industrial development
- c) Industrialization and institutions that support industrialization in Kenya
- d) Information needs of industries, especially small scale industries in Kenya
- e) Technology transfer in developing countries and particularly in Kenya
- f) Innovation and diffusion of technologies, etc.
- g) Scientific and technological information systems and services in Kenya
- h) Inter-institutional co-operation in Kenya

2.3 SYSTEMS ANALYSIS

A systems analysis of the Kenya Scientific Information, Documentation and Communication Centre (KENSIDOC) has been carried out. The results of the analysis are discussed in chapter eight along with recommendations.

2.4 PROTOTYPE DATABASES

Prototype databases that would facilitate the provision of scientific and technological information to industrialists and other users have been developed using the micro CDS/ISIS software. The databases are discussed in a chapter ten.

CHAPTER THREE

REVIEW OF INDUSTRIALIZATION IN KENYA

In order to understand the role of information-support to industrialization in Kenya, it is necessary to outline the industrialization process in Kenya from its initiation to its present state-of affairs. The process is discussed in the following sections.

3.1 HISTORICAL BACKGROUND

The history of industrialization process in Kenya dates back to early this century. After building the Kenya/Uganda railway at the end of the last century, the British colonial office decided to encourage white settlement in British East Africa (i.e. Kenya and Uganda). There were already about 1,000 white settlers in Kenya in 1915. The settlers depended a great deal on colonial state subsidies for the successful management of their farms; they depended on the colonial state's laws which allowed them access to cheap labour; they also depended on the colonial state to provide social services for them. In short, it was expensive for the colonial

state to maintain support to the white settlers who did not contribute as much to the colonial economy as did the African peasant producers.

To satisfy the settlers' consumer needs, a number of import-export houses established branches in Kenya as early as 1905. The purpose was also to use Kenya to supply consumer goods within the East African region. Some of those companies were Gailey and Roberts (importers of machinery and building materials), United Africa Company (importers of light consumer goods and buyers and exporters of coffee, hides, skins, cotton, oil seeds, beewax, sisal , etc). Mitchel Cotts and Company (exporters of agricultural products, e.g. wheat, maize, butter, cheese, etc), the United Africa Company - a subsidiary of Unilever (importers of agricultural and engineering equipment from Britain), Banmann and Company, Gibson and company, and Leslie and Anderson - all involved in the export of primary commodities and import of manufactured goods

However, instead of importing all manufactured goods, including those which were made largely from primary products produced in East Africa, a few industries processing primary products for sale within the East African Market, and for export in the case of

such items as tea, were established in Kenya before World War II. This was the beginning of import substitution industries. East African Breweries (beer production, 1922); the African Highland Produce Company, a subsidiary of James Finlay of the United Kingdom (tea manufacturing, 1924); Kenya Tea Company, a subsidiary of Brooke Bond UK (tea and coffee processing, 1924); East African Tanning Extract Company, a subsidiary of Forestal and Timber UK (wattle bark and extract manufacturing, 1932); and the East African Meat Company (1935), a subsidiary of Liebig's UK (meat processing), were some of the major primary processing industries established in Kenya before 1945 (Swainson 1980). The Magadi Soda Company, currently a subsidiary of Imperial Chemicals Inc. (ICI) of UK, was initially established in 1911 by the Germans for Soda extraction. This was an important manufacturing plant in the Kenyan context at that time. Other larger scale manufacturing units were the East African Power and Lighting Company, a subsidiary of Balfour Beatty (UK) and Power Securities (UK) for Power generation in East Africa, and the East African Portland Cement, a subsidiary of Associated Portland Cement (UK) established in 1933 for cement processing and clinker grinding.

The Period 1964-1974 saw a boom in import substitution in the context of industrialization in Kenya. From the very beginning, the establishment of import substitution industries had the objective of laying down the foundations for the development of an industrial sector that would reduce excessive dependence on primary production and the importation of manufactured and processed goods. It was further assumed that, as development proceeded, the attempt to reduce import of manufactured goods and promote exports (at a later stage of import substitution industries) were likely to be most directly motivated by an awareness of the balance of payments constraint on development (Anyang'Nyong'o 1988)

3.2 KENYA'S INDUSTRIAL GROWTH AND INDUSTRIALIZATION STRATEGIES

Manufacturing has played a continued key role in Kenya, especially in its national development since independence. In deed, it is only third after agriculture and government services in their contribution to the country's GDP and its relative growth has been significant. By 1980, the sector had been growing at an average rate of 9.5% while the total GDP grew at an average rate of 6.0%. The sector's contribution to output has increased markedly and its employment potential has

risen by about 2.5 times since independence. Despite this, there have been severe problems and constraints in Kenya's experience with industrialization . Industrial growth has slowed as the limits of import substitution for consumer goods have been reached and intermediate and capital goods have not become available in adequate quantity and reasonable cost. There has been substantial inefficiency and the sector has not been able to absorb the large number of workers it has attracted to the urban areas. Industrialization process in Kenya like in many other African countries, has been shaped by various factors, such as the initial conditions (i.e. colonial history); the economic, political and climatic conditions; the strategies adopted and the policies applied. While the first two are external factors beyond the control of policy makers, the other two are instruments used by policy makers to influence industrial performance. Policies and strategies were occasionally adjusted to the initial conditions and external environment to shape industrial trends. Policies favouring the provision of information to entrepreneurs have not adequately been used. The strategies and policies used in Kenya to influence industrial growth are discussed in the following sections.

3.2.1 Immediately after Independence

Soon after independence, Kenya like many other African countries, had a great interest in industrialization to achieve greater economic independence. This interest stemmed from the general discouragement of industrialization, and only permitted in limited cases to serve the colonial market and interests. Furthermore in the latter cases, industries were owned and managed by the Europeans while the indigenous peoples (Africans) were virtually excluded. At the time of independence, the economy was heavily dependent in terms of (a) market dependence, (b) technological dependence, (c) managerial and entrepreneurial dependence and (d) foreign investment dependence. The resulting emphasis on industrialization and the objectives set for it were heavily geared to challenge and, reverse such dependence. Thus import substitution was adopted as a major strategy to spearhead the industrialization process. Under this strategy industries mainly that substituted for consumer imports were primarily based on imported inputs, i.e capital and intermediate goods. Import substitution was easy to implement through policies that protect domestic production. The infant industry argument became a

cornerstone to the country's industrialization strategy where these industries gained considerable government support for protection.

The Government consequently pursued a tariff and trade policy that provided high levels of protection. Tariffs for finished products were highly prohibitive with tariff rates for locally manufactured goods like footwear, textiles and cosmetics being the highest. On the other hand, government allowed importation of intermediate goods and capital equipment free of duty. Strict import licensing was also applied with almost a total ban on items that were manufactured by local industries. Other measures employed by the Government to promote industry were attractive investment incentive packages in the foreign investment protection Act of 1964 to encourage foreign investments. As a result considerable new investment was provided by foreign funding in manufacturing. Government also directly contributed to industrialization by engaging in equity participation in key industries. Further price control was used only selectively during that period.

Having been assured of a local market, while the economy enjoyed a strong fiscal performance, low rates of inflation and favourable balance of payments position,

the manufacturing sector grew rapidly during the first decade after independence. Further the East African Common Market Agreement was also signed in 1967 opening doors for Kenya's manufactured goods into the wider East African market. The tendency of this import substitution industrialization strategy was to favour consumer goods industries, reflected by a lower dependence on imported consumer goods but an increasing reliance on imported inputs and capital goods. Thus in the 1960s the share of consumer goods in total imports was 27% compared with 6% during 1978-82. The share of intermediate goods increased from 55% to 68% while that of capital goods increased from 15% to 26% during the same periods.

The steady growth of the manufacturing sector continued through the 1960s into the early 70s. During the period 1964-1973 the sector grew in real terms at an average annual rate of 8.4 percent, compared with an overall real growth of GDP of 6.6 percent. As a result, the share of manufacturing in GDP increased from 10.4 percent to 12.1 percent.

3.2.2 Events in the 1970s

A turn around of events began in the early 1970s when rising oil prices, international inflation and recession severely affected the country's economic performance resulting in a serious drop in incomes and consumer demand. There were wide balance of payment deficits that arising from the escalating imported oil bill. Also the general increase in prices rose by 46% while export prices increased by only 12%. Declining growth during that period was accompanied by the inability to move beyond the initial stages of import substitution and with continued high overall dependence on exports. The industrialization strategies and policies employed had already introduced new distortions and were not able to achieve the objectives of sustained industrial growth low-cost production and productive employment. Those policies provided little incentive to invest in the intermediate and capital goods industries that were needed to establish a more integrated and independent industrial structures.

Policy makers became pre-occupied in isolated solutions to the economic crisis. Little attention was given to the fundamental structure problems that were evident right from the beginning of the second decade

after independence. Such problems were the rapid population growth, the slowing down of growth in the agricultural sector, the narrowing of the scope of import substitution, the slow growth rate of exports and the high rate of under utilization of capacity. In the 1970s, the Government applied industrial policies that were not co-ordinated and instead were influenced by efforts to solve the severe balance of payment deficits. Thus, the system of import licensing was strengthened to provide protection to individual industries on an ad-hoc basis. **The use of import licensing became further intensified by the use of import bans, quotas and/or letters of "No objection" privileges with a view to discourage imports and hence reduce the import bill. This protection trend led to an industrial structure that had resulted in:**

- a) High cost of production;
- b) Anti-Export orientation;
- c) Creation of monopolies;
- d) Development of Rural-Urban imbalance; and
- e) Increase in unemployment.

3.2.3 Structural Adjustment Programmes

By the second half of the 1970s Government had already sensed the danger of continued domination of protected import substitution approach to industrialization. The 4th Development plan (1979-83) indicated that protected import substitution contributed to anti-export biased industries and the country could no longer afford inefficiency in industrial expansion.

Thus it became clear that though some sub-sectors continued to experience reasonable growth, the scope for continued rapid growth based on import substitution was limited. The strategy seemed to increase rather than reduce the dependence of the economy on external forces. A more neutral policy environment was needed if the industrial structure was to become more independent of foreign exchange availability and generate a larger share of its own foreign exchange needs.

Industrialization in Kenya was also seen to be in need of a larger and growing domestic market to absorb industrial goods to enable more industries to achieve economies of scale. Moreover, the sector needed to be more efficient to enable it compete with imports under moderate protection and enable it to become more export oriented.

The high rate of population growth and the consequent threat of increased unemployment rate strengthened the urge to raise productivity and growth of the economy. With the projected rise of Kenya's workforce to 14 million by the year 2000, employment opportunities have to be generated on a large scale. The industrial sector has to create more jobs if it has to play its role in national development. Consequently it has to be efficient, rural-based, productive and local resource based. The Government indicated this need in the sessional paper number two of 1985 and re-emphasised it in the sessional paper number one of 1986 where it further indicated that rapid economic growth will be a key prerequisite to sustained generation of employment.

To achieve the above kind of industrial structure, there was need for major structural changes, that is changes in the structural composition of growth so that a larger proportion of Kenya's resources are channelled into those industries which can use them most efficiently.

The structural adjustment program was initiated in the budget message presented in Parliament in June 1980. The strategy was outlined in the 1979-83 Development Plan and reiterated in the sessional paper number four of

1980. The initial steps were the removal of bans on imports and the use of No objection certificates. At the same time export compensation was raised from 10% to 20% and interest rates raised by one percent. This was the beginning of an import liberalization policy that was to gradually improve the efficiency of the manufacturing sector and expose it to international competition. To facilitate this policy, a new set of import schedules and procedures was published in November 1981 where items were placed on one of five import schedules which varied in degree of restrictions in foreign exchange approval. The other step was the revision of price controls: prices on many products produced locally under reasonably competitive conditions were freed from price controls.

Structural adjustment will continue to be a major guiding strategy for industrial development as outlined in sessional paper number one of 1986 and the current Development plan (1989-93). The former in particular has categorically stated that industry will be restructured to become far more productive and attain rapid growth in order to achieve the five goals that are part and parcel of structural adjustment in the sector. These goals of the industrial sector are:

- a) expansion and diversification of Kenya's export bias;
- b) creating of jobs at a rate exceeding 4% per year;
- c) development on the basis of relatively high and rising productivity;
- d) attracting and generating indigenous Kenyan entrepreneurs and managers; and
- e) supporting and promoting the development of agriculture and rural areas.

Structural adjustments guided by these objectives will involve an integrated market-based structure which is expected to result in an industrial structure that is to be characterized by:

- a) a high export bias;
- b) efficient import substitution;
- c) increased utilization of existing capacity;
- d) small scale industries and informal sector manufacturing; and
- e) local resource-based industries.

The market-based incentive structure in support and promotion of this industrial structure will involve continued and intensified use of the following policy instruments:-

3.2.3.1 Import and tariff policies

More uniform import duties and more liberal import licensing will together make industrial inputs readily available at lower cost while inducing manufacturers to produce for export markets. The continuing tariff adjustments are focusing on the remaining high duty rates which sustain excessive protection of industry.

3.2.3.2 Export promotion policies

Government will widen the scope for manufacturers to expand their activities in the export market through provision of a wide range of incentives. These incentives are:-

a) **Export Processing Zones (EPZ)**

An EPZ comprises an earmarked area, either near an airport or a seaport provided with various physical, communication and service facilities and custom offices. The entire production from the Zone, however, remains strictly for the export market.

b) Manufacturing-under-bond

Manufacturing-under-bond offers exporters potential for simplifying the steps that must be followed in obtaining import inputs and moving products to export markets. The scheme, worked out during the 1987/88 financial year, allows imported inputs free of duty and local purchases free of sales taxes provided the eligible production facility is licensed entirely for export production.

c) The Green channel scheme

The scheme simplifies and speeds up steps required to receive administrative approvals for import licenses and foreign exchange releases. It essentially consists of utilization of green forms and folders which are easily distinguishable and which are thus dealt with expeditiously at all stages of processing.

d) Export compensation scheme

The Export compensation scheme established in 1974 had the basic aim of giving incentives to exporters generally and of helping in the

promotion of manufacturing for external markets. However, experience with this scheme over the years indicates that it has not resulted in significant expansion of exports, Government will improve on the system by setting up a three-stage duty-drawback facility providing for remittance of import duties on the actual value of imported inputs for the manufacturing of exports within one month.

e) Export credit insurance and Guarantee scheme

External marketing is an area replete with risks. Government will set up a consortium of local commercial banks and insurance companies to operate the Export credit insurance and Guarantee scheme.

f) Preferential Trade Area (PTA)

Under PTA, exporters are expected to break through the Trade Area market of lower tariffs and also make them more competitive by having to compete with goods from other PTA countries.

g) Export Information and promotion

Government will reactivate the Kenya External Trade Authority (KETA), which was started in mid 1970s but had not performed well, to play the role of middleman between foreign buyers and domestic suppliers and to organise participation in international trade exhibitions.

3.2.4 Investment Policy

Government has already realised that the industrial development goals as mentioned, can be achieved by the private sector acting under price and other incentives that it establishes. In short, direct involvement of Government in modern industry would be uneconomic. Instead it will be involved indirectly in support of industry by promoting agricultural growth, extending infrastructure, and providing other incentives. The major task of Government now is to encourage both domestic and foreign private investors through for example the development of capital markets to channel savings into more productive investments, improve the borrowing abilities of foreign investors in the local financial markets and improvement of investment approval procedures for new investments. Late last year and early this year,

the Government has tried to put in place a number of policies meant to liberalize the foreign exchange market in order to stimulate production for export. The government has also stressed the importance of small scale industries in contributing to socio-economic development.

3.3 SMALL SCALE AND JUA KALI (OR COTTAGE) INDUSTRIES

The definition of small scale is not easy, because smallness is a relative concept, and any definition involves several factors which vary from industry to industry. Several factors on which this definition can be based are number of employees, capital employed, turnover or a combination of these.

If one of those factors is applied individually, it cannot reveal the size and scale of operations. Capital investment is one of the factors commonly used but an enterprise may require a high capital investment and only a small number of workers and therefore it would be wrong to classify such an enterprise as small scale. Furthermore, capital may include working capital in some industries, and in others, working capital can constitute a significant proportion of total capital employed in some industries.

It is therefore not easy to give a definition to suit all situations. A country can adopt a definition that suits its particular circumstances. In Kenya the following definition is adopted at the national level. Small scale industries are units engaged in processing, manufacturing, assembling and/or servicing activities having total fixed investment ranging from Ksh. 50,000 and Ksh. 500,000 if the cost of land, buildings and civil works are included and between Ksh. 50,000 and Ksh. 300,000 if the above mentioned costs are excluded; or in which employment varies between 6 and 49 persons and the plant is run partly or wholly with motive power (Siika 1987). Industries with a fixed investment and employing less than 6 persons are not grouped as small scale industries but are called Jua kali (or cottage) industries.

Many developing countries assign a very important role to small scale enterprises. Kenya is no exception and it has included the role of small scale enterprises in its development plan programmes. Small scale operations have distinct advantages over large scale enterprises, these advantages which have very important social and economical significance especially for countries where unemployment and underemployment pose serious problem to development. Below are some of the advantages:-

- a) **Small scale enterprises provide a natural complement to the usually cumbersome large scale enterprises and contribute to the success of the large scale by providing backward and forward linkages. Due to their locational flexibility, small scale enterprises provide regional dispersion of industry and consequently facilitate equitable distribution of income. This in turn alleviates the numerous social and economical problems resulting from concentration of industries in a few major cities.**
- b) Small scale enterprises use labour intensive methods of production and hence are capital saving. This is very important not only in providing employment but also help many developing countries where capital is the more scarce factor.
- c) Small scale enterprises provide training ground for indigenious entrepreneurs who may gradually take over operations of large scale enterprises. They also serve as the origin of innovation through the process of developing new products. Additionally they encourage productive use of idle resources, including labour, capital and entrepreneurship.

d) Small scale enterprises are flexible and can adopt more easily to changing circumstances. This therefore makes them more appropriate than large scale enterprises in situations where markets are limited and unpredictable. Large scale enterprises tend to be inflexible and depend on large and secure markets.

The Government's main instrument for providing financial assistance to small scale industries is the Industrial Commercial and Development Co-operation (ICDC) and the Kenya Industrial Estates (KIE), see chapter four, sections 4.5.3 and 4.5.4. The District Joint Loan Boards which are also Government agencies also provide small loans, particularly for the purchase of stock. They are manned by public officers who assist in the processing of loan applications.

In Kenya, the importance of developing small scale industries is fully recognized and the Government has assumed a leading role in the promotion of such industries. The methods adopted are many and varied but they all involve the training of potential indigenous entrepreneurs in various kinds of institutions such as Kenya Industrial Estates, Rural Industrial Development Centres, Management Training and Advisory Centre, the

Kenya Industrial Training Institute, National Vocational Training Centres, Trade schools, and the polytechnics.

The promotion of small scale industries in Kenya is aimed at helping the economy to achieve such objectives of industrialization as

- a) generation of employment opportunities;
- b) utilization of available local resources as source of raw materials;
- c) import substitution;
- d) export promotions;
- e) development of local entrepreneurship; and
- f) diversification of industrial development.

It is therefore necessary to promote small scale industries by providing facilities, services, technology and guidance to industries at the stages of establishment, operation and management.

CHAPTER FOUR

INSTITUTIONS THAT SUPPORT INDUSTRIALIZATION IN KENYA

Kenya is endowed with a number of Science and Technology institutions established mainly within the public sector to support the development and diffusion of technology. The institutions consist of research institutes, academic institutes, parastatals, and Government ministries and departments. There are also development finance institutions established to finance viable projects. Kenya also host some international research institutes and development agencies. Some of the major institutions that support industrialization are discussed here.

4.1 NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY (NCST)

The National Council for Science and Technology (NCST) was established by an Act of Parliament in 1977 (Science and Technology Act), as a statutory institution of the Government of Kenya.

The Science and Technology Act requires NCST to determine priorities for scientific and technological activities in Kenya, and to advise the Government on a

national science policy. NCST comprises 12 appointed members (who are specialists in the main scientific disciplines including social sciences) and permanent secretaries of Government ministries with significant functions related to science and technology. NCST is served by a secretariat comprising the Secretary to NCST, who is the chief executive, and a team of specialists and support staff.

From its inception to date, the performance (activities) of NCST in respect of its advisory functions has progressed satisfactorily. It should be noted, however, that NCST has not been without constraints that hampered some of its functions. Nonetheless, it has recognised the challenges ahead and evolved a new set of priorities which will strengthen the gains achieved and contribute towards the realisation of the goals set in the 6th National Development plan (1989-93). NCST is confident that with the cooperation and assistance of various public institutions and the private sector, its goals will not only be achieved but also surpassed.

As stated in the S&T Act, the functions of NCST are as follows:

- a) to determine priorities for scientific and technological activities in Kenya in relation to the economic and social policies of the Government and its international commitments;
- b) to advise the Government on a national science policy, including general planning and the assessment of the requisite financial resources;
- c) to ensure the application of the results of scientific activities to the development of agriculture, industry and social welfare;
- d) to advise the Government on the scientific and technological requirements for the conservation of natural and social environment in Kenya;
- e) to ensure co-operation and co-ordination between the various agencies involved in the machinery for making national science policy;
- f) to promote public confidence in scientific expenditure and an atmosphere conducive to scientific activities;

- g) to consider and advise generally on all scientific activities, including-
- * the application of the results of research;
 - * the transfer of technology into agriculture and industry;
 - * scientific and technical manpower (actual and potential);
 - * scientific research (oriented and non-oriented) and technology;
 - * **science education, not only at the advanced level in respect of the quality and quantity of potential manpower training but also at lower levels in respect of general science education for the public; and**
 - * scientific documentation, statistics, surveys and general information;
- h) to advise on suitable organizational arrangements for planning, managing and co-ordinating scientific activities at various levels, including the setting up of new research committees, and of research councils, research establishments and technical services;
- i) to advise the Government on the overall financial requirements for implementation of the national science policy and on disbursements to the agencies concerned;

- j) to review generally and advise on the programmes and budgets for the promotion of the research and related scientific activities proposed by Ministers concerned and ensure that they are in harmony with the national science policy;
- k) to carry out independently or in co-operation with any appropriate person, body of persons, agency or institution such surveys and investigations as the Council may consider necessary for its tasks;
- l) to sponsor such national and international scientific conferences as it may consider appropriate;
- m) to maintain relationships with corresponding scientific organizations in other countries; and
- n) to undertake any other activities likely to assist in the carrying out of its functions.

Activities of NCST have been in all spheres of science and technology. Major activities have been:

4.1.1 Research Clearance

Formal research clearance was instituted in Kenya by the Office of the President in 1966. The responsibility of assessing the technical and ethical aspects of research proposals submitted for clearance was delegated to NCST in 1979. Nevertheless, research permits are issued by the Office of the President based on the advices of NCST. Over 300 applications from both Kenyan and foreign researchers are processed annually for clearance. Research institutes have been given standing research clearance, therefore, they undertake research within their own terms of reference and memorandum of understanding between themselves and the Kenya Government without having to submit an application of research clearance.

A Research permit is the Government seal of approval of research undertaken in Kenya. It is therefore necessary for the Government to examine each research proposal to make sure that such permits are issued to projects which are in the interest of the Government and people of Kenya. At the same time, a Research permit, being the Government's approval of the projects, facilitates enormously access to data from public institutions and officials as well as other sources. In

addition, the arrangement for affiliation to Kenyan public institutions places the researcher in contact with facilities and experts highly knowledgeable on Kenyan conditions and sources of data. These are important advantages which make the tasks of the researcher considerably easier.

The affiliation arrangement is also a contract between the researcher and the affiliating institution on behalf of the Kenya Government and helps to ensure that the researcher will carry out the research according to the agreed research methods and deliver findings through accepted forums. Therefore research clearance in Kenya is to be seen both as a screening as well as a facilitating mechanism for research. Consequently, the specific objectives of research clearance in Kenya are:

- a) to facilitate co-ordination of research called for in the S&T Act;
- b) to encourage quality research that will directly benefit Kenya and to encourage research which will increase the body of scientific knowledge as a whole;
- c) to secure the data and results of research work undertaken in Kenya.

- d) to document and monitor all research work going on in the country and have centrally available information on such work;
- e) to facilitate useful research work and discourage projects which are not in the national interest;
- f) to ensure maximum benefit and dissemination of knowledge and technology to users of research activities in the country;
- g) to eliminate the unauthorized collection and transfer of research information and materials;
- h) to ensure that research in Kenya is conducted according to professional ethics;
- i) to ensure that relevant national institutions are informed on intended and on-going research work in their areas of responsibility and that they are given an opportunity to influence the course of research work in their areas of interest;
- J) to discourage unnecessary duplication of data collection for on-going research projects or research already undertaken or research about to be undertaken; and
- K) generally, to protect national interests and as far as possible discourage clandestine activities which may be undertaken under the cover of research.

4.1.2 Research Fund (Grant)

NCST Research Grant is a major programme. It was started in 1979 to support important areas of research which, for various reasons, are not being undertaken by the publicly funded institutions and to assist talented researchers who may come up with new ideas of potential importance to the country. From its commencement to date, NCST has funded over 400 research projects by individual **Kenyans mainly from universities and national research institutes**. The results of the researches are deposited at NCST, which also monitor the project from initiation to completion, on-site evaluation inclusive.

At present, the research grant programme has become so popular that the demand at times is far in excess of the available funds. Due to its limited resources, the NCST cannot continue to fund projects in all areas. It has therefore become necessary to outline the areas on **which focus could be made not only for NCST research grants but also other national resource allocations** in order to achieve concrete results and maximum impact. In order to assist in considering the applications, NCST set in 1986, six specialist committees consisting of eminent scientists who are Kenyan nationals. These committees are **in the areas of Agricultural sciences, Industrial**

sciences, Health sciences, Biological and Physical sciences, Social sciences and Energy sciences. NCST with the assistance of the specialist committees have set up research priority areas in Kenya. These were published in a pamphlet and distributed to all relevant institutions including national research institutes and universities.

NCST has also found it necessary to contract some experts to undertake research that are of great and urgent importance to the country, e.g post-harvest technologies. There also exists a special fund in NCST known as the technology fund, established in 1989 to support small scale and jua kali entrepreneurs who may not be in a position to come up with good technical research proposals.

4.1.3 Publications

NCST has published several publications including scientific reports, annual reports, newsletter, etc. It has also published proceedings of workshops, seminars and conferences in which NCST was involved/or had funded. Major publications of NCST are:-

- * Science and technology for development: a report of the National Council for Science and Technology, 1980.
- * Subject guide to information sources in Kenya, 1984.
- * Survey on private sector research and development (R&D) resources and activities in Kenya, 1988.
- * Guidelines for the formulation of research project proposals, 1989.
- * Proceedings of the National Conference on Cooperation between the Private sector, Public Research Institutes and Universities in Research, Innovation and Diffusion of Technologies, 1989.
- * Industrial technology policy and regulatory environment for development, 1990.

4.1.4 Kenya Scientific Information, Documentation and Communication Centre (KENSIDOC)

This activity is discussed in chapter seven, section 7.1.1.

4.1.5 Popularisation of Science and Technology

In addition to the publication of a newsletter, NCST participates in the Nairobi International show. It's pavilion under the Ministry of Research, Technical Training and Technology consists of various exhibits on science and technology. NCST also sponsors the Student Science Congress, whereby students exhibits indigenous technologies to members of the public.

4.1.6 Conferences, Workshops, Seminars, etc.

Nationally, NCST has sponsored a number of conferences, workshops and seminars. At the international level, NCST has had major inputs. For example, Kenya's participation at the United Nations Conference on Science and Technology in Development (1979) and UNISPACE-82 was coordinated by NCST. NCST's contribution towards publication of proceedings (mainly of national scientific conferences) has been particularly valuable and contribute towards dissemination of scientific information. NCST's Secretariat also participates in other conferences as may be necessary. NCST has also organised a series of seminars and workshops which helped to focus attention on the role and needs of the informal sector in national economy.

4.2 RESEARCH INSTITUTES

The six public research institutes, organized under the Ministry of Research, Technical Training and Technology are: Kenya Agricultural Research Institute (KARI), Kenya Medical Research Institute (KEMRI), Kenya Marine and Fisheries Research Institute (KEMFRI), Kenya Forestry Research Institute (KEFRI), and Kenya Industrial Research and Development Institute (KIRDI). The research institutes are generators as well as users of scientific and technological information. Each of the research institutes has an information centre (library) where results from research are documented. The centres also contains other publications. However, dissemination of research results to potential users has not been fully developed to facilitate the faster flow of information to potential users.

KIRDI is a typical institution basically established to disseminate research findings to local firms. Established in July 1980, KIRDI's main functions are:-

- a) To identify and develop process and product technologies appropriate for the country's domestic market and export potential;
- b) To facilitate replacement of imported inputs with domestic ones;

4.3 UNIVERSITIES

The four public universities (namely, University of Nairobi, Moi University, Kenyatta University and Egerton University) and private universities, as stated in chapter one, section 1.1.4, are by their respective charters expected to carry out research in an atmosphere of intellectual freedom. There are also 4 national polytechnics, 576 youth polytechnics, 17 institutes of technology and 19 technical training institutes. In 1986, the University of Nairobi set up the University-Industry Link Committee with membership drawn from the public and private sectors.

Universities are represented at several national bodies and committees by academic staff members; while members of the public and private institutions also sit in various university boards, and are members of university councils. Universities also participate annually in the Nairobi International Show, where various university departments exhibit some of their research findings and innovations. The universities pavilions are of great attraction to the local manufacturing sector, because they have many research products which can be put in commercial use. In addition, the university colleges have set up annual open days, designated for the general public visit to various departments.

Perhaps one of the most spectacular contribution to the science and technology potential of Kenyan universities was the launching of the first domestically sourced cars early in 1990, built with local components and by local personnel. The vehicles, popularly known as the Nyayo pioneer cars, are the result of a challenge by His Excellency President Moi to the University of Nairobi in 1986 to come up with a suitable design for the Kenyan economy. The university worked in conjunction with the Kenya Railways Corporation, the National Council for Science and Technology, the Kenya Army, and the Kenya Polytechnic. Further discussions about universities is in chapter seven, section 7.2.

4.4 GOVERNMENT MINISTRIES, DEPARTMENTS AND STATUTORY BODIES

Several Government Ministries, Departments and Statutory bodies support and/or are involved in industrialization in one way or another. The major ones are discussed here.

4.4.1 Kenya Bureau of Standards (KBS)

In the last thirty years, Kenyan manufacturers have failed to penetrate effectively international export markets. They have also faced lukewarm acceptance or non-acceptance of their locally manufactured goods in the domestic market due to consumer preference for imported goods. To some extent, both problems can be attributed to real and/or perceived low quality of locally manufactured goods.

It is therefore important to make Kenya's manufactured goods competitive and popular in both the local and external markets by raising their quality. It is also necessary to protect consumers from low quality and harmful products. Recognizing this, the Kenya Government established the Kenya Bureau of Standards (KBS) to establish standards. Its main function has been to establish minimum standards for various products. The process of setting standards has not been an easy one. It requires considerable amount of research, expertise, financial resources and involves lengthy discussions with manufacturers of the products for which standards are to be established.

In addition to establishing and enforcing standards, KBS offers a number of other facilities to local producers to enable them improve the quality of their products. It provides advice and assistance for the formulation of quality control; conducts relevant training programmes in the areas of standards and quality control for different industries, organizes annual seminars on standardization and quality control; and provides quality control laboratory facilities for use by interested manufacturers for material testing.

A number of factors have been identified by KBS as the main cause of low quality of locally manufactured products. These include negligence on the part of manufacturing company, and poor maintenance of the existing machinery. KBS officials blame Kenyan manufacturers for failing to keep pace with constantly changing needs of the consumers, through market research and development (R&D).

4.4.2 Ministry of Commerce and Industry

The Department of Industry in the Ministry of Commerce and Industry is responsible for formulating, executing industrial policy and supervising overall industrial development in the country. The Department

offers guidance to the investors in the identification of new investment opportunities in collaboration with the Investment Promotion Centre (IPC). The Department also assists in the implementation of viable projects. Within these general objectives there are other specific objectives such as:

- a) to encourage dispersal of industries;
- b) to increase exports of manufactured goods;
- c) to increase productivity of industries;
- d) to create employment;
- e) to improve the quality of manufactured goods;
- f) to increase the involvement of indigenous entrepreneurs in manufacturing;
- g) to encourage the development of large, medium and small scale industries; and
- h) to implement industrial research findings.

4.4.3 Investment Promotion Centre (IPC)

In order to encourage investment in Kenya by both foreign and domestic businessmen, the Government established the Investment Promotion Centre (IPC) in 1986 and charged it with the responsibility of promoting investment and assisting investors to obtain investment approvals. IPC's objective is to generate employment

through the promotion of private investment. IPC provides information and support services to investors, as well as recommending necessary policy and legal reforms to improve the investment climate. IPC may be called upon to provide the following: basic information on Kenya's investment climate; detailed information on investment rules and procedures; information on major investment opportunities; advise on how to obtain financing; suggestions on how to succeed in the Kenyan environment; and assistance in arranging site visits. IPC has identified areas that investors can embark on; the areas include manufacture of goods that can be exported and goods that can substitute imports using local raw materials.

4.4.4 Kenya Industrial Property Office (KIPO)

Kenya Industrial Property Office (KIPO) was established by the Government in December, 1989 as per the Industrial Property Act of 1989. The Act calls upon KIPO to examine application for and grant, industrial property rights; to screen technology transfer agreements and licenses; to provide patent information to the public and to promote inventiveness in Kenya. KIPO has commenced the activities mentioned, but since it is a new institution, most potential users are not aware of its

existence. KIPO needs to hold seminars and the like in an endeavour to publicise itself and its services. Small scale and Jua kali entrepreneurs also find that application forms for the grant of industrial property rights too technical for their understanding. This calls for the amendment of the forms to fit all potential owners of property rights.

4.4.5 Ministry of Research, Technical Training and Technology

The Ministry resulted from the merger of the Ministry of Research, Science and Technology, and the Ministry of Technical Training and Applied Technology in January, 1993. The Ministry has two departments concerned with Science and Technology: Department of R&D, and Department of Technical Training and Applied Technology.

The Department of R&D develops policy guidelines for scientific and technological activities, ensures their adoption, promotes development of facilities, mobilises financial resources, champions development of human resources and provides national coordination services especially with respect to scientific and technical information and promote public awareness on the role of S&T in national development (NCST 1989).

The Department of Technical Training and Applied Technology has the following functions:-

- a) Development of technical training policy.
- b) Administers technical education, i.e. in charge of Technical Training Institutes, Institutes of Technology, National Polytechnics and Directorate of Industrial Training.
- c) Development and implementation of Jua kali programmes

4.4.6 The Tender Boards

If used properly, the Tender Boards could act as important institutions in the industrialization process. The government is a major consumer of various manufactured goods in Kenya, implying that the pattern of government expenditure can influence industrial development in the country to a considerable extent.

Most of the major government purchases go through the tender system, which comprises of some departmental and ministerial tender boards and the Central Tender Board (CTB) which handles large tenders.

4.5 FINANCIAL INSTITUTIONS

Immediately after independence, the Kenya Government recognised the need to develop a financial infrastructure capable of providing financial back-up essential for faster industrialization and general economic development. In addition to encouraging growth of commercial and non-banking financial institutions and insurance companies, the Government embarked on a deliberate policy of establishing development finance institutions to specifically promote industrialization in the country. Presently there are 28 commercial banks, 58 non-bank financial institutions, 47 insurance companies, 7 development finance institutions, and a number of building societies (IPC, 1992). The seven development finance institutions are: Development Finance Company of Kenya (DFCK), Small Enterprises Finance Company Limited (SEFCO), Industrial and Commercial Development Corporation (ICDC), Kenya Industrial Estates (KIE), Industrial Development Bank (IDB), East African Development Bank (EADB), and Kenya Tourist Development Corporation.

4.5.1 Development Finance Company of Kenya (DFCK)

DFCK is one of the more important financial institutions established in the post-independence period to facilitate the industrialization process in Kenya. It was incorporated as an investment company on 13th September, 1963. DFCK provides large and medium-term local and foreign currency financing for projects in industrial, agro-processing and tourism sectors. By the end of 1983, DFCK had invested in 156 projects either in the form of equity or loans (Ikiara, 1986). The figure excludes 20 projects which had matured and fully paid off the company's loans. The company established the small scale industries programme in 1978 in order to reach the small Kenyan entrepreneurs who had been largely bypassed by the large/medium scale programmes. In 1983 the programme was changed and incorporated into a subsidiary company of DFCK, known as Small Enterprises Finance Company Limited (SEFCO).

4.5.2 Small Enterprise Finance Company limited (SEFCO)

SEFCO's investment guiding principles have attempted to remove some of the problems which hindered development of small scale projects in the past. The condition governing SEFCO's financial assistance are more flexible

so as to reduce the problems hindering the penetration by indigenous Kenyans into the manufacturing sector. One of the main constraints has been inadequate working capital, which was not normally provided by the financial institutions. SEFCO now has provision for financing working capital.

4.5.3 Industrial and Commercial Development Corporation (ICDC)

ICDC was originally established as the Industrial Development Corporation (IDC) in 1954 by the colonial government, with the objective of promoting the colony's industrial development. After independence, IDC was expanded to become ICDC so as to play a bigger and diversified role in the economy including financing of commercial enterprises. The corporation, wholly owned by the Kenyan Government, is charged with the responsibility of promoting participation of indigenous Kenyans in industrial and commercial development, promotion of the industries with capacity to earn and/or save foreign exchange, facilitate rural development, increase the use of locally available raw materials, create job opportunities, and enhance diversification of the country's economy. In addition to loan lending, ICDC also provide management guidance both in identifying viable projects and in the operation of the enterprises.

4.5.4 Kenya Industrial Estates (KIE)

KIE was established in 1967 as a subsidiary of ICDC. Its major role was to provide medium and long term finance to indigenous entrepreneurs starting with small scale industrial enterprises. In 1978, it was separated from ICDC and became an independent parastatal under the Ministry of Commerce and Industry. KIE's programmes entails the provision of factory building at reasonable rents to indigenous intrepeneurs. Machinery and equipment is provided to entrepreneurs at reasonable rates of interest but working capital is provided by the entrepreneur. Technical and managerial advices is provided in the initial stages as well as advice on the day to day running of business. In 1988, the KIE's informal sector programme was introduced with the main aim of providing loans to micro enterprises and Jua kali artisans. KIE today remains the principal Government agency for creating and fostering industrial development through the development and financing of small scale enterprises

4.5.5 Industrial Development Bank (IDB)

IDB was established by the Kenya Government in 1973, to facilitate industrial development in the country. Its

main focus was to be promotion, establishment, expansion and modernization of medium and large scale industrial enterprises. By the end of the first 10 years of operation, IDB's equity and loan portfolio had reached Ksh. 775.5 million. It had shares in 33 projects and had provided loans to 96 enterprises. The company's participation is spread over many sectors of the economy. By the end of 1983 (Ikiara 1988), the sectors which had received the largest proportion of IDB funds in terms of equity and loans were hotels and tourism (16.6 percent), metal industries (13.8 percent), textiles and fabrics (13.3 percent), engineering and metals (10.3 percent), and agricultural processing in the form of food and beverages (10 percent).

4.5.6 East African Development Bank (EADB)

EADB's mandate is to promote development in Kenya, Uganda and Tanzania. It provides medium and long-term loans designated in foreign currencies.

4.5.7 Kenya Tourist Development Co-operation (KTDC).

KTDC's financial programmes are for projects that would enhance tourism in Kenya. The projects include Hotels and tourist attraction sites such as Game parks

and Geographical areas, i.e it specifically handle the development of the necessary infrastructure for tourism in Kenya.

The development finance institutions have mainly financed viable projects without critical assessment of their priority in the economy. This has led to over-investment in some sectors and under-investment in some other key sectors. These institutions will only play a more effective part in the industrialization process if they make a deliberate effort to finance projects which fill the gaps that exist, especially in the production of inputs required by other domestic industries. Collaboration with IPC may solve this drawback. Also to be noted is the fact that in some instances, two or more development finance company's have not knowingly financed the same projects; this shows lack of co-ordination or consultation among the finance companies.

4.5.8 Commercial Banks

Commercial Banks also have a role to play in the industrialization process, through their financial advances and/or loan arrangements.

4.6 OTHER INSTITUTIONS

Other institutions that support industrialization are: Kenya Institute of Industrial Training (KITI), Chamber of Commerce and Industry, Kenya Association of Manufacturers, Tea Research Foundation, Coffee Research Foundation, Central Bank of Kenya (CBK), etc. CBK was established in 1972. The Bank's role in industrialization revolves mainly in the way foreign exchange is allocated and controlled, and the process of technology acquisition. The central Bank could adopt foreign exchange control and allocation policies which discriminate in favour of certain domestic industries. For instance, during foreign exchange shortages, the bank could give priority to those industries and sectors regarded as strategic or more important to the economy. The Bank could also use foreign exchange allocation to protect certain domestic industries by preventing importation of competing products.

There are also a number of international research organisations and non-governmental organisations based in Kenya, whose activities contributes to industrial development in one way or the other. These include: the International Centre for Insect Physiology and Ecology (ICIPE); the International Council for Research in Agro-

The weak coordination among the institutions means lack of the relevant information for some users, at the right time. There is need, therefore, to reactivate information systems where they exist and establish some where they don't exist. This will enable the institutions concerned about industrialization to be informed of the industrial infrastructure and requirements that are needed for industrialization.

4.8 MAP ILLUSTRATIONS

The maps numbers 1 and 2 on appendix 12 shows the distribution of industries and electricity. The maps shows that areas with high density of industries are sufficient with electricity. Map number 3 shows the distribution of mineral deposits, while map number 4 shows the communication (transport) network. The areas with high density of industries as shown in maps 1 and 2, also have excellent communication network.

4.9 INSTITUTIONAL LINKS, INFORMATION FLOWS AND INFORMATION SOURCES

Having outlined the activities of institutions that support industrialization in Kenya, it is useful also to look at how the institutions interact, the information

flow patterns and the information sources. As stated by Neelameghan (1992), a wide range of organizations and agencies, in the public and private sectors, are directly or indirectly involved in the development of industries, especially the small scale enterprises. The small scale enterprises receives a variety of assistance including finance, know-how, information advice, equipment, etc., from different agencies; or it may have to operate according to regulatory measures formulated by some of them.

Therefore information systems established to provide industrial information should be aware of the interlinkages and information flows among the institutions. Profile of institutions should show the type of services, assistance, etc., offered by the institutions, e.g.

- a) what kind of information is being generated, by which unit or by whom and for what purpose in organization;
- b) what information is transmitted to which other agency, in what form and at what frequency;
- c) does the information flow accompanies/parallels the assistance/advisory service pattern from an agency to the enterprise;

- d) what information is received/demanded by an agency from a small enterprise;
- e) how is the information received by an agency from another agency or the small enterprise handled, processed and used;
- f) what data and information would be most useful to each agency in order for it to be able to provide optimal assistance to the small enterprise;
- g) what documentation is available about the structure, programmes, services and activities of these agencies; and
- h) what are the contact points, information flow/channels, etc., to each of the agencies.

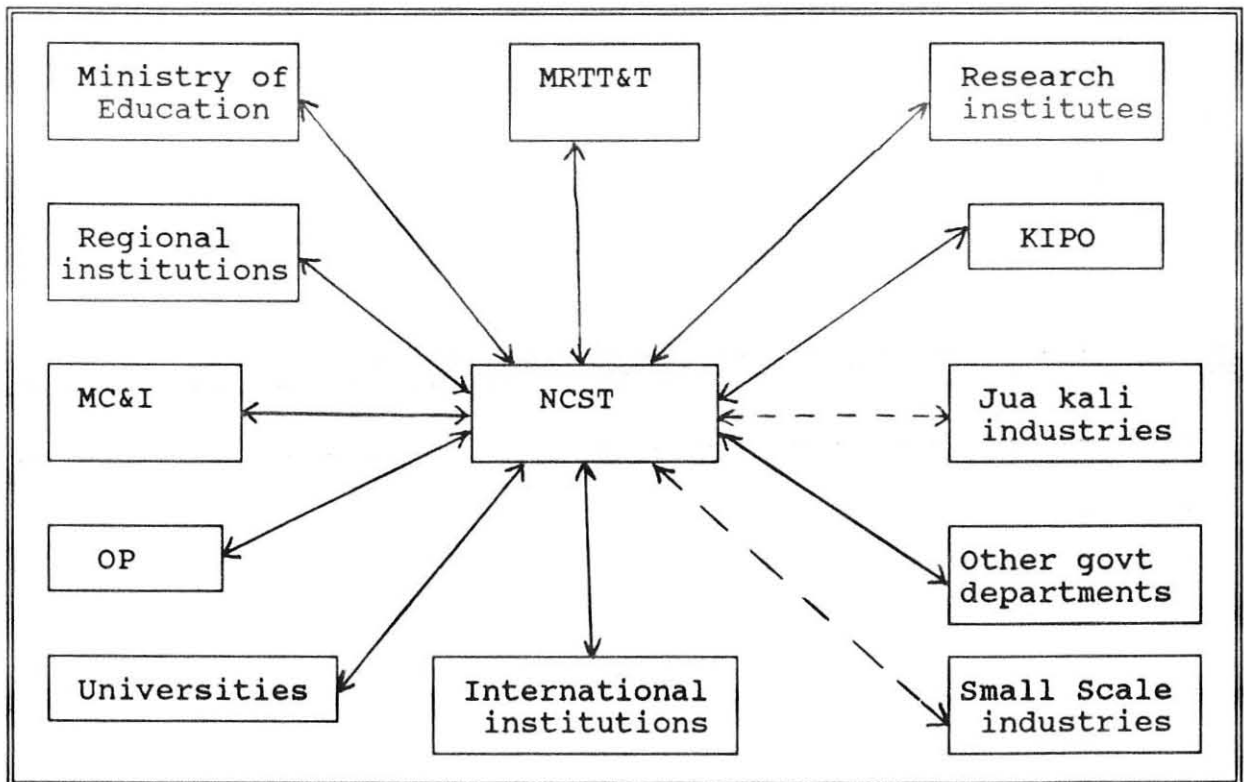
Such information would also help in establishing networks and resource sharing arrangements among the agencies and between them and the small enterprises.

Based on the functions and/or activities of institutions that support industries (especially small scale industries), the following subsections shows the types of linkages that exist, the information flow pattern and the information sources.

4.9.1 Interlinkages with the National Council for Science and Technology (NCST)

NCST is an institution having the mandate to coordinate other institutions for the successful execution of developmental activities. Its linkages with other institutions is illustrated in figure 4.1. The solid lines represent the present linkages, while the dotted lines represent linkages that are recommended. The linkages are mainly on advisory and policies relating to science and technology matters. The links with the Office

Figure 4.1 - Interlinkages with NCST



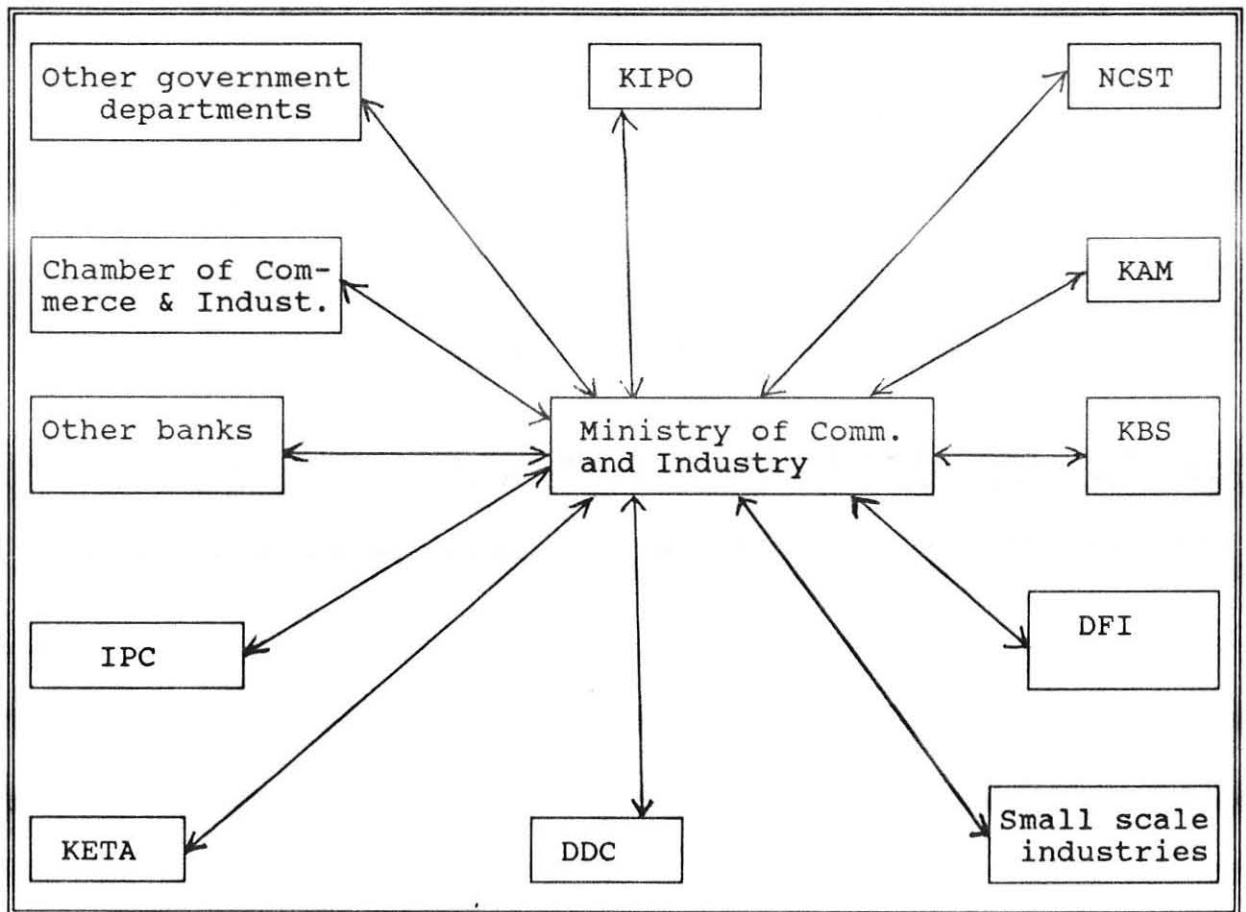
abbreviations used are shown on page 85

of the president is on technical advices on the research clearance applications.

4.9.2 Interlinkages of the Ministry of Commerce and Industry

The linkages between the Ministry and other institutions is as illustrated in figure 4.2 . The type of links are as explained in appendix 2

Figure 4.2 - Interlinkages with the Ministry of Commerce and industry



abbreviations use are shown on page 85

Abbreviations of the figures 4.1, 4.2, 4.3 and 4.5

KIPO	- Kenya Industrial Property Office
NCST	- National Council for Science and Technology
KAM	- Kenya Association of Manufacturers
KBS	- Kenya Bureau of Standards
DFIs	- Development Finance Institutions
DDCs	- District Development Committees
KETA	- Kenya External Trade Associations
IPC	- Investment Promotion Centre
OP	- Office of the President
MRTT&T	- Ministry of Research, Technical Training Technology
MC&I	- Ministry of Commerce and Industry
CBK	- Central Bank of Kenya

4.8.3 Interlinkages with Development Finance

Institutions (DFIs)

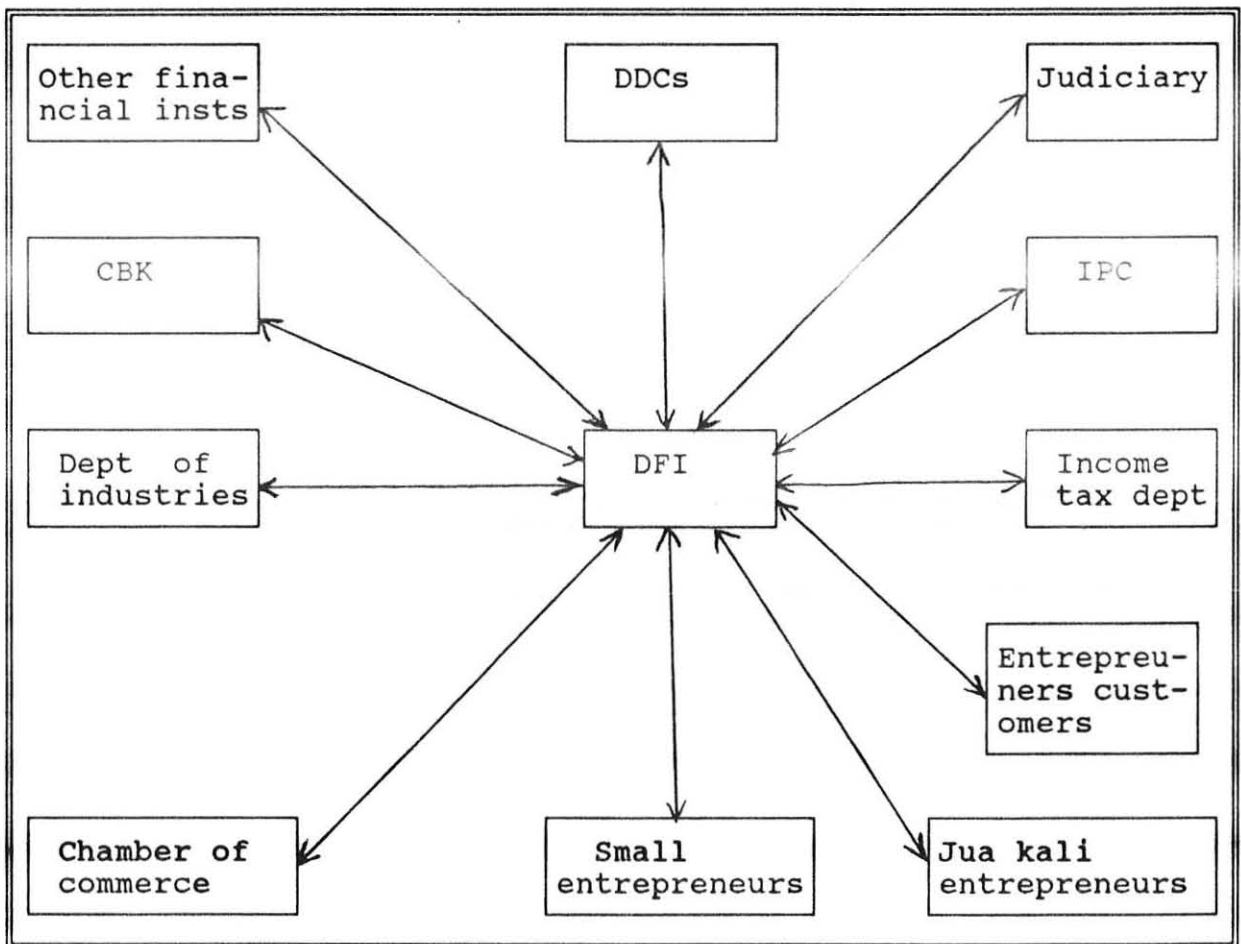
The DFIs and other financial institutions provide the following types of services to small entrepreneurs:

- a) financial assistance;
- b) economic and technical advice and information;
- c) advice and information on the small industries sector e.g., scope and prospects of small industries, technical know-how, marketing, etc.;
- d) research and development facility liaison with related organizations.

For executing its functions, such as examining the economic viability and technical feasibility of project proposals submitted by small entrepreneurs, the bank collects information from different sources. Information is collected and used by the DFI for monitoring the progress of the small industries which it finances. At

the same time the bank also generates promotional literature, pre-sanction reports, inspection reports, monthly and quarterly reports, etc. These can be useful sources of information for the entrepreneur and other agencies concerned with the development of small industries. Figure 3.2 illustrates a DFIs links with small enterprises and other organizations.

Figure 4.3: Interlinkages with Development Finance Institutions (DFI)



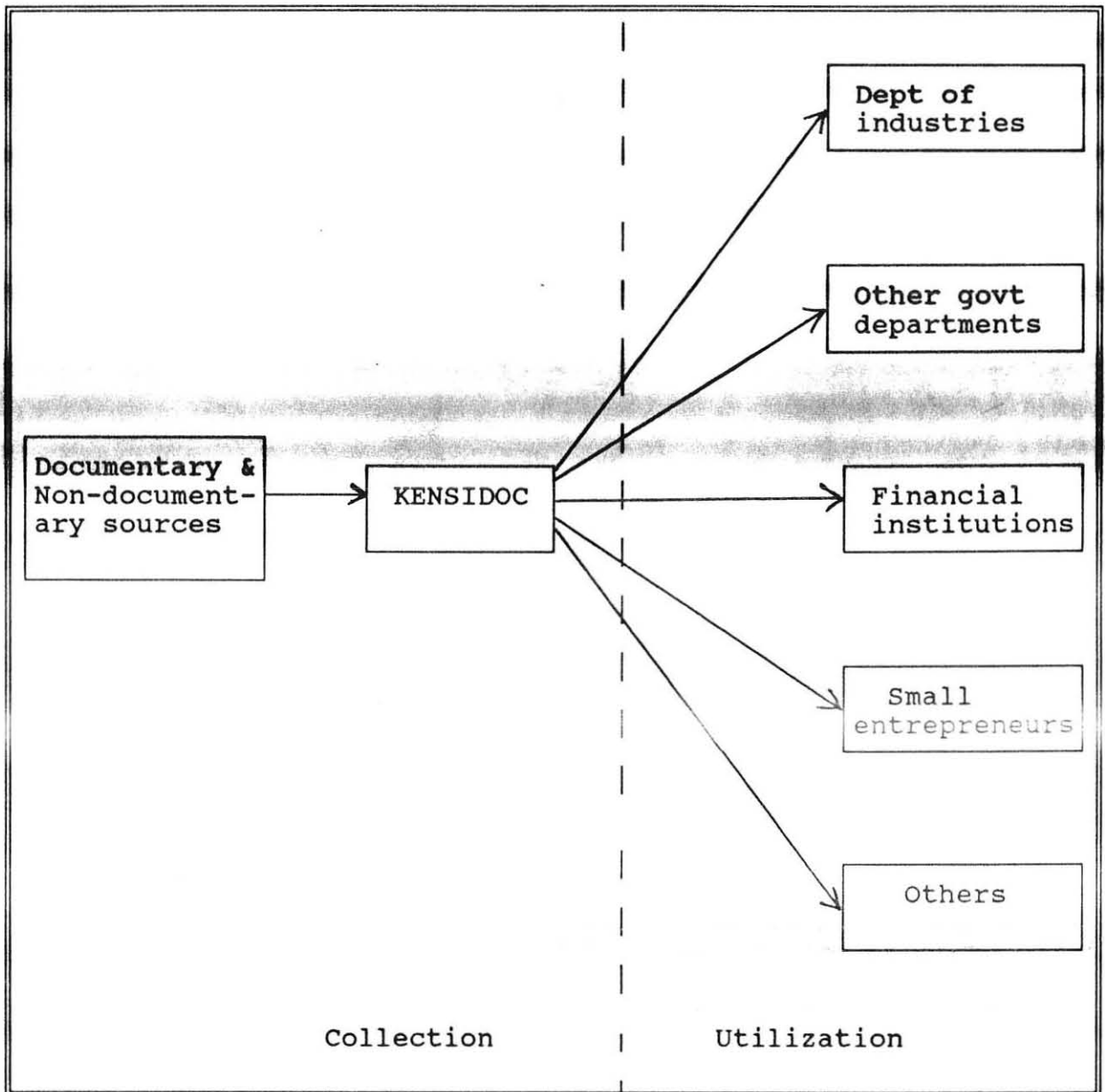
abbreviations are as shown on page 85

Basically, four types of information are needed for the promotion and development of small scale industries. These are: Technical information; Development information; Regulatory information; and Market information.

Figure 4.4 illustrates the inter-institutional flow patterns of technical information.

Development information usually flows from the generators such as DDCs, Industrial offices, to the users such as small enterprises. Regulatory information emanates from government regulation-making bodies to areas intended for, e.g. industrial regulations for industries and they can be sued for not adhering to the regulations. The market information flow is as illustrated in figure 4.5

Figure 4.4 - Technical information: flow pattern



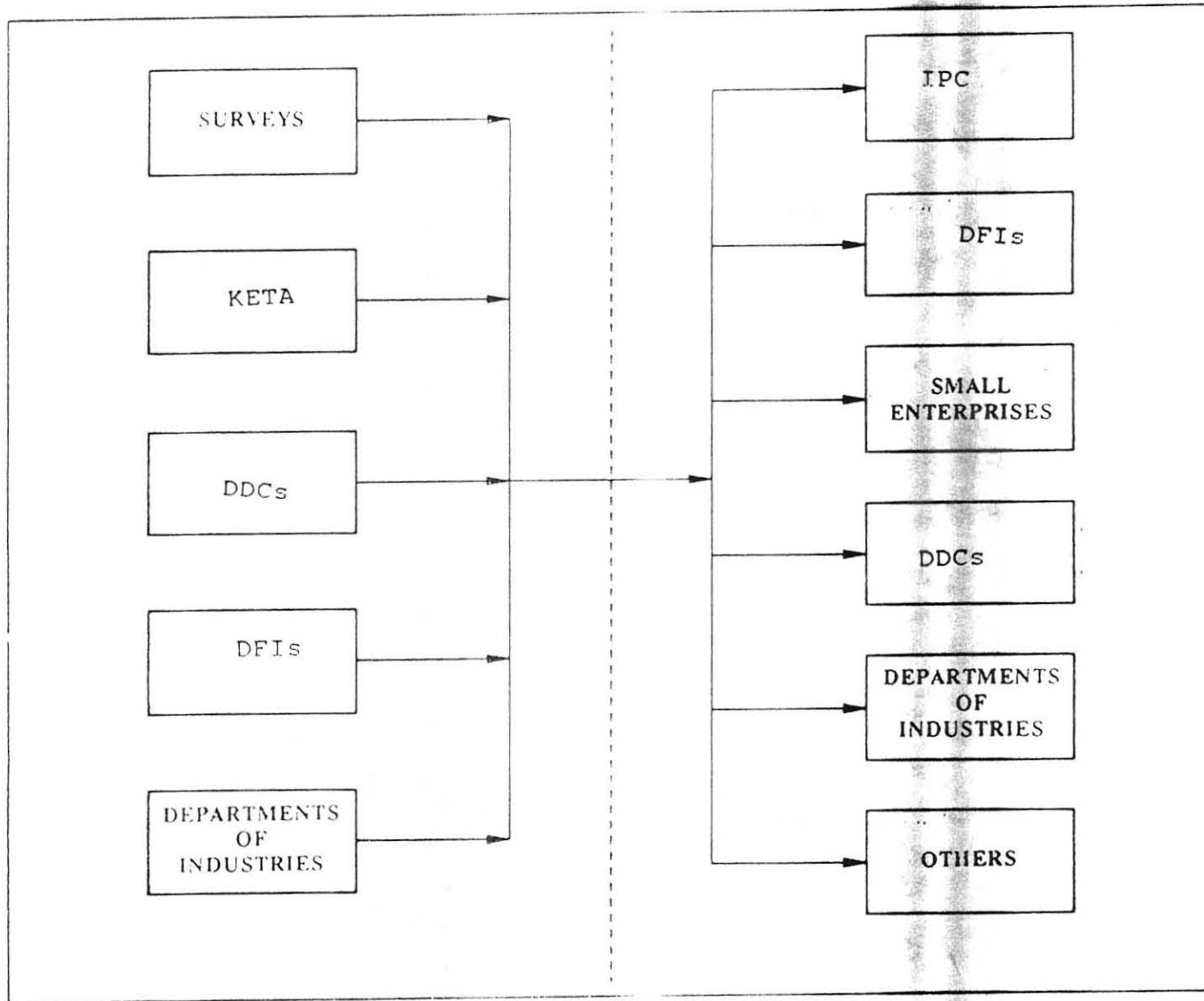


FIGURE 4.5
MARKETING INFORMATION: FLOW PATTERN

abbreviations are as shown on page 85

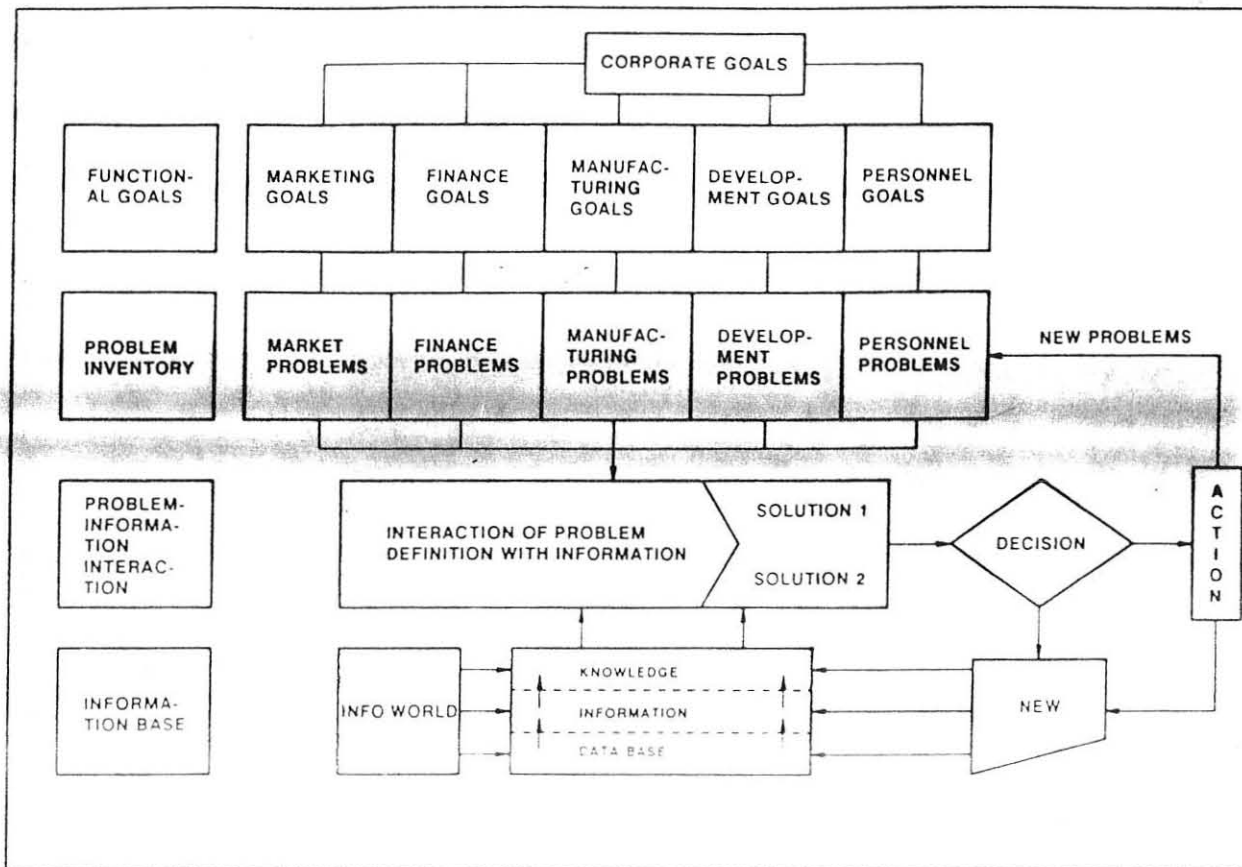
CHAPTER FIVE

5.0 INFORMATION NEEDS OF SMALL SCALE INDUSTRIES

The development of small enterprises is of vital importance to developing countries. The small industries sector contributes, in several countries, close to 50 per cent of the Gross National Product (GNP) and provides employment to an important segment of the workforce (Neelameghan 1992). The need to provide efficient and effective information support to manage various facets of small enterprises is being recognised in an increasing measure.

A small scale enterprise, defined in the case of Kenya in chapter three section 3.3, like any other production organization has the following major functions that have to be executed: Production, marketing, personnel and finance. Figure 5.1 shows an enterprise viewed as a dynamic continuous problem solving process. The role of information as an aid to finding solutions to problems and decisions thereof and the pattern of flow of information within the enterprise and from outside as indicated. The enterprise is viewed as a Commodity/Service Production-Distribution System (PDS). It is, in general, made up of interacting functional

Figure 5.1 - Business as problem solving process



Source: Neelameghan, 1992

components, such as the following: Input, Output, Processing, Marketing and System management. Expected outputs of a PDS include: Goods, Services and Technology/Knowledge. The proportion of these outputs may vary from one system to another, and the output of one system may be used as input to other systems. Major

inputs to a PDS include: Human resources of various types, materials, facilities, equipment resources; Technology/knowledge resources and Financial resources.

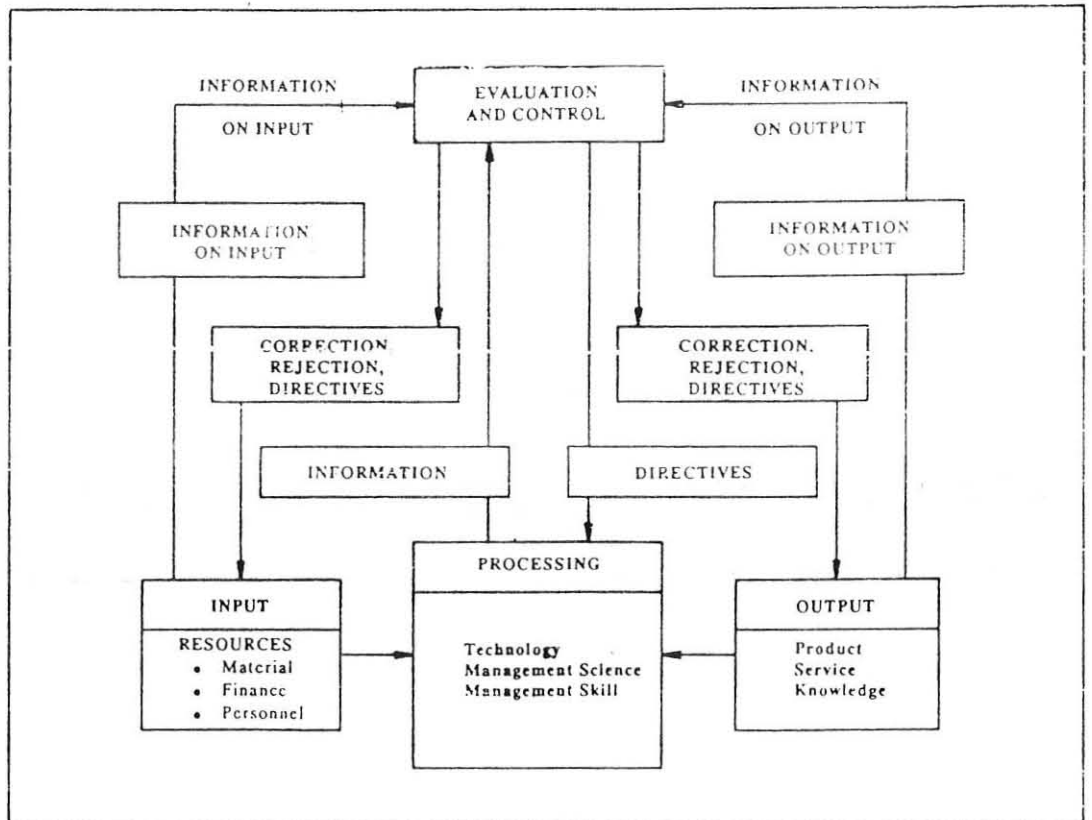
Essential functions of the PDS management include: Resource allocation, that is planning the appropriate allocation of mobilizable resources to the components of the PDS; Direction; Monitoring; Quality control; Performance assessment and system development. The effective and efficient performance of these management functions requires timely, reliable and relevant data and information on such aspects as the following:

- a) Resource options
- b) Alternative sources of each of the resources
- c) Characteristics and conditions of availability of each resource
- d) Alternative strategies for resource mobilization and development
- e) The capacity and capability of the system (enterprise), that is, information obtained through systems analysis
- f) Performance of the system, that is, information obtained through performance analysis
- g) System requirements, that is, requirements analysis information
- h) Utilization of the resource inputs

- i) Market potential, that is, market research information or market intelligence
- j) Environment, that is, state of the economy, industry, regulatory measures, technological developments, etc.

Figure 5.2 shows a business enterprise viewed as an input-output system indicating the dynamic flow and use

Figure 5.2 - Business as input - output model



Source: Neelameghan, 1992

of information within the system and in a quality control context. Information is shown as an input for quality evaluation, control and development in relation to the different component units.

For the execution of the activities, the management requires relevant information so as to perform activities such as Strategic Decision making (strategic planning) and Tactical planning. Strategic planning is the process of determining the major objectives of an enterprise and the policies and strategies that will govern the acquisition, use and disposition of resources to achieve those objectives. Tactical planning is concerned with details of deployment of resources to achieve the strategic plan goals. An essential common characteristic of small enterprises is the way they are managed and operated: usually, the owner/manager assumes the full responsibility for strategic and tactical decisions. The following sub-sections deal with information needs of small scale enterprises. Subsection 5.7 deals with the information sources.

5.1 INFORMATION FOR MANAGEMENT

In an organization, strategic decisions made by those in managerial positions or in authority can affect the functioning and operations of that organization.

Therefore, the primary objective of an information system for the enterprise should be to provide the decision makers with relevant, reliable and timely information to assist them in making gainful decisions (Neelameghan 1992).

Figure 5.3 illustrates in a general way information flow in a Management Information System (MIS), while figure 5.4 illustrate the enterprise environment. An MIS may serve a single enterprise or may be designed to serve a group of enterprises and the agencies concerned with them. A small enterprise may not have the necessary resources to establish and operate a sophisticated MIS. Therefore, the government or another agency of small enterprises promotion and development may set up a common or cooperative information system for a group of enterprises, for example, in an industrial estate, though each enterprise will need an information facility integrated into its structure to assist its various management and operational activities and make effective use of external information facilities.

The stakes and risks involved in strategic decision making are relatively high and therefore the enterprise may be subjected to external influences and interventions. Hence, the development as well as trends in the environment - the economy, the political,

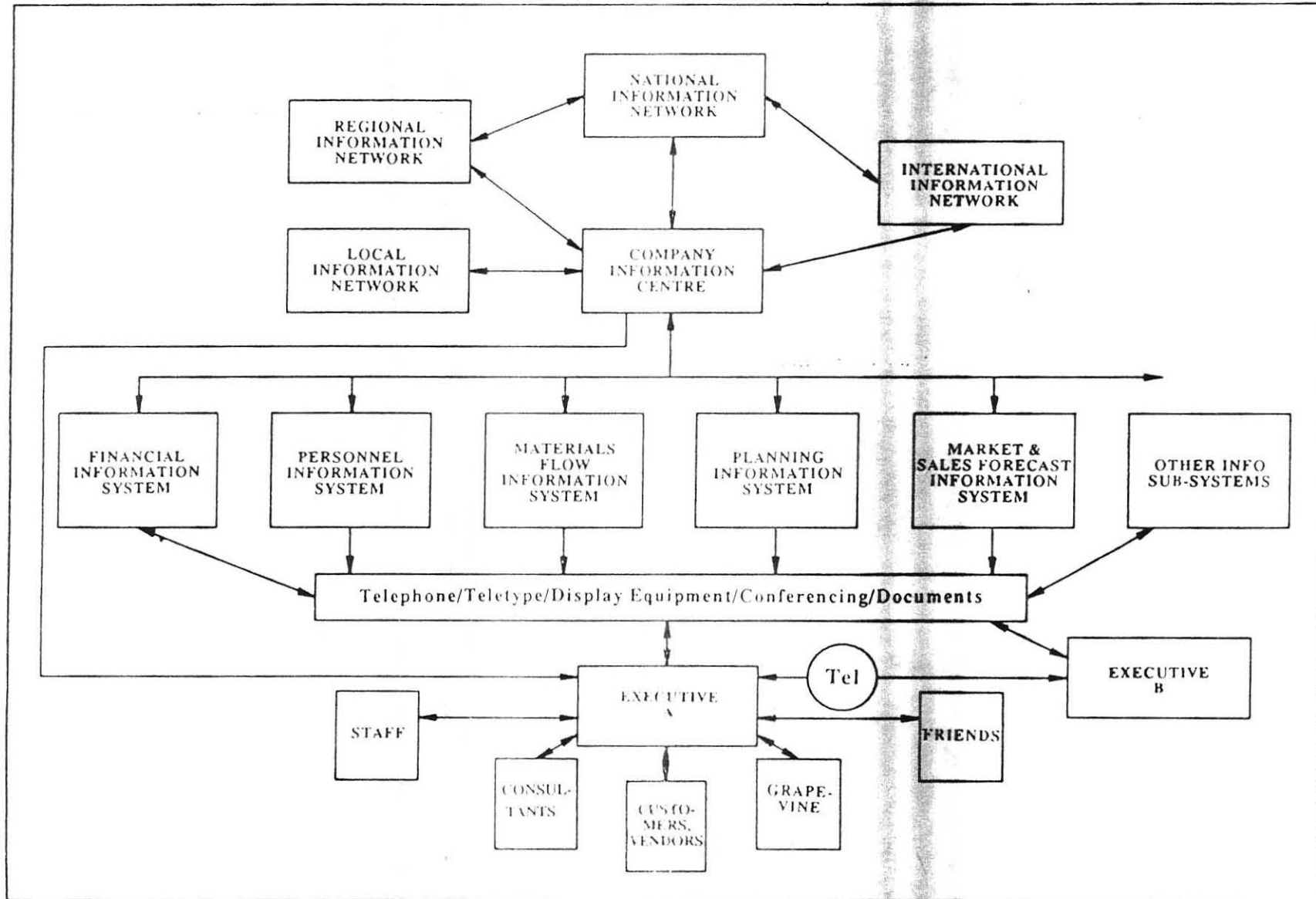
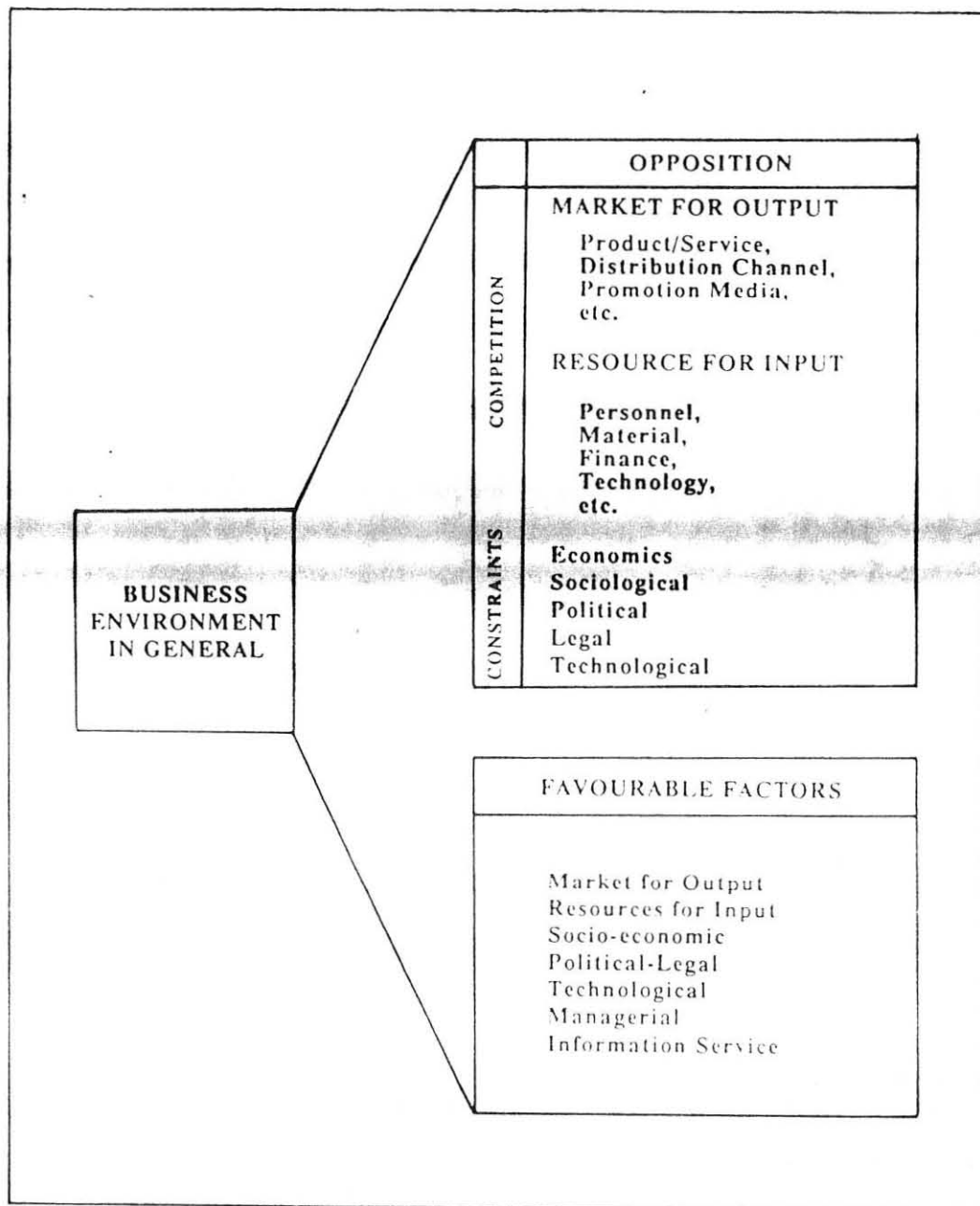


FIGURE 5.3
 MODEL OF INFORMATION SYSTEM FOR BUSINESS MANAGEMENT

Source: Neelameghan, 1992.



BUSINESS OBJECTIVE : Minimise Loss; Maximise Profit;
Perpetuate in Business

Minimise **OPPOSITION;**
 Maximise **FAVOURABLE CONDITIONS;**
 Through **PLANNING for PROFITABILITY and GROWTH based on
 PRECISE, RELIABLE INFORMATION made available at
 all levels at the RIGHT TIME in a conveniently USABLE FORM**

FIGURE 5.4
BUSINESS ENVIRONMENT

Source: Neelameghan, 1992.

regulatory, social, technological and related factors/issues - at the local, sectoral, national and international levels need to be scanned and decision makers alerted of their likely impact on the affairs of the enterprise. Similarly, they should have timely information on potential opportunities for resource mobilization and development, new projects, expansion of activities and programmes, etc. The above mentioned environmental trends are discussed in the following subsections.

5.1.1 Political conditions

Examples of political factors that may affect the planning and development of enterprises and hence need to be kept continuously informed about include:

- a) Durability of the existing regime
- b) Attitude of the regime and of its opposition to business and other financial investments.
- c) The institutional process of succession in the national government.
- d) Political risks, such as, competing political philosophies, social unrest and disorder, vested interests of local business groups, recent and impending political independence, and armed conflict and internal rebellion for political power.

- e) New international alliances and regional groupings.

5.1.2 Social Conditions

Enterprises find that involvement in social issues is not an optional luxury but an important part of the climate in which any modern enterprise must operate and develop. Daniel Bell, commenting on the conditions of social changes that affect activities of enterprises, says that social changes arise from

- a) A diffusion of existing things, of privileges and goods, from the few to the many. This leads to a change of scale and change of institution;
- b) Contraction of time and space due to transport and communication facilities; and
- c) Increased 'non-market' public decision - more and more of the problems cannot be settled by the market, but involve community decisions. This produces an increasing interest in measuring satisfaction, discontent, health, education, progress and other behavioral characteristics of society that cannot be kept track of by money accounts.

Therefore, forecasting social values and social indicators appear to be of equal importance as forecasting such traditional economic indicators as GNP as major projections important to development planning, especially industrial development, and decision making. Such social indicators for the urban area include: Population density, early marriages, divorce rates, population per doctor, death from road accidents, number of automobiles to people, the proportion of teen-agers in schools, number of telephones to people, etc.

The important sociological factors to be taken note of and on which information and data would be frequently required include the following:

- a) **Demographic structure:** Size, location, age, sex, ethnic structure, occupation, economic distribution of the present and future population, and the rate of projected change in these factors.
- b) **Shifting expenditure priorities:** Public versus private consumption of goods and services; preference shifts within product groups; acceptability of substituted and synthetic products; relative emphasis on personal needs,

home, transportation, communication, entertainment, health, education, foreign versus domestic goods, etc.

c) **Role of government:** Activities of local, state and federal governments as customers, investors, competitors, quasi-judicial controllers, coordinators of economic, social and political activities, and as sources of information.

d) **Public and legal attitudes towards business:**
Attitude toward big business and small business;

toward sanctity of patents; toward what constitutes monopoly, interstate commerce and restraints on trade; toward public control of prices, profits, labour and material costs, etc.

e) **Labour conditions:** Labour back-pressures against automation and the introduction of new products; the availability of skilled labour; the labour union-management bargaining balance; domestic versus foreign labour costs; management flexibility on hiring and layoffs, etc.

f) **Education:** The number of trained scientific, technical and skilled personnel output from academic and training institutions; the levels of sophistication of consumers; and the output of university research programmes.

- g) **Other factors:** For example, socially defined norms, social customs and traditions, cultural practices, urbanization, etc.

5.1.3 Legal and Regulatory Environment

It has been said that the thicket of regulatory conditions in some countries may be particularly dense and constitutes one of the main obstacles to business forecasting in those countries (Neelameghan 1992). A plethora of regulatory measures may be used by governments to intervene and overrule market forces. Regulatory conditions that may affect the operations of an enterprise include:

- a) Industrial licensing policy;
- b) Import restrictions and regulations;
- c) Regulations relating to monopoly and restrictive trade practices;
- d) Antitrust laws;
- e) Differential taxation measures;
- f) Tax holidays, exemptions, and remissions;
- g) Allocation of foreign exchange for import of capital goods and strategic raw materials and components not available indigenously;
- h) Export obligations and import substitutions including incentives and/or obligations for expenditure on research and development;

- i) Commodity rationing;
- j) Price controls;
- k) Channelling of foreign aid and collaborations;
- l) **Technical collaboration with foreign firms;**
- m) Availability of credit guarantees;
- n) Availability of priority sector credit;
- o) Capital issues control;
- p) **Reservation of areas of public sector investment;**
- q) **Distribution of goods;**
- r) **Labour legislation; and**
- s) **Judicial decisions affecting government regulations.**

These regulative measures may have a variety of impact on industries as a whole and on individual enterprises. Illustrative examples are:

- a) Government administrative regulations that delay carrying out of routine decisions may increase the marginal capital output ratio by either causing excessive inventory holdings or, in their absence, resulting in production delays.
- b) The building up of a new plant or modernizing an existing one could contribute to economic growth; but, the regulations and restraints on these routine decisions also cause losses.

c) Excessive controls may also produce regional inequalities within the country, a tendency to invest in too capital-intensive equipment, lags in the growth of the targeted priority industries, distortion in output pattern earlier envisaged, graft, and so on.

It may, therefore, become necessary to divert personnel to attend to all the diverse administrative tasks and handling of relations with the government and the bureaucracy at various levels. Small firms can hardly afford this.

A practical way through the maze is to assemble and organize all relevant information and data about each regulation, at least the more important ones, which affect the company, keeping up-to-date with any changes in them and in related areas, providing background information for understanding the rationale for the measures and systematically noting the nature of their impact as feedback information. This would enable all concerned making right judgements about any particular regulation given assumptions about their environmental conditions.

5.1.4 Economic and Business Conditions

The following macro-economic indicators of environmental conditions could have significant impact on business operations:

- a) Government expenditure in the economy
- b) Level of industrial production
- c) Degree of capacity utilization in the "industry" to which an enterprise belongs
- d) Availability of steel and other construction materials
- e) Availability of power/energy
- f) Foreign exchange situation.

The macro-economic indicators constituting the major external influences on the operations of an enterprise include:

- a) Growth and profitability of end-user industries
- b) Changes in the technical characteristics of the products required by the end users
- c) Behaviour of the government as a consumer/buyer of the output of the enterprise
- d) Nature of the competition offered by public sector units as supplier of competing products

- e) Nature of the competition offered by the public sector and in private sector with special reference to quality, price and efforts for development of new goods and services through research and development.

A useful approach would be to integrate information relating to a country's economic growth with that which applies to stability conditions. Examples of special issues relating to developing countries on which information and data would be required are:

- a) Changes in the growth of production and income;
- b) Extent of mobilization of resources for development;
- c) Changes in the national savings ratio to GNP;
- d) Efficiency of utilization of existing financial resources;
- e) Compatibility of the social institutional framework with development and related policies;
- f) Population growth problems;
- g) Relative emphasis on development in national planning vis a vis, for instance, defence;
- h) Stability of the currency; confidence in the future value of savings;

- i) Rate of increase in import capacity and of foreign exchange earnings;
- j) Measures of economy on expenditures on imports;
- k) Efficiency of management of balance of payments and external debts; and
- l) Internal consistency and compatibility between policies on development and those on finance.

5.1.5 Technological Developments

The status of the technological environment is of particular concern to enterprises using sophisticated technologies, such as, electronics, semiconductors, and chemicals. For such enterprises, the management has to periodically assess and act upon the strategic, administrative and operational implications of their commitment. They require information, expertise and expert advice on various aspects of technology and trends in research, sensitivity to potentially profitable ventures and organizational flexibility to respond productively to competition. The process of technological change may be considered in three stages: Invention, innovation, and diffusion. Technological environmental scanning covers:

- a) Research and development activities in progress;
- b) New product announcements;
- c) Patents taken and applied for;

- d) Technology transfer arrangements;
- e) Surveys of indigenous technology;
- f) Technology import and options thereof;
- g) Adaptive technology;
- h) Appropriate technology; and
- i) New management techniques and ideas, and problem solving and decision making tools and techniques.

A preliminary task is the study of technological sources and resources beyond the company's control, the scientific community in general and the company's competitors in particular. Government contract announcements, publicity releases, professional and trade talks and papers, the mass media, etc., are useful sources of information on current development programmes, which will be a starting point for forecasting. The important point is to analyze and digest the information and present in forms and formats convenient to users. For technologies that are not easy to forecast in this way, identifying gaps by matching existing technology with that required to achieve the sociological and economic goals set in the national development plans or implied in the sociological and economic forecasts may be attempted. The gaps thus identified may suggest lines of research and development work, or search for know-how by other means.

5.2 FINANCIAL INFORMATION

Most small enterprises have a chronic shortage of capital. This may be partly due to the entrepreneur's inability to attract or have access to sufficient capital and/or credit for his company and partly to a frequent imbalance between fixed and working capital. It can also result from poor inventory control, high wastage, low levels of efficiency in production, incorrect pricing methods, etc. Shortage of finance may prevent an enterprise from operating efficiently and impose additional costs when short-term credit has to be raised. Small scale enterprises, therefore, needs information on financial institutions and their loan terms. Discussions with the financial institutions staff or other financial advisers on financial management in enterprises is also a requirement.

5.3 MARKET INFORMATION

Marketing constitutes a difficult task for many small enterprises given their limited management resources and skills. Most SSIs in developing countries confine themselves to supplying their local markets; but several governments have devised mechanisms of assisting them to expand their markets through greater awareness of

market opportunities and greater information on SSIs products to potential clients. For example, there have been campaigns on promotion of export-oriented products. Thus information about national, regional and international market trends is a requirement. Entrepreneurs should also accept the fact that, long-term survival or growth of the enterprise depends on the entrepreneurial ability to adapt production to changing market conditions. Governments can play an important role in the development of local as well as international subcontracting information services, and in opening up new markets, for instance through public sector procurement. The information needs are as follows:

- a) Competitive position of products: Data from comparative study of competing products for evaluation against the market situation and/or the products being produced and those proposed for production by the enterprise.
- b) Customers: Variations in composition, priorities; new uses of products and services; causes of customer dissatisfaction.
- c) Market: Size and trend in size. Type and number of orders, and demand for new products. Market structure; territorial potential and yield and variations thereof. Customer demands. Relative market profitability.

- d) Sales: Distribution channels. Specifications, sales conditions and contracts. Legal and related information on contracts. Packaging, advertising, exhibitions, pricing, etc. Co-operative marketing schemes, government purchase schemes, and assistance offered by trade conditions.
- e) Sub-contracting: Information on prospective demands for parts, components, and products of the larger industrial enterprises directly as well as through sub-contracting exchanges.

5.4 COMMON SERVICES INFORMATION

For the efficiency of its operations, a production unit, particularly a small scale enterprise requires tool room, testing, quality control and workshop facilities. The competing nature of enterprises also make it necessary for enterprises to be in contact with R&D facilities, such as, laboratories. The laboratories of the NCST can provide such support to the small scale industries. For small scale units, however, it may not be viable to maintain such facilities by/for each unit. In industrial estates, such facilities may be provided as common services to all of the enterprises in the estates. There may also be private organizations or cooperative establishments providing such services. Each industrial

unit needs to be informed of the variety of such common services available and on the conditions of their use. Such common facilities also help in the maintenance and repair work, and for demonstration and training of new personnel. Common service facilities usually required by small scale enterprises include:

- a) Tool room, with dies, jigs and fixtures, forging, casting, and manufacturing facility
- b) Testing and quality control laboratory - mechanical, physical, chemical, and biological testing. This could be provided by R&D institutions.
- c) Workshop facility, such as for heat treatment, electroplating, forging, finishing, diecasting, foundry, and special purpose machines.
- d) Equipment available on lease or hire-purchase, for example, power tools, inspection equipment, hauling and material handling equipment.
- e) Mobile workshop and laboratory services, especially useful to industries located in rural areas.

5.5 INFORMATION ON OTHER FACILITIES

The small scale unit needs information on the availability and regulations concerning other services and facilities as well. For example,

- a) Warehousing
- b) Showroom, display and exhibition
- c) Advertising, and publicity channels and methods
- d) Legal advice
- e) Accounting and auditing
- f) Fire protection
- g) Insurance for persons and materials
- h) Clinics, first-aid and hospitals
- i) Banking and financial transaction facilities
- j) In-service training and apprenticeship
- k) Cooperative and sponsored research facilities for
 - * Testing of raw materials and products
 - * Carrying out investigations relating to: Local substitutes for raw materials imported from abroad or brought from other parts of the country; utilization of by-products and waste products; and finding solutions to manufacturing process problems, equipment problem, etc.

* Demonstration, setting up pilot plant, consultancy and technical matters including standards and specifications.

The research facilities could be provided by research institutes or university research laboratories. The NCST's research facilities can play an important support role.

5.6 INFORMATION REQUIRED AT DIFFERENT STAGES

Neelameghan (1992) has summarized, as shown in appendix 3, the variety of information to be provided at different stages to the different categories of persons involved in a product planning and development project. The variety of information in the appendix also applies to operating enterprises. For small scale industries without R&D establishments, there is need for governments to assist them in identifying R&D institutions relevant for their research needs.

5.7 INFORMATION SOURCES

Information sources include directories, periodicals and ad-hoc reports of the different institutions, and direct contact through correspondence and personal visits, with the appropriate institutions and agencies.

appendix 4 presents a brief survey of the major external sources of information on various aspects of establishing and managing a system for new product development and industrial production.

The information needs of small scale industries as outlined in the preceding sections are varied and wide for one institution to provide. Some countries have established agencies or institutions to collect information from the various institutions and disseminate the same to the industries.

The provision of information to small scale enterprises in Kenya has not been sufficiently coordinated to ease the tasks of industrialists in looking for information. The status of information provision in Kenya is discussed in chapter seven.

CHAPTER SIX

LITERATURE REVIEW

6.0 TECHNOLOGY TRANSFER

The role of technology in socio-economic growth, development, and trade has been extensively discussed since R. M. Solow's dramatic and much-quoted attribution of nearly nine-tenths of the growth of per capita income between 1909 and 1949 in the United States to technological progress. By 1966, S. Kutznetz, in substantially pioneering ideas concerning the rate, structure and spread of modern economic growth, concluded that the direct contribution of man-hours and capital accumulation would hardly account for more than a tenth of the rate of growth in per capita product, probably less (UNCTAD 1990). The remaining large unaccounted part must be assigned to an increase in efficiency in the productive resources - a rise in output per unit of input due to the improved quality of resources, or due to the effects of changing arrangements, or to the impact of technological change, or to all three. This is in agreement with Juma (Juma 1989) that recent studies have shown that the main sources of economic growth lie in technological innovation and institutional re-organisation.

A production function in which the output produced is in relation to capital, labour and managerial skills or organizational techniques has been experimented. The realization that qualitative improvements or innovations in any one of these elements could bring about important changes in output and productivity emphasized the importance of the economic aspects of technological change and innovation. International comparisons of the structure of production, the impact of national characteristics and technological capacity on the commodity composition of trade, as well as international technology transfer issues and policy responses, have become subjects of worldwide concern. More recently, the effects of technological change as well as the economic, commercial and developmental aspects of new and emerging technologies have been studied by UNCTAD. Several methods of technology transfer and absorption, as well as policies for stimulating and managing R&D as a source of technological change, productivity and competitiveness, have also been the subject of in-depth analyses. Attention is currently devoted to the issues of financing technology flows and technological investments (absorption, adaptation, generation) in order to enhance the contribution of technological advances to development, growth and trade.

It will be useful to understand the relationships between science, technology and production. Figure 6.1 present a cybernetic model of the inter-relationships of the three and shows the significance of information as a vital component in a nutshell.

In the model there are four types of boxes. Boxes I-III represent potentials of science, technology and production spheres respectively. The notions of S&T have been applied here according to the widely accepted convention which includes fundamental research in science, where as technology covers applied R&D.

Boxes IV-VI illustrate processes of transformation taking place in all the three spheres. The essence of science is the research activity aimed at discovering new phenomena and truths, the technology sphere focuses on transforming these theoretical developments into practical applications while production focuses on converting them into goods and services to satisfy human needs.

Boxes VII-IX present results obtained in the respective stages of the whole cycle. Box X illustrates the stock of world technical knowledge which is freely available and may be called non-proprietary. This type of external knowledge directly adds to the local sphere of

science and partly also the national technology, speeding up relevant R&D processes and simultaneously lowering their cost. Box XI represents the proprietary portion of world technical knowledge. It is protected by proprietary rights and kept confidential and is subject to international transfer on a predominantly commercial basis. The proprietary technical knowledge flows mainly into production and to a lesser degree to the technology sphere.

Technology, as defined in chapter one, section 1.5, is the scientific, technical, engineering and managerial knowledge necessary for the production of goods and services needed by the society. As applied to manufacturing industries, technology can be considered as the knowledge, skills and methods necessary for the productive functioning of an enterprise. It includes machinery and equipment, process engineering, all kinds of skills including managerial, financial and marketing; process and product know-how; institutional and organizational know-how; and information about equipment and knowledge including information on information (Haile-Meskel 1988). As summarized by Neelameghan (1991), the technology needed for the complex process of resource transformation has the following components which may be needed in different proportions or at different levels of sophistication in different situations:

- 1) Technoware or object-embodied technology,
- 2) Humanware or person-embodied technology,
- 3) Inforware or document-embodied technology, and
- 4) Orgaware or institution-embodied technology.

If technology is essentially Knowledge, passing on such knowledge to another is the essence of technology transfer. Accordingly, technology transfer may be defined as a process by which a package of knowledge is transferred from one who either owns it or has access to it to another who wants that knowledge.

Adei (1987), identified eight important channels for the transfer of technology. These are:

- a) Documentation, i.e. exposure to manuals, drawings, designs, layouts, process instructions, etc.;
- b) Instruction, including formal instruction of firm training sessions or leave-of-absence to study in schools, colleges, or universities and on-the-job training and exposure to the right kind of jobs;
- c) Conferences, workshops, seminars, etc.;
- d) Visits and exchanges of specific individuals among affiliates or between them and their headquarters;

- e) Supply of specialized equipment for the purpose of technology transfer;
- f) Working with trouble shooting teams;
- g) Joint ventures; and
- h) Importation and use of technology embodied goods.

Technology transfer may either be horizontal or vertical in character, or both. Vertical transfer takes place between different stages of R&D activities, implementation and exploitation of an innovation while horizontal transfer involves the transfer of technology from one country to another or between institutions at the same level (e.g. research laboratories, companies, etc) within a country.

International technology transfer, especially with developing countries as recipients, predominantly encompasses horizontal flows. Transfer of technology may take commercial or non-commercial forms. The latter covers all channels through which the freely available technical knowledge is disseminated all over the world (e.g. international conferences, training courses and publications). Commercial forms involve so called proprietary technology, access to which or whose use is usually restricted (through industrial property rights or institutional methods of keeping it confidential).

Effective transfer of foreign technology leads to the building of national technological capacity in which nationals develop the abilities to carry out tasks and functions successfully as well as to understand the scientific principles forming the basis of the technology so as to be able to undertake improvement, modification or to change them to suit differing situations.

These tasks involve both pre- and post-investment activities. Pre-investment tasks and functions comprise of project identification followed by techno-economic feasibility studies, detailed technical design and specifications, choice of suppliers and contract negotiations, installation of plant and equipment and start-up operations. On the other hand, post-investment tasks and functions consist of assimilating the technology through mastering the operations; repair and maintenance, renovation and spare part production. They also include functions of adopting technology to conditions under which it is expected to operate as well as of generating technology and introducing them into the productive system.

One of the most important determinants of the final balance of gains and losses resulting from technology transfer for the recipient country is the nature and

structure of links between science, technology and production spheres. In practice, it has frequently been the case in developing countries that, due to the weak link of local R&D infrastructures and between this sphere and the production sector, foreign technology proved detrimental to the domestic innovative activity. It replaced indigenous research efforts, diverted the attention of local R&D staff from the problem germane to the state of backwardness, biased scientific institutions towards current production issues (UNIDO 1989). The isolation of the R&D sphere from production has in turn resulted in the information gap. Even if technology required to catch up with imported innovations were available in the country, the local companies's demand has been channelled abroad because of the lack of awareness of existing possibilities. Thus, as a derivative of the initial technology transfer, further continuous purchases of foreign technology have been induced, thereby hampering the development of indigenous R&D activity.

An adequate and appropriate technological environment is required for successful technology transfer. Some aspects of this environment relate to the existence of technology policy defining main direction of technological development within the framework of

national development priorities, of people with basic training in fields essential to the successful running of modern industrial activities, of a legal and administrative framework for the transfer and development of technology, of R&D institutions and of industrial and technological information systems and services.

No one now denies the significance of technology in the overall transformation of an economy. While this issue is of relevance to all countries, the question here is how developing countries, in a vastly altered world of slow growth, major contractions in international trade, important financial constraints and an extremely rapid pace of technological and structural change, are to ensure that the most adequate strategic decisions concerning technology are taken and that accompanying policies and mechanisms are set in place and implemented in a mutually supportive fashion.

6.1 TECHNOLOGY TRANSFER AND DEVELOPING COUNTRIES

Technology transfer to and within developing countries take two forms, horizontal and vertical transfers, as discussed in the following sections.

needs a certain innovative capacity and has skill requirements that must be met. The relevancy of information systems for the technology acquisition and transfer is as explained in section 6.3

As technology is not defined by a single explicit blueprint, adaptive changes such as the use of different raw materials, downscaling of plant size, diversifying of the product mix and redesigning of the product may be needed. The lack of skills, raw materials, spare parts, market potential, etc., often force technology users in developing countries to introduce adaptations and organizational innovations into productive processes (UNCTAD,1990). These vital needs have helped to generate and build up technological capacities and capabilities over time. They appear to have laid a solid foundation for technological development in several developing countries, some of which are now starting to export technological elements or even composite projects.

It has been reported that in many cases, developing countries may not have information on less expensive but equally suitable technologies available in other developing countries (Neelameghan 1992). Therefore, international programmes, such as Technical Co-operation among Developing Countries (TCDC) stress, among other

things, the need for developing countries to widely disseminate and exchange information on technology developments in their respective countries and on their experience with the use of particular technologies (Neelameghan 1981). Information systems - national, regional, and global - should be capable of capturing and inventorying technology used in developing countries, disseminating widely information about indigenous technology within and outside the country through cooperative mechanisms, identify national technology needs, alternative technologies and their sources, and provide information support for technology assessment, transfer, choice and adaptation to the application environment. The kind of information and information support mechanisms needed for the purpose have been the subject of several national, regional and international discussion and papers. For instance, the main working Document of UNISIST II Intergovernmental Conference (1979), the United Nations Conference on Science and Technology for Development (1979), the UNCTAD and other UN agency conferences.

Timbergen identified that information and information exchange were key elements of international cooperation. If one nation (or group) has knowledge which enables it to achieve higher productivity, why are not

the others acquiring that information? The problem turns, in part, on the differential cost of communication within and between nations (and groups), that is, the cost of information transfer is an important factor influencing the world-wide diffusion of technological know-how. This communication cost varies with the area of application, averaging about 19 percent of the project cost as some studies have shown. Teece, based on his studies of technology transfer costs, points out that know-how transfer is not merely the transfer of a set of blueprints and manuals that are usable at minimal cost to all parties; that the resources required for communication of know-how are considerable (varying from 2% to 59% , averaging 19% of the total project cost), and that it is influenced by a number of factors. These findings and similar studies have important implications for the planning of national, regional and international technology information transfer mechanisms and bilateral cooperative arrangements in developing countries. In 1965, developing countries spent about US \$ 400 million in purchasing technology from developed countries; this expenditure amounted to about US \$ 1.2 billion in 1975, and to about US \$ 6 billion in 1985 (Neelameghan 1992). In importing and adapting technologies developed in environments different from their own, developing countries may be investing in technology transfer much

more than what would be required if their information systems were more effective and efficient.

A major proportion of the science and technology information sources in demand in developing countries are those generated and/or located in the developed countries of the west - for example, periodicals, reports, and databases. These sources are expensive to obtain or access and represent a substantial part of the foreign exchange component of the information systems in developing countries. Some countries cannot afford them. But what makes the situation ironic is that many developing countries often purchase back from abroad much of the worth-while research information or papers generated in their own institutions, even though it may only be a small fraction of the total volume (Neelameghan 1981).

It is apparent that several researchers in developing countries prefer to publish in foreign periodicals. Experience and studies indicate that one important factor is the poor technical publication capabilities in many of the developing countries. A good technical publication capability covers a whole range of facilities: an efficient and effective editorial and publications capability; a good refereeing system that

assists and encourages scientists to prepare papers of high standard; efficient and high quality printing and publishing facilities; and an efficient world-wide publications distribution and marketing system. A good national technical publication system will help capture at home most of the good research ideas generated in the country instead of having to pay in foreign exchange to obtain them from abroad later on; provide for better bibliographical control of the country's research efforts; enable the conservation and earning of foreign exchange through the sale and exchange of the periodicals and reports; facilitate the creation of databases of the nation's information sources which could become foreign exchange earning products.

6.1.2 Technology Transfer - from R&D Institutions
(Vertical Transfer)

It is significant that the role of science and technology in development within developing countries has recently received considerable political support. Ever since the ushering in of political independence to many third world countries in the 1950s and early 1960s socio-economic development has been recognized to be closely linked to the development of science and technology.

Taking developed countries, for example, their rapid economic and industrial successes are associated with the large investments that these countries put in their scientific and technological research.

The concept of building up technological capacities over time has led, in many developing countries, to the creation of institutional structures for R&D and technological services (UNCTAD 1990). Many factors, some of them of a technical nature, but some also dependent on macro-economic conditions, the age of the technologies, the importation of new technologies and the size of the enterprises have an important influence on the way in which the transfer of technologies from R&D institutes to enterprises operates in developing countries, and/or whether enterprises would undertake or generate a demand for such R&D and technical services.

Scientific and technological infrastructure developed in developing countries and capabilities thus created have, in many cases, failed to fulfil their full potential as yet, and sometimes appear to lack the necessary links with the importation of technologies from abroad, as well as with the real technological requirements of the productive sector (UNCTAD 1990). The reasons may stem from financing, management problems, economic factors and technology policy orientations.

Deliberate efforts are currently being made in many developing countries to promote the process of technology transfer from scientific and academic communities and R&D institutes to the productive sector, thus capitalizing on locally developed or adapted technologies. A shift of emphasis is also under way towards establishing links between R&D undertakings and the acquisition of technologies from abroad. The following sections deal with details of technology transfer from R&D institutions

6.1.2.1 Research-Industry links

As part of their overall developmental effort most developing countries are investing in research and development, in institutions of higher education, in research centres, and similar programmes (Neelameghan 1992). The long range goals include the development of research manpower, capabilities and facilities in the country, to provide support to development programmes, to make their own contribution to the fund of knowledge in various fields, etc. In many of these countries facilities to provide a frequently updated inventory of ongoing research and dissemination of research results to potential users are weak. The capacity and facilities needed to convert ideas generated by research into innovations and their practical applications in

development programmes are again deficient. The transfer of an idea from the laboratory to the field - for instance the small industries, as an appropriate technology involves several stages and time. Appropriate information support and services can help shorten the time lapse between the stages. Schumacher categorizes the various professional (and their organizations) that participate in the innovation and its transfer process as:

- a) scientists
- b) technologists
- c) innovation managers
- d) information consultants
- e) information brokers

Another related and important category would be extension/liaison personnel and other intermediaries that facilitate technology delivery.

Various methods are used to establish liaison, communication channels and exchange of information between research centres and the industry so that industry may become aware of the innovations of the research centres on the other hand and for research centres to become familiar with the problems, needs and

other aspects of industries, on the other. Thus, researches done in the country can at least in part be directly pertinent to the specific problems of industries. On the other hand, industries, particularly the small and medium scale enterprises, will have access to the expertise, information resources and facilities of the research centres. In some countries, work done and services rendered by a research centre to industry are a source of supplementary revenue to the centre.

Mentioned below are examples of cooperation between research centre (in university or independent) and industry as modalities of information and technology transfer. The research centre

- a) establishing and maintaining liaison with industrial units and enterprises agencies, offices, and organizations in the public and private sectors concerned with development and management of industries;
- b) providing advisory and consultancy services to industries and agencies concerned with industrial development;
- c) providing research and development support to industry;
- d) trouble shooting;

- e) assisting in technology assessment, evaluation and selection;
- f) establishing applied research/technology development centres/projects within university or research centre with industry support and using the human resources and facilities of the centre;
- g) training of industry personnel;
- h) identifying and selecting appropriate training programmes/centres;
- i) placement/attachment arrangement;
- j) organizing and conducting of courses and workshops;
- k) organizing/participating in field activities and extension services and supporting extension services;
- l) providing testing, research and proving/pilot plant facilities for use by industry;
- m) undertaking industry diagnostic studies;
- n) demonstration of know-how;
- o) organizing exhibits of innovations, new products, processing techniques, equipment, etc. and participating in such events organized by other agencies;

- p) organizing seminars and similar meetings on topics of interest to small industries and to organizations concerned with industrial development;
- q) organizing open houses, industry-research meets and similar get-together;
- r) assisting enterprises in establishing information service units, systems, databases, etc.;
- s) providing information services to small industries (see chapter ten);
- t) preparing and/or undertaking various studies and reports (see chapter ten).

Some good examples of liaison work carried out by institutions concerned with development of small enterprises, including provision of information support, are INFOTECH in Mexico City, the Danish Technical Information Service (DTS) in Copenhagen, the Caribbean Industrial Research Institute, Port-of-Spain, Trinidad, the National Institute for Small Industries Extension Training (NISIET) together with its Small Enterprises National Documentation Centre (SENDOC) in Hyderabad, India, and the Technology Resource and Livelihood Centre (TRC) in Manila, the Philippines. TECHNUNET-Asia (Singapore) supported by the International Development Research Centre (IDRC), Canada, and the ASIA-Pacific

Centre for Technology Transfer (APCTT) are examples of regional services that include liason work with small enterprises.

6.1.2.2 Commercial transfer and Dissemination of R&D results

Many developing countries have a strong component of R&D activities that are sponsored, supported or funded by governments or directly carried out by public sector institutions (UNCTAD 1990). Such R&D may concern itself with the design and engineering of new products and processes, as well as with the improvement, upgrading or updating of existing technologies.

On the other hand, it is generally recognized that publicly-funded R&D institutions are not always well-equipped to undertake the commercial exploitation of their own research results (UNCTAD, 1990). The knowledge and experience of bringing the results of R&D to fruition necessitates skill and specific measures. It is also recognized that the process of innovation and invention is only a small part of the total endeavour which leads to the use of the invention or innovation and finally to a business or commercial success. In an earlier study , it was reported that only one out of 500 ideas generated

in enterprises reached the stage of commercialization. In many instances, in fact, the phase after R&D results are successfully obtained is of critical significance, as it opens up possibilities for engineering design, marketing and commercialization of R&D results. It is only this phase which can create ever-increasing productive opportunities, including the increase of employment and foreign exchange earnings. Neelameghan (1992) has summarized the main stages which a new idea undertakes to be utilized, as illustrated in appendix 5. It has been observed that there is a gap between the different stages, resulting in delays of utilizing the new ideas. The gaps (delays) has been attributed to lack of information between the different stages, as there are no institutions mainly established for the purpose of information transfer. Such institutions are essential for efficient transfer of technology.

A few countries have tried to establish technology transfer agencies or national research development corporations to promote the transfer of technology from R&D institutes to productive enterprises (UNCTAD 1990). The main functions of these agencies consists in

- 1) disseminating information on the availability of technology;

- 2) selecting the acquiring party or parties and working out the arrangements and agreements for utilization;
- 3) giving assistance in obtaining patent protection;
- 4) preparing techno-economic feasibility and project reports;
- 5) helping in the transfer of data and information and fixing the possibility for fulfilment of the various stages for upscaling to industrial production;
- 6) collecting premiums and royalties from the entrepreneur and transmitting these to the R&D institutes; and
- 7) assuming responsibility for engaging in legal proceedings on behalf of the R&D institutes when necessary.

Technology Transfer Centres (TTCs) may be categorized as follows (Neelameghan 1992):

- 1) Technology Consultancy Unit (TCU)
- 2) Technology Transfer Unit (TTU)
- 3) Technology Coordination Group (TCG)
- 4) Technology Coordination Centre (TCC)
- 5) Technology Development Centre (TDC)
- 6) Technology Research and Development Centre (TRDC).

The principal functions of the TTCs are as shown in figure 6.2

figure 6.2 - Functions of TCs

Functions	TCU	TTU	TCG	TCC	TDC	TRDC
1. Documentation of available technologies & sources	X	X	X	X	X	X
2. Economic & business consultancy	X	X	X	X	X	X
3. Consultancy on licensing			X	X	X	X
4. Promotion of industrial cooperation			X	X	X	X
5. Transfer of foreign R&D results		X	X	X	X	X
6. Exchange of know-how among local industries			X	X	X	X
7. Transfer of local R&D results				X	X	X
8. Evaluation of imported technologies		X		X	X	X
9. Adaptation of imported technologies					X	X
10. Development of indigenous products					X	X
11. Development of indigenous equipment					X	X
12. Development of production processes					X	X
13. Applied research						X
14. Project management		X	X	X	X	X
15. Training					X	X

Source: Neelameghan, 1992

In many instances, applied R&D is carried out with relatively little reference to productive sector needs, yet valuable results or technological improvements of relevance to productive enterprises could be obtained, although they may remain idle for lack of information

(UNCTAD, 1990). This is in agreement with Onyonga (1978) that there is a tendency also in the developing countries for useful information to be filed up in departmental cabinets, be it in the Ministries or in any other institution.

The issue is less acute when selection of areas for investigation by the R&D institute is made on the basis of the identified needs of the productive sector. The R&D institutes are thus assumed to be aware of the candidate enterprises that are interested in their findings. Despite this, a note or brochure giving the relevant information on the characteristics of the new "results", the main raw materials, equipment and instrumentation needed and their availability, the approximate amount of investment required for using the technology or applying the improvement and the anticipated returns enable the entrepreneur to make a preliminary assessment of his possible interest. A public advertisement could also be inserted in technical and trade journals to ensure adequate coverage and enable interested parties to respond. It should be noted that preparation of information with a view to evoking entrepreneurial interest and the dissemination of information to prospective parties are an essential activity in the commercialization process.

6.1.2.3 Arrangements and agreements for utilization and transfer of technology

Worth-while technologies have often come to grief because of faulty selection procedures, unrealistic terms of agreements and conditions and choice of wrong party (UNCTAD 1990). Advertisement and acceptance of the highest bid may sometimes result in selection of an enterprise that does not have the requisite capability to upscale and operate the technology. After the parties concerned have come to an agreement, the nature of the information to be transferred should be clearly stipulated in it. The R&D institutes mainly generate information on process know-how, either on a laboratory scale or, at the most, on a pilot plant or prototype scale. Much more information on raw materials, equipment, energy requirements, disposal of effluents, input-output ratios, costing, markets and operating manuals, etc, is required for successful industrial operation. Few R&D institutes are equipped to assemble the various elements of technology as a package. Misunderstanding may arise because the purchaser of technology, who sometimes lacks previous industrial experience (e.g. potential entrepreneurs or small-scale entrepreneurs) expects a turnkey operation from the R&D institute of the kind he would receive from a foreign collaborator when importing

technology. Unless the various elements of information and data to be supplied are explicitly spelt out and the respective responsibilities of the parties clearly defined in the agreement, the project will suffer from delays, cost overruns and misunderstandings. The role of engineering and design consultancy agencies is crucial in bridging the gap between the data available from the R&D institutes and the technology package required for the setting up of an industrial unit by an entrepreneur.

6.1.2.4 Upscaling and marketing

Highly skilled design, capability exists in some of the research and academic institutions (Juma 1989). However, the capability is not effectively linked to the productive sector. The process of linking the design capability with the productive sector is complex and needs to be examined carefully. In most of the cases of transfer of results from R&D institutes, the data and information available are based on laboratory, bench scale or at best pilot plant operation (UNCTAD, 1990). Agreements signed should clearly stipulate that further development work required, and upscaling to industrial scale and market development, will be the responsibility of the purchaser/entrepreneur. Even the pilot plant stage, and more so the subsequent stages, need

multidisciplinary teamwork. These stages are also progressively more complex and increasingly cost-intensive. At times, the entrepreneur selected is unaware of the implications of his responsibility for development or of the costs involved and this accounts for a number of delays and failures in the production of indigenous technology. Such information should be made available in information support systems, be it technology transfer centres or otherwise

Even after a successful transfer of information, it will be necessary to monitor the plant when in operation and to solve technical engineering problems that could not have been foreseen in the earlier stages. Either the industrial entrepreneur should have competent technical/engineering personnel to deal with these problems or some understanding/agreement should be entered into with the R&D institute concerned for continued association and assistance. Technological/engineering inputs would also be needed for continuous improvement and updating of the technology. The association of the R&D institute usually ceases with the transfer of the data/information as stipulated in the agreement, but a farsighted view should visualize continued association over a sufficiently long period in an advisory capacity.

The above activities are among those necessary for speedy utilization of R&D results. However, these activities should be seen as part of the functional links between R&D institutions, consultancy and engineering organizations and productive enterprises. Consequently, it is essential for the various links in the innovative chain, namely laboratory-scale research, pilot plant investigations, scaling-up, design and engineering of commercial scale plant, production trials, etc. to be established and strengthened in order to ensure that R&D results effectively reach the productive sector.

6.2 LIAISON BETWEEN INFORMATION FACILITY AND ENTERPRISES

An information facility established to serve a group of small enterprises as in an industrial estate, should have close contact and interaction with the enterprises served (Neelameghan 1992). Such liaison work arises in the context of the information facility developing projects, programmes and services enabling the enterprises to have easy access to information and advisory services that they need for the efficient execution and management of their respective production, marketing and other business activities. The information facility/centre should independently study the background, infrastructure, interests and requirements of

the enterprises and the individuals therein as well as those of the organizations concerned with development of small enterprises. Such studies can provide the framework for establishing appropriate types of information and data services and to identify information sources, systems and services at local, national, regional and international levels which can be accessed and utilized. Activities designed to transfer technology to enterprises can also benefit from such studies and liaison work. In many countries such national or sub-national centre is part of or affiliated to an institution or agency concerned with small industries.

The main objectives of liaison work are:

- a) Identification of the technical problems that an enterprise may encounter in the conduct of its business and to encourage and persuade the personnel of the enterprise to use information in finding solutions to those problems; and
- b) Learning about and collecting data and information on the future plans of the enterprise so as to be able to offer pertinent advice and develop appropriate information services to aid the enterprises in the formulation of plans and in their implementation.

The secondary objectives and byproducts of liaison work can be:

- a) Identification of the actual and potential users of information and data in the different enterprises;
- b) Identification of the actual and potential uses of information and data in the enterprises;
- c) Stimulation and promotion of the effective and efficient use of information for increasing the innovativeness and productivity at all levels in the enterprises;
- d) Identification of the accessible information sources and services so as to develop information infrastructure and network facilitating information access and services to the enterprises;
- e) Study of the information seeking and use behaviour of the different categories of personnel in the enterprises;
- f) Identification of experts available in the enterprises, research and other institutions in different fields for preparing databases of profiles of expertise: such expertise can be drawn upon for providing information, consultancy and advice to assist the enterprises;

- g) Collection of data and information preparing:
- * databases of profiles of industries and products;
 - * user profiles for providing current awareness and SDI services;
 - * database of technology, innovation, new processes, techniques, equipment, etc. developed in the country and useful to the small enterprises;
 - * databases and other appropriate files that can help in assessing and evaluating technology needs and technology selection and acquisition in the country in general and in the small enterprises in particular;
- h) Promoting, planning and assisting in the establishment of information units in the enterprises to facilitate effective use of information;
- i) Promoting contact among enterprises with similar business activities, projects and programmes; between industries and R&D centre; and between these and information centre;
- j) Creating awareness about the information services available among industry personnel and orienting and assisting them in the effective use of the information services; and

k) Marketing technology, innovation and knowledge generated in the country and that flowing from abroad through various media linking up actual and potential users and suppliers of new knowledge.

Liaison may be established in more than one way. For example:

- a) The information centre may take the initiative to visit the enterprises with a view to discussing with the management the advantages to the enterprises in having the liaison with the centre and providing demonstrations of some of the value-added information products;
- b) Through conferences, seminars, etc. between the information centre staff and those of an enterprise or group of enterprises; and
- c) Stimulating the interest of enterprises in the use of information by offering various types of information services.

The information centre staff, usually engineers and technologists with experience in industry, visit enterprises and discuss with the supervisors and technical staff the problems encountered and the near-term and long-term plans for development of the

enterprise or group of enterprises, to identify areas needing technical advice and information and data support. The visiting team may include management specialist, economist, etc. as necessary . The initial contact may be to be established with/through the top executive of the enterprise, and subsequent visits may be to the plant/factory and meetings with the factory supervisory staff and technicians. An objective of the visits could be to convince the staff of the enterprise of the genuiness and commitment and capability of the information centre to help the enterprise with their problems and development plans, whether these raise technical, economic, marketing, regulatory or other issues.

Meetings, courses, lectures and training services for a group of enterprises may be arranged.

- a) to stimulate effective utilization of information by the enterprises in general or by those situated in a particular geographical area;
- b) to stimulate cross-flow on important ideas of interest to enterprises dealing with a particular product;

- c) to promote specialized information services to meet the specific needs of a group of industries or group of technical and managerial personnel in different industries; and
- d) to train personnel in the enterprises on how to organize information services to ensure efficient and effective flow of data and information to and within the enterprises.

Special meetings may also be organized inviting heads of the small enterprises, representatives of larger industries that consume the products or supply raw materials, equipment, etc. to the small enterprises, and representatives of government bureaux concerned with small industries, to discuss industrial development plans, the national and sub-national development priorities, and/or specific problems faced by small enterprises, for example in mobilizing resources, obtaining raw materials, marketing and export questions, establishment of special facilities for entrepreneurs, etc.

The liaison personnel bring back to the centre problems that need solutions, demands for data and information, contacts, consultation and research services to be followed up. Such follow-up may involve information

search, analysis and consolidation, the preparation of techno-economic reports, organizing market and/or feasibility studies, referring the problems to other institutes, experts and consultants who may be able to advise and help. It is essential that the centre prepares and maintains well indexed databases of relevant facilities and expertise available. Such services stimulate more effective use of the information services provided by the centre.

Extension personnel in industrial extension work for small industries constitute an important group of liaison officers. Providing information services, formal and informal, to small enterprises is an integral part of their work and functions. These industrial extension officers are expected to be adequately trained in the use of information sources, in interpreting and transferring and in the promotion of the use of information by entrepreneurs.

Extension services are of special importance in disseminating information and transferring technology to rural areas in developing countries. Autodiffusion of new technology, even one that is apparently of great relevance to rural areas, such as, biogas technology, is found to be difficult due to the economic, social and

cultural characteristics of rural population (Neelameghan 1992). Furthermore, this particular technology does not offer immediate economic returns and installations entails significant costs. In such contexts extension activities have proved to be invaluable in creating awareness of the advantages of the technology, and its eventual transfer, spread and proper utilization.

Broadly speaking, the objective of extension work is to help people to help themselves; to change the behaviour of the people by changing their knowledge, skills and attitudes in relation to a specific entity through their voluntary cooperation. Thus extension implies:

- a) conscious effort on the part of innovators or those concerned with development to reach the potential beneficiaries;
- b) the need for ensuring maximum cooperation of the beneficiaries for making it a self-sufficient and self sustaining mechanism;
- c) training and preparing a category of development functionaries - extension workers- who become an important information base and link to appropriate knowledge sources regarding the

technology and who play important roles in the dissemination of information and transfer of technology;

- d) importance of training of extension personnel in selecting appropriate information sources (documentary and other), in retrieving or extracting relevant information and in the effective presentation and communication of the information to the target group; and
- e) establishing an information infrastructure and network for the extension personnel to draw upon.

6.3 INFORMATION SYSTEM FOR TECHNOLOGY ACQUISITION AND TECHNOLOGY TRANSFER

It is important to stimulate the interest of all those working to bring about industrial development, and those responsible for it in using information effectively and efficiently. In particular, information to assist in pre-decision studies relating to the development of small industries is crucial. An information system for technology acquisition and transfer is therefore necessary. Such a system should be designed to support activities such as (Neelameghan 1992)

- a) identification of technology needs of the system

- b) technology assessment and evaluation
- c) arranging for technology transfer; and
- d) evaluation of technology management.

Details of information required and information sources in each of the above steps are given in appendix 6

6.4 TECHNOLOGY TRANSFER IN KENYA

Negotiating for technology transfer in Kenya is at present the responsibility of the recipient and the supplier, each trying to make a hard bargain in an attempt to attain his or her objectives (NCST 1990). It is only in the area of public investments that Government representations are made. Negotiation for technology transfer whether by the private or public sector, investors are inhibited by the following:-

- a) the inequality in skills at the bargaining table which gives the supplier of technology an upper hand in terms of technical knowledge, options, comparative prices;

- b) inadequate involvement of locally qualified persons. Already in Kenya there are persons qualified in various disciplines related to technology transfer;
- c) a centralized information system is a source of strength in technology negotiations. It helps the local buyer who may be totally unaware of the available options (patented or otherwise), the price ranges, the positive and negative aspects of each technology, the full implications in terms of inputs, output and/or the experience of others using the same or similar technologies. Information as a tool in industrial development is hardly given the weight it deserves in Kenya (NCST 1990). A process of selection of technology must of necessity be accompanied by the availability of adequate background information (see appendix 6).

The inadequacy of information is a reflection of weak institutional linkages and lack of co-ordination on matters of technology. As a result of the unregulated flow of foreign technology into Kenya, local investors have adopted an attitude of importing all (or most) of their needs with very little effort of sourcing locally. This attitude and approach has meant that indigenous

technology has grown at a slow pace while efforts by local entrepreneurs are frustrated.

Although Kenya spends considerable human and financial resources in conducting scientific research, information emanating from such research is not adequately disseminated (NCST 1987). This necessitated the present study. Often, results of scientific research end up in journals which are accessible to only a small group of scientists. Little attempt is made to translate the findings into a language which can be easily understood by planners and information disseminators such as community development workers. The situation is further complicated when researchers publish information relevant to the country in foreign journals which are not easily accessible to other scientists in the country. Mechanisms that contribute to the flow of scientific and technological information are as outlined in the next chapter.

CHAPTER SEVEN

7.0 PROVISION OF SCIENTIFIC AND TECHNOLOGICAL INFORMATION IN KENYA

There are various mechanisms that facilitate the provision of scientific and technological information in Kenya. The major ones are discussed in the following sections.

7.1 SCIENTIFIC AND TECHNOLOGICAL INFORMATION SYSTEMS AND SERVICES

Currently, there is no overall national information policy in Kenya, hence information systems developments are guided by the needs and capacity of individual institutions. However, there has been much discussion in various forums about the need for a national information policy, as well as a coordinated national information system (Wanjau 1992). The lack of an overall national information policy has therefore contributed to the inefficient flow of information to the users. However, there do exist a number of scientific and technological information systems and services in Kenya. Among these are libraries, documentation centres, archives, museums,

publishing establishments and extension services (NCST 1987). Those that are relevant to the present study are discussed in the following subsections

7.1.1 Kenya Scientific Information, Documentation and Communication Centre (KENSIDOC)

At the national level, the Kenya Government has recognized the vital role of scientific and technological information and has through the Science and Technology Act of 1977, called upon the NCST to consider and advise generally on all scientific activities including "scientific documentation, statistics, surveys, and general information". The NCST has in its report number 4 on Science and Technology for Development acknowledged that planned utilization of scientific and technological information is one of the most important tools for development: yet this remains one of the least developed areas in Kenya. A considerable amount of useful information is available in the country and can be sourced globally, but coordinating mechanism at the national level has not been established for effective selection and dissemination of scientific information. On the acceptance of the report by Kenya Parliament, NCST established in 1983 the Kenya National Scientific Information, Documentation and Communication Centre

(KENSIDOC) with the overall objective of developing information services necessary for the elaboration and implementation of Kenya's scientific and technological plans for socio-economic development (Kenya Government 1989). The medium-term objectives of KENSIDOC are to:-

- a) put at the disposal of planners, research workers and technologists appropriate tools for the identification of sources from which required information can be found (information referral services);
- b) provide information on research institutions, on-going research programmes and projects and research scientists in various disciplines;
- c) disseminate results of research undertaken in Kenya, about Kenya by local and foreign researchers; and
- d) strengthen information sources in priority scientific areas identified in national development plans and strategies such as agricultural, industrial, health and development planning.

In order to avoid gaps and duplication in the national scientific information databases, NCST has identified and has assigned specific responsibilities to

some sectoral resource centres (information systems) according to their areas of specialization (NCST 1987). The resource centres are listed in Appendix 7. From the list, it is useful to describe briefly those that are relevant to the study. These are discussed in subsections 7.1.2 to 7.1.5. Other systems that are not in the list but relevant to the study are discussed in subsections 7.1.6 to 7.1.14.

7.1.2 KIRDI Library

KIRDI library provides access to information contained in scientific and technical documents. The library contains published and unpublished literature in most fields of science and technology specially selected to meet the needs of industrialists. A collection of books, periodicals, newsletters, reports, trade literature and information files are available in the library (Gachuhi 1987).

Entrepreneurs and industrialists are free to use the library during the normal working hours. However, to be able to borrow books one requires to be registered as a member of the library at a nominal fee of Ksh. 400 and thereafter pay an annual subscription fee of Ksh. 100.

The technical staff in the institute can answer scientific or technical inquiries from industrialists by letter or on telephone depending on the length and urgency.

7.1.3 Ministry of Commerce and Industry Library

The library which is situated in Uchumi House serves the ministry staff as well as other members of the public. However, borrowing is restricted to the ministry staff. There is also an exchange programme with other ministries and departments.

7.1.4 University of Nairobi - Main Campus Library

The library serves the University staff, students and members of the public. Borrowing is restricted to University staff and students, but there are other special arrangements with the members of the public who are allowed to borrow on payment of fees. The library has an exchange programme with other libraries such as Government libraries, faculty libraries, other universities, etc. Special collections of the library include theses and dissertations produced for the university; maps and aerial photographs; unpublished reports, and reprints.

The information system's document-collection consisting of over 2,000 titles include the following:

- a. Government policy documents and development plans
- b. Statistical Abstracts (by Central Bureau of Statistics) and economic surveys
- c. Legislations including various Acts, Bills, Legal Notices, Kenya Gazette Supplements, etc.
- d. Miscellaneous reference sources including trade literature of various countries and technical reports.
- e. Books on accounting.

7.1.7 Mass Media

Mass media is a versatile channel for dissemination of information because it can be used to reach remote areas. However, Kenya's low rate of literacy and distribution problems limit the usefulness of the print media (NCST 1987). The high cost of television sets, lack of electricity in the rural areas, and problems relating to repair and maintenance also limit the feasibility of utilizing television for the dissemination of information. The radio, on the other hand, has wider coverage, but its potential has not been fully utilized. It should be noted also that there is lack of scientific

- f) To participate and assist in campaigns for the eradication of illiteracy;
- g) To stimulate public interest in books and to promote reading for knowledge, information and enjoyment;
- h) To acquire books produced in and outside Kenya and such other materials and sources of knowledge necessary for a comprehensive national library; and
- i) To publish the National Bibliography of Kenya and to provide bibliographical and reference services.

Kenya National Library Services has to some degree succeeded in its functions as a public library service. The service has been expanding steadily with the aim of eventually serving locational (administrative units) and village levels by the year 2000. At present, Kenya National Library Services has a network of 15 branch libraries with eight mobile Library vehicles (Ng'ang'a 1990).

In the other areas of its expected functions, Kenya National Library Services has not fared very well. Its role in planning and co-ordinating library, documentation and related services in Kenya, advising the government on

matters concerning library professional training and education exists only on paper (Ng'ang'a 1990). Although Kenya National Library Services is legally empowered to play a leading role in these matters, it has inevitably not achieved much. One area in which the service is to be complimented is the promotion of the library profession in the country through sponsorship and participation in seminars.

The Books and Newspapers Act of the laws of Kenya states, "In order to facilitate the publication of the National Bibliography of Kenya under section 4 (k) of the Kenya Library Services Board Act, before or within fourteen days after publication of the book, the publisher at his own expense shall deliver to the Director of the Kenya National Library Services, two copies thereof together with the prescribed particulars and signed by him". The Kenya National Library Services has not been able to prepare the Kenya National Bibliography regularly as per the requirement of the Act, nor the Kenyan Periodicals Directory.

Although the Kenya National Library Services has also assumed the role of the national agency for issuing ISBN to Kenya publishers, only a handful of such publishers have come forward to register with the Services for the purpose.

This was a slight deviation from the past where planning for projects was done at the ministry of Planning and National Development headquarters in Nairobi. More often there was not enough data or information and as such planning was haphazardly done and not even according to the priority needs of the districts (Wanjau 1992). Thus, the District Information and Documentation Centres (DIDCs) were established in 1984.

Currently there are over twenty DIDCs spread over the country which are in different stages of development. The DIDC programme is based on several related premises:

- a) Economic planning for area development requires a reliable and comprehensive database, describing the area in all its relevant aspects. Planning without adequate knowledge of the local environment places the public's welfare at risk.
- b) Implementing development requires reliable and timely monitoring and feedback of progress, problems, and impact, especially to detect unexpected and/or undesirable consequences of the development, and to signal unexpected bottlenecks to progress.

c) The decentralization of planning, plan implementation and monitoring is a priority of the Government and promotes speedier implementation of development activities for a given region or area. Increasing local capability to participate in the process has been shown to be an often critical determination of project success.

Kenya has a broad base of information primarily geared for macro-planning and analysis. However, it is less adequate for characterizing the great diversity of physical, ecological, economic, and socio-cultural system which characterise districts, over forty of them. This inadequacy was evident in the district planning exercise, covering the period 1989-93. A better district-level information base is essential if decentralized planning is to be effective.

The provision of a better district-level information and database should have direct effects on the transfer of information to and from headquarters planners, with the possibility of greater incentives for checking reliability before simply transmitting the data onwards. This should benefit development planning in Kenya, in general, as well as monitoring and evaluation of

activities and development research programmes. Integration of the DIDC function with the establishment of District Statistical Officers by the Central Bureau of Statistics will further strengthen the overall system.

Ultimately, the DIDC Network can increase the transfer of pertinent information from international sources directly to the areas of the country where the information and research studies are most relevant. This latter depends on close working relationships between the central clearinghouse at the nucleus of the DIDC network and the sources, generators, and users of information - whether occurring in Nairobi or the Districts.

7.1.10 Central Bureau of Statistics

The Bureau provides data on industry, transport, trade, exports, imports, sectoral employment, population censuses, mortality rates, rate of population growth, infant mortality rates, prevalent disease, hospital beds and available professional. This is the kind of user-oriented information system that can assist in planning and strategic decision-making.

For a country like Kenya which is keen and investing in industrial development so as to increase employment potential, there is need for information related to industrial planning which the Bureau of Statistics is not able to handle adequately at the moment (Ndavi 1990) - data on raw materials, technology, domestic and world markets, price and salary indices, legal data concerning building permits, plot allocations, plan on use of land, building types and public utilities. This kind of data would be invaluable to the prospective investor and the economic planners especially if they are planning for the rural community where information of any type is not easily accessible.

7.1.11 Telecommunications

The telecommunications network has been expanded extensively and it covers the whole country. Although not every centre in Kenya has telephone service, the major industrial, commercial and administrative centres have been provided with good telecommunications facilities affordable by the Kenya Posts and Telecommunication Corporation (KPTC) (Njohihio 1988). The development of the network follows closely the Government guidelines on provision of basic infrastructures throughout the country

so that capacity for promotion of social and economic development is enhanced. This has resulted in KPTC providing automatic telephone exchange in all District Headquarters and presently the emphasis is to automate divisional (administrative unit) Headquarters .

The transmission facilities that are linking telephone exchanges throughout the country are of high quality. The transmission network is composed of overhead trunk routes and radio routes and they are suitable for transmission of both voice and data. Information transfer through telecommunications network is possible through telex, facsimile transfer, telephone, teleconferencing and data communication. KPTC provides all of these facilities except for teleconferencing.

7.1.12 Publishing Firms

Kenya has a number of public and private publishing firms. Public firms include Jomo Kenyatta Foundation, Kenya Literature Bureau (KLB), Government printer, Nairobi University Press (NUP), etc. The Jomo Kenyatta Foundation and KLB have been assigned the task of publishing books for primary and secondary levels.

Several of the books published by the firms are authored by the Kenya Institute of Education. The Government printer is the publisher of central Government documents.

The Nairobi University Press (NUP) was established in 1984 to make up for the deficiency of teaching materials at the tertiary level of education. Many books and other materials at this level have been imported, eating into the scarce foreign exchange. Besides, most of the imported materials are not relevant to the local educational needs. It should be noted, however, that the current publications from NUP are not covering the science and technology areas.

7.1.13 Workshops, Conferences, Seminars, Shows, etc.

Workshops, conferences, seminars, shows, etc., have contributed to the transfer of technology in Kenya. These are usually organized by Government ministries and departments depending mainly on the availability of funds. Agricultural shows are held once a year in each of the districts and/or provincial headquarters. In addition there is the Nairobi International Agricultural Show, also held once a year. The exhibits of the shows are

varied and wide including, agricultural products, industrial products, government services, research findings, etc. However, there is some bias to agriculture.

In 1989, the annual Jua kali exhibition was initiated to sensitise the Jua kali sector and the people in general on activities of the informal sector. The annual exhibitions are staged on a rotational basis in various provinces. Such exhibitions have always left enthusiasts amazed at what the Jua kali artisans can offer. The objective of the exhibitions is also to create markets for such products. The exhibitions are organized by the Ministry of Research, Technical Training and Technology. In the industrial sector, the Ministry foresees the Jua kali as forming the base-line for technological advancement. The small Jua kali are destined to grow into sizeable private enterprises. The Jua kali is already being sub-contracted in various services and goods delivery such as in building and other construction works.

7.1.14 Centre for Chemical Information and Informatics

The decision to form a centre for chemical information and informatics in the department of Chemistry, University of Nairobi, was taken as a positive step to reinforce research and teaching activities and to contribute, in particular, to the Chamomilla project. The main interest has been information processing, making use of computerized techniques. The project received an IBM PC/XT microcomputer from Unesco and the Mini-micro CDS/ISIS database management software (Rose and Schulz 1990).

However, there have been problems that have inhibited the performance of the system. The principal problems as per Rose and Schulz are:

- a) the lack of a clear institutional commitment to establishing such a system within the department, in conformity with the plans agreed upon within the Unesco-assisted project;
- b) inadequate staff for the development of the proposed system, in terms of both manpower and training in the information field;

- c) insufficient emphasis on the provision of information services, either within the department or industrial contacts; and
- d) inadequate or irregular links with international sources of expertise and information, including ICCS and Unesco, on the development of the project.

7.2 INTER-INSTITUTIONAL CO-OPERATION

There is no system in the world, however, well organised that can operate effectively in isolation (Imende 1988). This statement applies to the Kenyan industrial system which has been documented as not doing well as expected. The system's collaboration with other systems (mainly R&D systems) is weak. However, there exists some industry-university-research institute linkages in Kenya (Mwamadzingo 1991). There are, for example, interactions between universities and industry through individual staff members being involved in industry or through faculty- and department-based consultancies. For instance, at the faculty level there are some consultancy units which provide services to the industry. These include the Industrial Research and Consultancy Unit, the Housing and Building Research Institute, the Faculty Project Office at the University

of Nairobi and the Appropriate Technology Centre of the Kenyatta University. The University of Nairobi has other formal links with the industry, such as the Chemistry Industry link programme in the faculty of science, and the Engineering Education-Industry cooperation pilot project established in the faculty of engineering in 1985.

For the Chemistry Industry link programme, industrial liaison activities are mainly on an individual basis with as yet, little central co-ordination from the Chemical Industry Consultancy Unit (Rose and Schulz 1990). Academic staff have few opportunities to meet their industrial counterparts to explore areas of mutual interest, a situation which is exacerbated by the lack of accurate information on companies, chemicals and research interests in an easily accessible database. In 1986, the University of Nairobi set up the University-Industry Link Committee with membership drawn from the public and private sectors. Other universities in Kenya are represented at several national bodies (e.g. industries, research institutes, etc) and committees by academic staff members; while members of public and private institutions also sit in various university boards, and are members of the University councils.

The recognition of the importance of University-Industry interface in Kenya is by no means been limited to the academics (Mwamadzingo 1991). Similar opinions have been expressed by governmental policy makers as well as by the industrialists themselves. For instance, NCST is very keen in developing appropriate mechanisms which encourage and ensure a high level of interaction with the industry and in determining research priorities and application of research findings from the national universities and research institutions. NCST and KIRDI have looked into the mechanisms of cooperation of the private sector, public research institutes and universities in research, innovation and diffusion of technologies.

Despite these efforts in industry-university-research institute linkages there has been widespread concern that much of the research carried out in universities and public institutions (e.g. research institutes) does not reach and/or does not address the real needs of the productive sector, and the results therefore remain largely unapplied. This is discussed further in chapter eight, section 8.2.

The conflicting and diverse views on the effectiveness of the existing relationships implies that the subject is a complex one, which calls for a proper understanding of the factors that could lead to improved linkages, resulting in an enhancement of the country's industrialization process. This is another justification for the present study.

7.3 PUBLICATIONS

One of the most important channels of communication between institutions today is through publications (Liyai and Gathua 1985). Researchers often submit their findings to the sponsoring organizations, where at times, they are stored and remain unknown and unavailable to potential users. A list of some of the serial publications in the field of engineering, science and technology published in Kenya is given in Appendix 8. In addition to these, there are also annual reports of the institutions concerned with matters of science and technology. The reports, however, deal mainly with activities undertaken by the institutions during the period under review. As a strategy for disseminating information, the institutions must regularly document and publish lists of research proposals, project findings and their latest publications. This helps to avoid duplication of effort

among individuals and institutions. At the same time information on what has been done points to any gaps and shortcomings, thus widening the scope for future research as well as for collaborative work. It is through such regular publications that experts in given fields can easily be identified and their expertise utilized when required. However, such publications and documentation activities in Kenya are not well coordinated.

CHAPTER EIGHT

8.0 RESULTS AND DISCUSSION

Results of the study are discussed in this chapter. The methodology and procedures have been outlined in chapter two.

8.1 INFORMATION SYSTEMS AND SERVICES

The investigation revealed that most of the small scale industries do not have information systems and services that could assist in acquiring new technologies. It was noted, however, that the executives of some of the industries had small collections of publications on the manufacture and production of goods/commodities their respective enterprises were concerned with.

Universities, research institutes, government ministries and departments, parastatals, and other science and technology institutions, on the other hand have information systems and services. Every university department, research institute, and other science and technology institutions have a library or an information system and in some instances, databases. Notable information systems and services are discussed in the following sections.

8.1.1 Kenya Scientific, Documentation and Communication and Communication Centre (KENSIDOC)

The survey of information systems that facilitate the flow of information to industries, indicated that the Kenya Scientific Information, Documentation and Communication Centre (KENSIDOC) had a major role in coordinating other systems, so as to enhance the flow of information. All research results are deposited in KENSIDOC and it is expected to play a major role in the dissemination of research findings.

There was a national complaint that KENSIDOC was not performing its activities as expected, and thus the dissemination of research findings was inadequate. This necessitated me to undertake a systems analysis of KENSIDOC so as to identify the constraints which hamper the performance of its functions effectively. The results of the analysis is discussed in chapter nine.

8.1.2 KIRDI Library

The Kenya Industrial Research and Development Institute (KIRDI) library serves the KIRDI staff and industrialists who are members of the library. The current awareness services that used to be provided were

reported to have been discontinued since the Institute stopped subscribing to the journals in the field of industry due to financial reasons. Therefore, there was no systematic way of disseminating information to potential users, e.g. information on new technologies. The library has several technical reports, but no officers are assigned for the digestion of the reports. This was due to the fact that library personnel of the information section were not specialized to perform the tasks. The system displays some of the publications at the Nairobi International Agricultural Show, which is held once a year.

It was noted that KIRDI was planning to develop a computerized information system. There is a project to network KIRDI with the institutes concerned with industrial development in Morocco, Senegal, Tanzania, Nigeria and Cameroon. Already there were plans to purchase five more computers. The project is financed by IDRC. It is hoped that the project would succeed and assist in enhancing industrial information services in Kenya.

8.1.3 KIRDI Consultancy Services

KIRDI offers consultancy services to entrepreneurs. The consultancy work is done by a group of specialist staff. The consultants in the projects unit advise entrepreneurs and potential entrepreneurs in the following areas:

- a) marketing
- b) results of market research
- c) competition
- d) viability of project

A nominal fee is charged for these services. Reports of the studies and analysis are kept up-to-date by reviews of market changes, etc.

8.1.4 Ministry of Research, Technical Training and Technology Services

The Ministry has a technical training centre at Karen. The centre, in addition to training, undertakes demonstration and exhibition of indigenous technologies. The training is geared to small scale entrepreneurs and Jua kali artisans. The Ministry also assists the Jua kali artisans to form associations. The associations assist in the following ways:

- a) The members interact among themselves and exchange ideas.
- b) It would assist the Ministry to identify potential and new entrepreneurs, and therefore, would be in a position to render the required assistance.
- c) For record-keeping and planning purposes, since the Ministry has the necessary data (information).
- d) **A formal group(s) consisting of small scale entrepreneurs would legally exist in the form of association(s) and can therefore seek any legal protection (of trade and products), or whenever there is need.**

The Ministry also assists potential innovators (mainly Jua kali artisans) in the patenting of new technologies.

The Ministry has identified a site at Kariobangi South and has plans to build a workshop where the technologies from institutes of higher learning will be integrated with the Jua kali know-how with a view to upgrading and improving both the processes of Jua kali manufacturing (tools and materials) and the products they produce. The workshop will also be some kind of a

"research" institution, whereby experts from universities, research institutes and polytechnics will be working side by side with the Jua kali artisans (who in most cases would have come up with an innovation or invention).

8.1.5 Ministry of Commerce and Industry Services

The Ministry passes information to the industrialists through the District Industrial Development Officers (DIDOs), by means of extension services. The extension services include briefs on where to obtain raw materials and where to market the products. The current emphasis of the Ministry is for the industries to produce new products, hence new technologies are needed. The Ministry is also planning to develop an industrial information centre.

The Ministry publishes directories of industries, raw materials and products, and has plans to publish a newsletter. Several technical reports are also available for use by industrialists. However, the Ministry does not digest technical reports into languages, forms or formats that are understandable by the target users.

8.1.6 Centre for Chemical Information and Informatics

The Centre is networked with Datex of Germany through the Kenya Posts and Telecommunication (KPTC) data communication system. The network has been named Scientific and Technological Network (STN). The STN is also able to access information from the US information databases via Datex. This is an achievement in Kenya, and should be put to full use to achieve the purposes it is meant for.

8.1.7 Kenya Industrial Estates (KIE) Consultancy Services

KIE offers extensive consultancy work to entrepreneurs. Consultancy services are rendered only to clients, mainly small scale entrepreneurs. KIE has established industrial estates in nearly all the districts of the country, and KIE-sponsored projects are scattered all over the country. Consequently, KIE'S consultancy services reach most parts of the country.

The full range of services offered by KIE to both new and existing industries include planning, preparation, implementation and appraisal of small scale enterprises; provision of industrial premises at

relatively low rents; repair and tool manufacturing facilities at the organization's technical services centres and provision of extension services on management, technical problems, marketing and accounting. In addition to the industrial estates, KIE has also established Rural Industrial Development Centres (RIDCs) and Industrial Promotion Areas (IPAs).

The problem which KIE is experiencing is that there is a major shortage of entrepreneurial skills among indigenous Kenyans, resulting in serious underutilization of existing facilities; Except for the Nairobi industrial estates, where all the factory sheds are being used, a large proportion of the sheds built in industrial estates, and RIDCs all over the country are not occupied. Further studies to establish the real causes of such underutilization of facilities are necessary.

8.2 INTER-INSTITUTIONAL COOPERATION

The study revealed that linkages (cooperation) between the universities, research institutes, government ministries and departments, parastatals, and other science and technology institutions, and the industries were extremely weak. Researches undertaken by the universities and research institutes were mainly selected

by individuals or the institutions, i.e., the industries do not play a role in the choice of research. There appear to be no formal collaborative arrangements between the industries and the universities, research institutes and other institutions. The industries do not know what the universities and research institutes can offer. At the same time, the universities and the research institutes do not know what the industries problems are and what technologies they may benefit from.

Contract research could be a solution, but the industries are concerned about the credibility of the universities and the research institutes. The Government must formulate policies that promote the industrialization process. This is mainly the task of NCST which has the mandate to advise the government on all matters relating to science and technology. Unfortunately, NCST's secretariat was reported not to be adequately equipped with the right calibre of staff to handle the issue. The task of coordinating the industries, universities, research institutes and the other institutions is also a task of NCST.

Considering the fact that industries have money, while the universities and the research institutes have manpower and facilities, the government should come up

with policies that ensures collaboration between the industries (especially small scale and Jua kali industries) with the universities and research institutes, so as to ensure that industries can finance research projects of their own choice in the universities and research institutes. Exchange of staff is also possible when there is cooperation. Notwithstanding the above, there exists some cooperation between some industries and universities and research institutes, as discussed in the following sub-sections.

8.2.1 Universities-Industry Cooperation

Cooperation between the industry and the universities include the following:

- a) the Chemistry-Industry Cooperation in the Chemistry Department, University of Nairobi;
- b) the Engineering Education-Industry Cooperation of the Faculty of Engineering, University of Nairobi;
- c) the Appropriate Technology Centre of Kenyatta University;
- d) the Industry Research and Consultancy Unit, University of Nairobi;

- e) the Housing and Building Research Institutes, University of Nairobi; and
- f) the Faculty Project Office at the University of Nairobi.

In addition to the above, there are also departmental consultancies and individual consultancies with industry. However, discussions with the university staff revealed that not much has been achieved from the cooperation as in most cases they were informal arrangements with industries. For example, concerning the Chemistry-Industry Cooperation, cooperation is mainly on MSc student projects and the department does not undertake other industrial research projects (e.g. contract research), except in some instances on an individual basis which has nothing to do with the department. It was reported, however, that the department was in the process of initiating industrial courses whereby students in the BSc degree courses would be expected to choose from the ordinary chemistry courses or the industrial chemistry courses. The students who choose industrial courses would be attached to industries for a period of two years under the supervision of both the industry and the Department.

It was also noted that the Department does not collaborate with small scale industries and Jua kali artisans which the government has recognized as crucial in the promotion of the economy and reduction of unemployment. This is an area that the Department and other university-industry cooperation arrangements should address in future. The NCST is expected to be a kind of mediator between the industries and the universities.

Recently, the government announced that Universities' budgets would be reduced, and therefore, universities are expected to find ways of becoming self-reliant. One way is through collaboration with industries, which the universities cannot afford to neglect, as this would mean income to the universities. In order that universities in Kenya can take an effective part in the country's development through proper linkages with the industries, the universities, as a powerful source of science and technology know-how, should be very familiar with the problems faced by the industries.

The information on the problems (i.e. problem profiles) should be provided by government information systems such as KENSIDOC and/or the Ministry of Commerce and Industry information system. The information should

be passed on to the universities information systems, including the libraries and the Centre of Chemical Information and Informatics.

8.2.2 Industry-Research Institutes Cooperation

The linkage and communication between research institutes and the industry is not adequate. Kenyan indigenous enterprises rely largely on external technological links, since these appear easier to reach in practice due to their efficient dissemination activities. To this end, Kenyan enterprises and other production sectors have utilized national research facilities only to a very limited extent in resolving their technological problems. This in turn, has slowed the growth of these local research institutions as centres of research having direct application to the productive sector.

The commercialization of R&D findings has also met with only limited success, because of the weak industry-research institutes linkages, limited entrepreneurial ability, inadequate dissemination of technological information, etc. NCST, as mentioned earlier, has a responsibility in ensuring cooperation between R&D institutions and the productive sector.

8.2.3 Universities-Research Institutes Cooperation

There exists some collaboration between the universities and public research institutes including the Kenya Agricultural Research Institute (KARI), Kenya Medical Research Institute (KEMRI), Kenya Trypanosomiasis Research Institute (KETRI), Kenya Marine and Fisheries Research Institute (KEMFRI), Kenya Forestry Research Institute (KEFRI), etc. The collaborations are notable in the faculties of Science and Engineering. However, the collaboration is mainly in research relating to theses and dissertations at the universities. The students in this case who are mainly from the research institutes act as a link between the research institutes and the universities since they have to register in the universities for the award of Masters or PhD degrees. There appear to be no formal collaboration arrangements between the universities and the research institutes, and it could result in duplication of research. NCST, although having the mandate to coordinate all the research activities in the country, has not come up with modalities of ensuring that universities and research institutes collaborate in research programs and projects.

A database of all research projects in the country is recommended and this should be operated by NCST, who should have the mandate of approving new projects, so as to reduce duplication. This will also facilitate dissemination of research results.

8.2.4 Other Cooperation Arrangements

It was noted that there were no formal collaborative arrangements between the universities, research institutes, the government ministries and departments, parastatals, other science and technology institutions and the industry. The only government body that has been having some collaboration with the other institutions is the NCST. This led to the establishment in 1986 of a University-Industry Link Committee, of which NCST was a member. The records at NCST show that the Committee last met in 1987 and no reasons were given for the discontinuation of the Committee.

The author feels that the Committee should continue, but should be chaired by NCST. The Committee should be renamed technology transfer committee or inter-institutional cooperation committee, and membership should be drawn from, among others, industries, universities, research institutes, and other government institutions.

The Ministry of Commerce and Industry which has no formal collaborative arrangements with the universities, has an interest in the collaborations. The Ministry of Research Technical Training and Technology also does not have formal collaborations with the universities, but the Ministry is interested and willing to collaborate. The Ministry, however, has very close collaborations with the research institutes which fall under its jurisdiction.

The Ministry of Commerce and Industry was reported to be having collaboration with the Kenya Association of Manufacturers. It also has collaborations with institutions responsible for industrial development , internationally and regionally.

There is no clear collaborative arrangements between the universities, research institutions, other institutions, and the development finance institutions and/or other financial bodies. This was evident in the case of the Industrial and Commercial Development Corporation (ICDC) and the Faculty of Science of the University of Nairobi; both parties had arrangements to establish some industries for the development of indigenous products such as avocado oil, dyes, etc. The arrangements failed because there were no formal procedures to be followed.

In the case of the Kenya Industrial Estates (KIE), a client who is a potential investor in an industrial enterprise approaches the KIE for financial assistance. Usually, such clients, get the information about a new technology or innovation from a research institute or university, or other science and technology institutions. The KIE personnel conducts a feasibility study on behalf of the client. They then advise him/her on the best way to invest if the project is viable. This could be a duplication of effort as the feasibility studies could have been done by the generators of the technology. Collaboration with R&D institutions, would enable the flow of information, thus reducing unnecessary activities.

8.3 PUBLICATIONS

The study revealed that most of the universities' staff publish their research findings in local as well as foreign periodicals. However, the publications do not do much in the dissemination of technologies; the circulation of the periodicals to entrepreneurs is minimal and they are not digested into languages, forms or formats that are understandable by the target users.

It was also noted that though sometimes the Universities staff come up with good research results, they are at times reluctant to publish and widely distribute their results because they fear that their findings might be "hijacked" by other parties without any worthwhile course of redress, or gratuity. This is because they cannot have sole copyrights for the processes or models. The establishment of KIPO was a welcome achievement that was seen as a saviour to those who could have lost on their research findings. However, the patenting of technologies (processes) was extremely poor since KIPO has stipulated many procedural steps and requires payment of fees. The small scale entrepreneurs also reacted that the patenting procedures were tedious, with forms that require highly technical persons to fill. There is need, therefore, for KIPO to carefully consider these problems.

The Faculty of Science publishes two journals, the BioChemPhysics and the Science news journal. BioChemPhysics, first published in 1991, is available only to those who subscribe to it, the annual subscription fee being Ksh. 800. Articles for the journal are from local as well as foreign university staff and researchers.

Science news, a bimonthly journal is available free of charge. It is usually distributed to the departments of the universities and some government ministries and departments. Articles in both the journals are not digested and presented in forms or languages that are understandable by the small entrepreneurs, hence may not be effective in the dissemination of information to small industries.

KIRDI does not publish journals, but publishes annual reports and occasional brochures; and there are also several investigative reports. Other government institutions also publish annual reports and technical reports, but the information needs to be analyzed, consolidated and repackaged for the needs of entrepreneurs.

Information systems established to support industrialization have not provided appropriate services, e.g. information analysis, consolidation and repackaging, provision of digests of papers (foreign and local) and other technical reports into languages, forms or formats that are easily assimilable by the target users, selective dissemination of information services, reviews, trend reports, etc.

8.4.3 Manpower

Graduates from the faculties of engineering and science who are expected to form the kind of manpower needed for industrialization have no formal training in industrialization. On employment, therefore, the graduates take a long time to become familiar with the industrial activities and environment. This problem is being looked into and the faculties (engineering and science) of the University of Nairobi are planning to introduce industrial education in their curricula. This should also be undertaken by other universities and faculties.

8.4.4 Co-ordination

There is lack of co-ordination of institutions that are responsible for industrialization in Kenya, resulting in the slowing of the process of industrialization. This calls for co-ordination of the institutions which should include the following: National Council for Science and Technology (NCST) - as coordinator, Ministry of Commerce and Industry, Kenya Bureau of Standards (KBS), Kenya Industrial Property Office (KIPO), universities, research institutes, Investment Promotion Centre (IPC), development finance institutions, Chamber of Commerce and Industry, Central Bank of Kenya (CBK), Kenya Association of Manufacturers (KAM), Ministry of Research, Technical Training and Technology, Polytechnics, etc.

8.4.5 Finance

Inadequacy of financial resources was also identified as hindrance to industrialization. Potential investors do not always have the necessary capital for the projects and this necessitates them to seek loans from financial institutions (mainly development finance institutions). The loans are not always forthcoming. Part of the reason is that the entrepreneurs may not be able to furnish all the market, technological information and data needed to support their applications for funds.

8.4.6 Management Problems

Management of industrial enterprises (projects) have proved to be difficult for small entrepreneurs. The institutions responsible for training in industrial management, therefore, should endeavour to promote the managerial skills through appropriate courses, seminars, workshops, etc., with resource persons drawn from the universities, and other specialized centres.

8.4.7 Patents

Though an institution responsible for industrial property rights has been established in Kenya, the study revealed that the area of patents was still a problem in industrialization efforts. The problem arises from the fact that the institution is new, and hence not known nationwide, and also the bureaucratic procedures of patenting adds to the problem.

CHAPTER NINE

9.0 SYSTEMS ANALYSIS AND RECOMMENDATIONS

9.1 SYSTEMS ANALYSIS

The systems analysis of KENSIDOC was undertaken by interviewing the officers in charge of the centre and other senior staff of NCST. The analysis was enriched by perusing publications of NCST (mainly annual reports), and also by observation. The broad objective of the analysis was to identify impediments that were hindering KENSIDOC from discharging its functions efficiently. The specific objectives were to find out.

- a) how the legal matters affect the performance of KENSIDOC;
- b) how documents are acquired and how the research findings are disseminated;
- c) the sufficiency of manpower vis a vis the tasks at KENSIDOC; and
- d) the extent to which KENSIDOC was fulfilling its objectives.

on the basis of the findings, some possible solutions for improving the performance of KENSIDOC will be proposed.

9.1.1 Legal Matters

The legal matters concerning the establishment and activities of KENSIDOC dates back to 1977, when NCST was established under the Science and Technology Act and called upon, among other things, to consider and advise generally on all scientific activities including "scientific documentation and information, statistics, surveys and general information". NCST in its report number 4 of May, 1980 on Science and Technology for Development, recognised and stated that "planned utilization of scientific and technological information is one of the most important tools for development.

Based on the advice by NCST, the Government formulated broad policy guidelines on scientific and technological information. As stipulated in sessional paper number 5 of 1982 on the acceptance of NCST's report

on Science and Technology for Development, the Government's policy on scientific and technological information should:

- a) ensure optimum utilization of knowledge in science and technology in order to achieve the national goals for the betterment of society;
- b) ensure the availability of adequate information for decision making in management and policy formulation both in Government and in the private sector;
- c) provide documentation and information services relevant to present needs, together with a capability for developing services to meet the future needs of users of information;
- d) perform collection, organization, preservation, translation and dissemination of information generated in the country;
- e) provide scientists and other users in the country with a means of obtaining new scientific findings which originate in other countries; and,
- f) promote national and international cooperation on the exchange of information and expertise.

Based on the above, NCST established KENSIDOC in 1983. It should be noted here that there is no separate enactment establishing KENSIDOC, but it exists under the aegis of NCST. There is no document that elaborates the structure and expected activities of KENSIDOC.

NCST's report number 15 on Research clearance in Kenya: Procedures and Guidelines, concerns the submission of research reports. It states (only for foreign researchers) that, Final reports, must be submitted to the Government within a year after the date indicated on the research application form as the completion date of the research work. The report does not say anything concerning the submission of reports on research carried out by Kenyan researchers.

KENSIDOC has, therefore, been functioning without clear guidelines, and hence perhaps its poor performance.

9.1.2 Manpower

KENSIDOC is seriously deficient in manpower resources, an important reason for its poor performance. The total number of staff as specified by their designations and qualifications, is as follows:

- a) One Chief Science Secretary (Head of KENSIDOC) - BSc, MSc, Diploma in Communication Policy.
- b) Assistant Science Secretary - BSc, at the moment he is pursuing an MSc degree in Information Science at the School of Information Studies for Africa (SISA), in Addis Ababa University. His designation is expected to be changed to Information Scientist, on completion of the course.
- c) One Documentalist - B.A, no formal training in Documentation.
- d) One programmer - Diploma in Computer Studies
- e) One Library Assistant - Certificate in Librarianship; at the moment she is pursuing a diploma course in Librarianship at the Kenya Polytechnic.

KENSIDOC and NCST in general have failed to attract staff mainly because of the unattractive scheme of service of NCST. NCST has been losing staff who move out to other better paying jobs, especially when they have acquired the necessary skills. The other fact is that NCST does not employ its staff directly, since it is not autonomous. Thus recruitment of staff is through the Public Service Commission. KENSIDOC has also been without a scheme of service, but there is a new proposal which is subject to approval by government. It is hoped that the new scheme would help solve the manpower problem of KENSIDOC.

9.1.3 Facilities and Equipment

At present, KENSIDOC has 5 microcomputers, a microfiche reader/printer, book shelves, catalogue card cabinet and a display rack. The computers are, however, not being used for the purpose they were meant, for lack of staff trained in the design and development of databases. The computers have therefore been turned into word processors. It is hoped that the computers would be put to proper use when the author (after completion of

his studies in information science) reports back to duty. KENSIDOC has attempted to develop a research projects database since 1985, but progress has been unsatisfactory, again due to the lack of personnel with necessary competence.

The computer models at KENSIDOC are Wang-Pc with a 5.25 inch drives. The mass storage capacity of the computers is inadequate for comprehensive databases. NCST should acquire additional and more powerful computers with adequate storage capacity.

9.1.4 Services

While on the spot reading and reference services are offered to members of the public, borrowing of documents from KENSIDOC is restricted to NCST staff. Staff of NCST and some members of the public have complained about the poor services offered at KENSIDOC. This is mainly due to the fact that documents are at times mishelved and therefore their location becomes difficult. The number of personnel at KENSIDOC are not sufficient to handle all the tasks of the centre.

KENSIDOC through NCST also publishes the NCST Newsletter. The Newsletter, although intended to be a quarterly publication, has been irregular due to lack of articles. KENSIDOC should promote and encourage papers by NCST staff and other members of the public for publication in the Newsletter. It can also be used to disseminate technological information to enterprises.

Current Awareness Services (including Selective Dissemination of Information services, and Information Analysis and Consolidation services, are not being offered at KENSIDOC, though it has several publications that are relevant to industrialists.

9.1.5 Cataloguing

The cataloguing of documents in KENSIDOC was only undertaken by library consultants who were consulted during the establishment of the system. Regular cataloguing is not done for lack of manpower with skills and knowledge in cataloguing. The documents are, therefore, partially catalogued. In addition, there is a store of uncatalogued documents awaiting to be attended

to. The initial classification and cataloguing were based on the Universal Decimal Classification scheme and Anglo-American Cataloguing rules. The problem is expected to end in September, 1993, when two officers, now in training, report back to duty on completion of their studies.

9.1.6 Acquisition of Documents

KENSIDOC acquires documents through donations and exchange programmes. In addition, all research reports are supposed to be deposited in KENSIDOC. The submission of reports by foreign researchers has been fair. As for Kenyan researchers, the submission of reports has been poor except for projects sponsored by NCST. Though there is an assumption that all theses, dissertations and reports on other research projects are to be submitted to KENSIDOC through NCST, the modalities of submitting such reports are not clearly defined and communicated to the persons concerned. This matters requires immediate attention.

9.1.7 KENSIDOC Budget

Development budget for KENSIDOC was not printed in the government's approved estimates for the 1991/92 and 1992/93 financial years. Considering the financial constraints that the government had at that time, there could have been an assumption that KENSIDOC was in a position to run by itself, may be with the assistance of donors, until the financial status of the government improved. At present the budget is not a major problem since what is already in place has not been put to use. The author feels that even without the budget, KENSIDOC would be able to run some of its activities well, provided the modalities of submitting the research reports are clarified and adhered to. There would be need, however, for a budget for the purposes of acquiring other documents, for equipment, supplies, binding of documents, maintenance, etc.

9.2 SYSTEM RECOMMENDATIONS

Based on the results of the analysis, the investigator proposes several recommendations, the implementation of which could improve the performance of KENSIDOC. The recommendations are practicable enough to be implemented without spending a considerable amount of money, taking into account the financial constraints of NCST. The recommendations are discussed in the following sub-sections.

9.2.1 KENSIDOC Structure

For KENSIDOC to function smoothly, there is need to document its structure and its activities together with the number of personnel required. The system should have a structure of the form shown in figure 9.1

Key to the figure

1 - Document selection unit, 2 - Ordering unit, 3 - Accession unit, 4 - Reader service unit, 5 - Reserve unit, 6 - Reference unit, 7 - Audio visual unit, 8 -

Binding unit, 9 - Cataloguing unit, 10 - Classification unit, 11 - Network unit, 12 - Information retrieval unit, 13 - Data entry unit, 14 - Reprography unit, 15 - Newsletter/Annual report unit, 16 - Digest unit, 17 - Agricultural and allied sciences unit, 18 - Industrial sciences unit, 19 - Health sciences unit, 20 - Biosciences unit, 21 - Physical sciences unit, 22 - Social sciences unit, 23 - Information sciences unit.

9.2.1.1 Director's functions

The Director's duties include strategic decision making with the assistance of the NCST executive, and the Committee on Information and Documentation. The Director should be a person with a degree in information studies or a first degree in science/technology/engineering and formal training in information studies. He should be quite familiar with the activities of NCST and the support to be provided by the information system. The current Head of KENSIDOC has such qualifications. The Committee on Information and Documentation membership should be drawn from, among others, the universities, research institutes, parastatals, government ministries

knowledge in cataloguing. The person should have a degree in scientific or technological discipline and training in library/information science.

9.2.1.4 Circulation division

This division is concerned with the lending and shelving of documents and with interlibrary loans. The division has to ensure the maintenance of documents. The division should be manned by at least a semi-professional with library training.

9.2.1.5 Publication division

The publication division publishes NCST's documents which include annual reports, Newsletters, Digests and other analysis, consolidation products, etc. NCST's publication needs are considerable, and, therefore require to have a publishing unit so as to reduce publications cost. It is, therefore, recommended that NCST establishes a desktop publishing system. Such a system is easy to implement and the cost involved is not high. The system requires an IBM compatible Microcomputer

with at least a 20 MB hard disk, a detachable keyboard, a mouse, a printer, a laser printer, a scanner and a publishing software (e.g. Xerox Ventura). In addition to the publishing software, word processing software should also be available. Manning of the publication division requires personnel skilled in the publishing techniques including the following: authorship, editorship, book design, typography, art work, and printing. Some of the NCST secretaries could also be trained on the publishing techniques, so as to assist in publication work.

9.2.1.6 Database division

The activities of the division include database design and development, data entry, query-response services, selective dissemination of information, current awareness services, etc. Already NCST has some computers and therefore the activities of this division are easy to implement with additional microcomputers. The Database division should be manned by personnel with a minimum of a degree in information science, or a first degree in a scientific or technological discipline and training in information handling.

9.2.1.7 Analysis and consolidation division

The analysis and consolidation division is relevant to NCST in relation to the functions and activities of NCST as elaborated in chapter four. Since all research reports are submitted to KENSIDOC, the reports should be analyzed, consolidated and repackaged in forms or formats useful to the target users. This division therefore will ensure the dissemination of research findings. The activities of this division can be implemented, by utilizing the NCST secretariat staff who are specialists in various disciplines. There is need for training them in information analysis and consolidation and for one person designated to coordinate the activities of the division.

9.2.2 Manpower

The new scheme of service of KENSIDOC should be implemented as soon as possible. The personnel should have regular meetings to appraise their activities or services.

coordination, research submission, etc, which are not being performed fully at the moment. Also retaining of manpower would be achieved by developing a favourable scheme of service. KENSIDOC would, thus, be in a position to perform its activities satisfactorily. In view of the above, the government is also called upon to re-examine the activities and/or functions of NCST vis a vis the legal matters governing it.

9.2.5 Environment

Any given system has an "environment". The environment consists of a set of elements not deemed to be the system's components; but, any change in their attributes affects the attributes of the system. The components belonging to one sub-system may be considered as parts of the environment of another sub-system. As for Information Storage, Dissemination and Retrieval (ISDR) systems, the parent organization usually furnishes the environment. Usually, the system derive their input from the organization and provide output for it. Also, information generators, users, vendors, etc, are part of the environment of the ISDR systems. KENSIDOC should,

therefore, keep abreast of changes taking place in the environment.

Good relationship between the information system personnel and that of other systems and/or departments should be maintained. Seminars on the services provided by the system should be encouraged, the attendance of the seminars should include users of the system.

9.2.6 Services

In addition to the normal library and referral services, KENSIDOC should provide additional services such as those briefly discussed in chapter ten

9.2.7 Networking

It is recommended that KENSIDOC be networked to other information systems, nationally, regionally and internationally. This will enable KENSIDOC access to information that may not be available in their own databases.

Table 10.1 - Information services

INFORMATION SERVICES TYPE	Dominant User Groups			
	TM	R&D	MM	TECH
1. Reference service				
* Reference service	X	X	X	X
* Retrospective search	X	X	X	X
* Technical enquiry service	X	X	X	X
* Clearing house service	X	X	X	X
2. Current Awareness Services				
* Current papers notification	X	X	X	X
* Research in progress notification		X	X	
* Selective Dissemination (SDI)	X	X	X	X
* Current events notification	X	X	X	X
* Newsbrief and bulletins	X		X	X
* Patents notification	X	X	X	X
* Standards notification		X	X	X
3. Information Analysis and Consolidation				
* Research abstracts		X	X	
* Digest for managers	X		X	
* Technical digest	X	X	X	
* Digest for technicians				X
* Numerical data service		X	X	
* Statistical digest	X		X	
* Executive information service	X		X	
* Products/Process/Innovation information		X	X	X

continued in the next page

4. Specialized Services			
* Market research/intelligence	X		X
* Forecast/Trend reports	X	X	X
* Company profiles	X		X
* Contracts & tender notices	X		X
* Environmental scanning	X	X	X
* Technology transfer information	X	X	X
* Decision support system	X	X	X
* Expert systems	X	X	X
5. Common Services			
* Library service			
* Document delivery			
* Document reproduction			
* Translation			
* Editorial/Technical writing			
* Publication Services			
* Organization of seminars/exhibits			

Source: Neelameghan, 1992

(Note: TM = Top Managers; R&D = Research and Development Group
MM = Middle Managers; TECH = Technicians/Operators)

Other services that are important, especially to the industrial sector include preparation or commissioning of:

- * surveys: market, industry, technology, economic, etc.;
- * feasibility studies;
- * "small industry profiles" by commodity;

- * forecasts and trend reports;
- * statistical reports;
- * composite documents containing different types of data and information;
- * information analysis, consolidation, and repackaging;
- * information bulletins: new products, processes, etc.;
- * referral service;
- * technical inquiry service and related products;
- * company profiles; institutional profiles;
- * patents information services;
- * environmental scanning;
- * notification of contracts and tenders;
- * charts and maps of resources location;
- * numerical data sources and databases.

Supporting the above types of services by preparing directories and inventories, and database of profiles of institutions, agencies, information sources, etc., such as, the following:

- * centres of excellence
- * technology centres;
- * industrial development banks and financing organizations;
- * technology information centres;
- * technology data and information bases and sources;
- * small enterprises (sector-wise);
- * chambers of commerce;
- * industry associations;
- * management and labour associations;
- * small industries advisory and assistance agencies;
- * documentation and information systems and services;
- * training centres and training programmes in fields of interest to small enterprises;
- * government agencies/departments of development planning, R&D support, industry, trade and commerce, industrial licensing, regulatory measures, quality control, standardization, environment, etc.;

- * regional trade, economic, and other groupings;
- * international assistance agencies and programmes;
- * technology transfer, collaboration, and other cooperation agreements and arrangements;
- * skill and expertise.

Some of the services could also be provided by other information systems, such as the Investment Promotion Centre (IPC) information centre, the Ministry of Commerce and Industry information system, KIRDI information system, etc.

10.1.1 Services Recommended for Immediate Provision

The services recommended for immediate provision are discussed below.

10.1.1.1 Current Awareness Services

Current awareness services are designed to keep users abreast of the developments in their respective areas of interest. For this purpose, they issue products at periodic intervals - every week, every two weeks, every month or, in some cases, more infrequently. Forms of dissemination in this category are: lists of acquisitions, bulletins of tables of contents, bibliographic bulletins and indexes. Another current awareness service is the Selective Dissemination of Information.

10.1.1.2 Selective Dissemination of Information (SDI)

Selective Dissemination of Information (SDI) is a procedure for supplying each user or group of users with the references to documents relating to their specific areas of interest selected from among the descriptions of all the documents received during a period (e.g. week, fortnight, month, etc). The rapid expansion of such service is due mainly to the spread of machine-readable databases.

10.1.1.3 Information Analysis and Consolidation (IAC)

Information Analysis and Consolidation (IAC) consists of the selection, analysis, evaluation and compression of information and data obtained from one or more sources and presenting the result in a language, style and format appropriate to the specific target users. IAC products are of different types; state-of-the-art review, critical review, trend report/analysis, feasibility/status/forecast report, handbook, manual, do-it-yourself booklet, guidebook, country profile, company profile, product profile, industry profile, monograph, digest, newsbrief, etc.

10.1.1.4 Query-response services

The query-response services involves the retrieval of information from the databases based on users queries. This activity may result in bibliographies with or without abstracts, preparation of information analysis and consolidation products, etc.

10.1.1.5 Translation services

It is also necessary to translate some documents from English to Swahili (a Kenya national language), thus facilitating access to information by those who may not be conversant with English, e.g. the small entrepreneurs, Jua kali artisans, the general public, etc. The tasks of translations may be performed by a panel of translators, with a secretary (coordinator) to coordinate the activities. Editorial assistance will also be necessary.

10.1.2 Benefits of the Services

The services, if provided regularly and the quality is high, will be beneficial to the users and to the country at large. They will, for example, assist in technology assessment, evaluation and selection; and other requirements as detailed in chapter six (section 6.1.2.1).

10.2 APPLICATION OF INFORMATION TECHNOLOGY

The development and provision of information services discussed in the preceding sections of the chapter require the building up of appropriate information sources, the analysis and extraction of data and information from them relevant to the different user groups of KENSIDOC (ranging from researchers, through technologists, government executives, entrepreneurs, liaison workers, to the general public) and creating databases to enable quick retrieval of information and data for providing the different services.

The developments in the 1980s in microelectronics, telematics and electro-optic technologies not only facilitate the design, development and use of various types of databases and information retrieval but also have brought down the cost of information technology application within the reach of even small institutions in developing countries.

Micro computers with high data storage capacity and powerful information handling capabilities and off-the-shelf powerful Database Management System (DBMS) software are now available at reasonable cost. Examples of DBMS are Micro CDS/ISIS, dbase, Rbase, ORACLE, etc. Micro CDS/ISIS, recommended for use in KENSIDOC, is a menu-driven generalized information storage and retrieval system software designed specifically for the computerized management of structured textual databases. One of the major advantages offered by the generalized design of the system is that CDS/ISIS is able to manipulate an unlimited number of databases each of which may consist of completely different data elements. It has powerful index generating and retrieval features, and databases in ISO 2709 format can be exchanged. The capabilities of the software can be further enhanced with programmes written in CDS/ISIS Pascal. The minimum hardware requirements for running CDS/ISIS are: IBM-PC/XT/AT or compatible equipment, 640 RAM memory, 1 floppy disk unit, 1 hard disk, 1 display screen and a printer. The current version 3.0 has multiuser facility in a network environment using Novel Network, Banyan Vines, etc.

10.3 PROTOTYPE DATABASES

In order to provide some of the services discussed in the preceding sections, there is need for development of databases. Prototype databases for some of the databases have been developed using Micro CDS/ISIS version 3.0. The databases developed can be adapted and expanded by KENSIDOC and other information systems that support industrialization in Kenya. The individual databases in the prototype are as follows:

10.3.1 ABNCD+ Database

This database consists of profiles of experts, institutions, information systems, research projects, and bibliographic database. A sample output of the records of the database is shown in appendix 9. The database was prepared using the already defined ABNCD+ field definition table shown in appendix 10. ABNCD+ is an acronym derived from the names of those who are closely associated with the ABNCD+ prototype development database project (Abebe Rorissa et al 1992).

10.3.3 Other Databases

The other databases that are relevant for industrialization include the following:

- a) Equipment database
- b) Raw materials database
- c) Products database
- d) Energy database
- e) Technologies database, etc

10.4 USERS DATABASE SEARCH-REQUEST FORM

For all search queries to be uniform in structure and to facilitate preparation of appropriate search expressions, a users database search-request form has been devised. The structure of the form is as shown in figure 11.2. The form may be revised as need arises.

Figure 11.2 - Users databases search-request form

<p>1. Name of user _____</p> <p>2. Institution of user _____ _____</p> <p>3. Address of institution _____ _____</p> <p>4. Date _____</p> <p>5. Subject area of query _____ _____</p> <p>6. Please give a short description of the problems to be searched _____ _____ _____ _____ _____</p>
<p>Official use only</p> <p>a) Initials of searcher _____ Signature _____</p> <p>b) Databases with possible solutions _____ _____</p> <p>c) Search results description _____ _____ _____</p> <p>d) Query versus search results comment _____ _____ _____</p>

CHAPTER ELEVEN

CONCLUSION AND RECOMMENDATIONS

11.0 FINDINGS OF THE STUDY

In the context of a developing country a good information system for the industry should ensure that information is appropriate to the needs of the industry, e.g. in terms of making decisions, application of new technologies and production processes, etc. The information system should, therefore, provide reliable, relevant and timely information in forms that are easily understandable by the users. Kenya as a developing country needs such a system.

Information of potential usefulness to Kenyan industries are being generated in Kenya and all over the world. The extent of usefulness of such information depends on its timeliness, reliability and relevance to user's needs, the Kenyan entrepreneurs and all those concerned in one way or other with the promotion and development of industries in Kenya. This can be achieved by:

- a) developing easily accessible and conveniently usable information resource bases; and
- b) implementing effective and efficient information systems and services.

In Kenya, some facilities already exist, but these need to be strengthened and new facilities should be set up, to ensure a more effective dissemination and flow of information to points where the information is needed. In some countries, governments and non-governmental agencies have identified the needs of industries and are successfully operating special departments and facilities to satisfy the identified needs.

Libraries, documentation systems and information systems are major nodes in information flow. There are information systems and libraries in the universities, research institutes, government ministries and departments, parastatals, and other science and technology institutions. Some of these have specialized information and data sources, documentary sources, expertise, etc. Such resources should be made available and accessible to industries through networking and proper coordination of the systems.

Information dissemination can take several forms: through publications, audio-visual media, on-line services, lectures, workshops, exhibitions, conferences, etc. Information centres should adopt quick and efficient means of communication with other information sources both within and outside the country to be able to access and obtain the required information and information sources, to meet the needs of users wherever they may be located in the country. The application of modern information technology can facilitate information access, flow and dissemination.

11.1 RECOMMENDATIONS

The following recommendations have been made in line with the findings of the study.

- a) A special industrial periodical (quarterly) should be published in Swahili in order to supply rural industrialists as well as urban entrepreneurs with information regarding prices of machinery, market trends, sub-contacting possibilities, financial matters, etc. The

periodical could also serve as a forum for exchange of ideas among small industrialists. This task can be handled by the Kenya Association of Manufacturers or the Ministry of Commerce and Industry. Some special research reports and articles could also be translated into swahili.

- b) **Information systems that support industrialization** should be improved so as to provide the kinds of services needed. The key services include, current awareness services, selective dissemination of information, information analysis and consolidation, database services, translation, etc. It should be noted that some of the services provided by information systems may not be known widely even in Kenya. Information about such systems and their services should be disseminated through the mass media (print, radio or television), through industry/information workshops, training courses, exhibits etc.
- c) **The government should initiate action to formulate and implement a national policy on information systems and services in collaboration**

of other appropriate agencies. Such a policy would promote cooperation, coordination and networking among information systems, enhance their use, and help create necessary infrastructures.

- d) **Industrial policies and strategies should be structured in a way that the provision of information to industries and development of appropriate information support systems are declared prerequisites and integral part of industrial development.**
- e) Information systems should be networked, so as to facilitate access to national, regional and international database services and the provision of information necessary for industrialization.
- f) The institutes of higher learning (universities, polytechnics, etc) should include industrial education in their curricula. Such curricula should include use of data and information, information systems, etc. This will enable the trainees to be prepared for industrial careers, thus closing the gaps that exist at present.

h) It is recommended that technology transfer centres be established so as to promote stronger links between the R&D institutes and the productive sectors. The centres should be coordinated by the National Council for Science and Technology.

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APPENDIX 1

GROSS DOMESTIC PRODUCT(1980 PRICES)							
SUB-REGION/COUNTRY	GDP(US \$ BILLION) AT 1980 CONSTANT PRICES				GROWTH RATE (PERCENTAGE)		
	1980	1984	1989	1990	1980-90	1984-90	1990
NORTH AFRICA	133.5	145.5	162.2	167.2	2.3	2.3	3.2
ALGERIA	42.3	50.1	53.1	54.4	2.5	1.4	2.5
EGYPT	21.0	29.9	35.7	36.6	5.7	3.4	2.7
LIBYAN ARAB JAMAHIRIYA	35.7	27.5	28.4	30.3	-1.6	1.6	6.9
MOROCCO	17.8	19.2	23.9	24.7	3.3	4.3	3.4
SUDAN	7.9	8.6	9.5	9.0	1.3	0.8	-5.3
TUNISIA	8.7	10.2	11.6	12.2	3.5	3.0	5.2
WEST AFRICA	124.2	109.8	132.4	136.0	0.9	3.6	2.9
BENIN	1.4	1.6	1.6	1.6	1.7	0.0	0.0
BURKINA FASO	1.4	1.6	2.0	2.0	3.6	3.8	-0.4
CAPE VERDE	0.1	0.1	0.1	0.1	3.2	0.0	-5.8
COTE D'IVOIRE	10.2	9.9	10.3	9.8	-0.4	-0.2	-4.5
GAMBIA	0.2	0.2	0.3	0.3	2.3	7.0	6.9
GHANA	4.2	3.9	5.2	5.4	2.5	5.6	4.8
GUINEA	1.7	1.9	2.2	2.3	3.2	3.2	4.8
GUINEA BISSAU	0.2	0.2	0.2	0.2	2.6	0.0	-2.0
LIBERIA	1.1	1.1	1.0	0.7	-4.5	-7.3	-30.8
MALI	1.7	1.8	2.4	2.4	3.3	4.9	-0.1
MAURITANIA	0.7	0.7	0.8	0.8	1.2	2.3	2.8
NIGER	2.5	2.1	2.5	2.5	-0.2	2.9	3.1
NIGERIA	93.6	79.3	97.7	101.7	0.8	4.2	4.1
SENEGAL	3.0	3.3	3.8	3.9	2.8	2.8	3.5
SIERRA LEONE	1.1	1.1	1.1	1.1	-0.0	0.0	2.3
TOGO	1.1	1.0	1.2	1.2	0.6	3.1	2.5
CENTRAL AFRICA	26.8	32.0	33.8	34.4	2.5	1.2	2.1
BURUNDI	1.0	1.1	1.4	1.4	3.8	4.1	-0.5
CAMEROON	6.7	9.6	9.4	9.5	3.6	-0.2	1.0
CENTRAL AFRICAN REPUBLIC	0.9	1.0	1.1	1.1	2.1	1.6	0.3
CHAD	0.7	0.8	1.1	1.1	4.3	5.5	2.4
CONGO	1.7	2.9	2.8	2.9	5.4	0.0	5.3
EQUATORIAL GUINEA	0.1	0.1	0.1	0.1	6.6	0.0	-0.2
GABON	4.3	4.3	4.3	4.8	1.2	1.9	11.5
RWANDA	1.2	1.3	1.4	1.3	0.7	0.0	-4.4
SAO TOME & PRINCIPE	0.0	0.0	0.0	0.0	0.4	5.9	12.7
ZAIRE	10.3	10.9	12.2	12.2	1.7	1.9	0.1
EAST & SOUTHERN AFRICA	49.2	51.7	62.2	62.8	2.5	3.4	0.9
ANGOLA	6.1	6.1	7.9	7.7	2.4	4.0	-3.5
BOTSWANA	0.9	1.4	2.3	2.3	9.7	8.6	1.5
COMOROS	0.1	0.1	0.1	0.1	-1.8	0.0	0.9
DJIBOUTI	0.3	0.3	0.3	0.3	-1.2	0.0	0.7
ETHIOPIA	4.1	4.4	5.0	4.9	1.8	1.8	-2.1
KENYA	7.1	7.9	10.1	10.3	3.8	4.5	2.5
LESOTHO	0.4	0.4	0.5	0.5	2.7	3.8	14.4
MADAGASCAR	3.2	3.0	3.4	3.5	0.8	2.6	3.0
MALAWI	1.2	1.4	1.7	1.7	3.2	3.3	3.3
MAURITIUS	1.1	1.3	1.9	2.1	6.4	8.3	6.5
MOZAMBIQUE	2.4	2.1	2.2	2.2	-0.9	0.8	3.1
NAMIBIA	2.0	1.9	2.0	2.2	0.9	2.5	6.0
SEYCHELLES	0.1	0.1	0.2	0.2	3.3	12.2	5.8
SOMALIA	2.4	2.5	2.9	2.9	1.9	2.5	0.1
SWAZILAND	0.5	0.6	0.7	0.8	4.0	4.9	4.6
TANZANIA	5.1	5.1	6.1	6.3	2.1	3.6	3.4
UGANDA	2.8	3.0	3.7	3.5	2.3	2.6	-4.9
ZAMBIA	3.9	4.0	4.1	4.0	0.3	0.0	-2.9
ZIMBABWE	5.3	5.9	7.1	7.3	3.3	3.6	3.1
TOTAL AFRICA	333.7	339.0	390.6	400.4	1.8	2.8	2.6

N.B. ALL FIGURES ARE IN BILLION 1980 US \$ AND ARE ROUNDED OFF TO ONE DECIMAL PLACE

APPENDIX 2

Interlinks of the Ministry of Commerce and Industry

Linkage with	Reasons for linkage
1. NCST	Industrial policies, research findings and other advices
2. KIPO	Industrial property rights
3. IPC	Investment priority areas, regions, etc.
4. KETA	External markets advices
5. KBS	Products standards, environmental matters, etc
6. KAM	Industrial problems
7. DFIs	Refers loan applications to the directorate of industries for technical and economic feasibility verification.
8. Other banks	as in 7

continued in the next page

APPENDIX 4

SOURCES OF INFORMATION

Information on	Source of information/contact point
1. Technical assistance & industrial information in general	Business information Bureau. Trade associations. Specialized library/information service to industry. Government agencies for promoting small enterprises International agencies such as UNIDO. Bilateral and regional development aid agencies
2. Overall feasibility	A variety of techno-economy & feasibility reports are prepared by such agencies as the following: a) State and central governments; UNIDO, UNDP, ILO and other international and regional bodies; b) Theses and dissertations; c) Large industrial undertakings; d) Management and industrial consultants; e) Research papers in journals, conference proceedings, technical reports, etc.
3. Sources of finance	Stock exchanges, banks and financing organizations (industrial financing corporation; refinancing corporation; national industrial corporation); company share holders; investment directories; information centres
4. Consumer demands and preferences	Sales and distribution agencies. Chambers of commerce. Market research bodies. Overseas trade commissions and agents. Trading corporations and subcontracting agencies
5. Human resources: Recruitment, training, welfare	Employment exchanges. Universities and technical training institutes. Facilities for in-plant training, apprenticeship. Trade unions; joint consultations. Periodical interviews. Work councils. Government regulations.

continued in the next page

APPENDIX 5

IDEA-TO-ADOPTION CONTINUUM

	Objective	Criteria	Leads to
1. Research	To advance Knowledge; New ideas	Validity: 1.Hypothesis tested 2.Generalizability	Basis for invention
2. Development			
21 Invention	To innovate: Provide new solution to an operating problem	1.Appropriateness 2.Estimated viability 3.Relative contribution	Invention
22 Design	To engineer: Systematise/arrange the components of the solution To prepare a design package for institutional use	1.Institutional feasibility 2.Generalizability 3.Performance	Design package or innovation package
3. Diffusion			
31 Dissemination	To inform: Create widespread awareness of invention among practitioners/potential users	1.Intelligibility 2.Fidelity 3.Pervasiveness 4.Impact	Awareness about the invention
32 Demonstration	To build conviction: Provide opportunity to examine and assess the qualities of the invention	1.Credibility 2.Convenience 3.Evidential assessment (alternative professional consideration)	Building conviction about invention

continued in the next page

APPENDIX 6

TECHNOLOGY ACQUISITION, INFORMATION NEEDS & INFORMATION SOURCES

Tasks and sub-tasks	Information required and sources (illustrative)
<p>1. IDENTIFICATION OF TECHNOLOGY NEEDS</p> <p>11 Inventory of technologies in use - traditional, locally generated, imported or acquired</p> <p>12 Assessment of technologies in use in relation to their relevancy to development objectives and priorities</p> <p>13 Identification of irrelevant and superfluous technologies in use in relation to development objectives and priorities</p> <p>14 Identification of technology gaps in relation to the country's/industry's programmes and needs</p> <p>15 Preparation of inventory of technology needs in relation to development objectives, priorities and plans</p>	<p>Information on:</p> <ul style="list-style-type: none"> - Existing survey and reports of R&D work, technologies in use in the process of development - Details of national and sub-national development plans, programmes and forecasts <p>Sources of Information and data:</p> <ul style="list-style-type: none"> - Institutional reports and national updated register of on-going research and technology generated - Patents taken and applied for - Profiles of innovations licensed for commercialization - Registry and profiles of industries in different sectors - Registry of foreign collaborations, import/export of technologies, goods, services, etc. - Queries received by technology centres, industrial development banks, technology information centres, small enterprises assistance and advisory bureaux, documentation and information services, technology transfer centres, institutions of higher learning, R&D establishments, etc.

continued in the next page

<p>new or imported technology in the local environment; to identify new facilities and resources needed for applying the technology</p> <p>34 Adaptation of technology to fit local conditions and requirements as necessary; developing and mobilizing additional or new facilities and resources as may be necessary</p> <p>35 Incorporation of the adapted technology into the regular production stream or use</p> <p>36 Promotion and support of indigenous R&D and technology capabilities for the productive use and improvement of the new/imported technology</p>	<p>- Technology transfer mechanisms including movement of people between scientific, technological and industrial centres/enterprises; spin-off from new missions and projects; scientific and technical publications (books, serials, reports, directories, patents, standards and specifications, engineering drawings, trade literature, etc.); mass media, exhibitions, fairs, demonstrations, get-together; interaction of suppliers and consumers; sales and marketing; consultancy services; science and technology meetings, training courses, on-the-job training, workshops, extension services; technology banks, technology development centres; centres of excellence; proving plants, etc.</p>
<p>4. TECHNOLOGY MANAGEMENT EVALUATION</p> <p>41 Establishing criteria and periodicity for evaluation with special reference to goals and targets</p> <p>42 Organization for and implementation of evaluation programme</p> <p>43 Feedback and adjustments in technology management activities</p>	<p>Information required</p> <p>- Data and information on operational experiences with various technologies in the country and on other countries in similar environments. Factual and reliable information on the context and conditions of applications of the technologies, the inputs, experiences, problems and solutions developed. The results: goods, services, know-how, social costs and benefits identified.</p> <p>- Information methods of technology management evaluation.</p>

Source: Neelameghan, 1992.

15	Tembo Times	Kenya Breweries Ltd	4
16	Ujenzi	Kenya Cement Industry	4
17	Build Kenya	Peter Moll Africa Ltd	12
18	Building news	Cassman Brown & Company Ltd	12
19	Motor Mart & Exchange Ltd	Motor Mart & Exchange Ltd	1
20	On the move	Leyland Kenya Ltd	12
21	Roller News	Stirring Astalsi (Africa) Ltd	3
22	The UniAfric News	Gailey & Roberts	4
23	Auto News	Peter Moll Africa Ltd	12
24	Automobile Association of Kenya	Media Services	-
25	The Cooper Motor Corporation Ltd	CMC Ltd	1

APPENDIX 9

SAMPLE RECORDS FROM ABNCD DATABASE

*** Research projects ***

PROJ. TITLE IMPROVING THE ROLE OF AGRO-BASED WOMEN GROUPS IN
RURAL DEVELOPMENT
INSTITUTION University of Nairobi, Department of Urban and
Regional Planning, Kenya
PROJ. NO. NCST/5/002/1133
START DT 1991-09-20
DURATION 8 Months
HEAD Akoth, J. N.
GEOG. COVERAGE South Nyanza (Kamagambo location)
INST. TYPE Academic
DESCRIPTORS Agriculture, women, rural development
SUBJECT HEAD. Social Science
FINANCE Government of Kenya, 9,000

*** Research projects ***

PROJ. TITLE FACTORS AFFECTING OR CONTRIBUTING TO CHANGE OF
SECONDARY HOME ECONOMICS CURRICULUM IN KENYA,
1963-1985
INSTITUTION University of British Columbia, Nancouver,
Canada
PROJ. NO. NCST/5/002/1130
START DT 1991-10-08
DURATION 4 Months
HEAD Kagima, L. K.
GEOG. COVERAGE All Kenya Provinces
INST. TYPE Academic
DESCRIPTORS Home economics, Curriculum
SUBJECT HEAD. Home economics
FINANCE CIDA

*** Research projects ***

PROJ. TITLE WATER SUPPLY AND DEMAND IN ELDORET
INSTITUTION Moi University, Department of School of
Environmental Studies
PROJ. NO. NCST/5/002/E/1129
START DT 1991-10-24
DURATION 1 Year
HEAD Nyaoro, W.
GEOG. COVERAGE Uasin Gishu District
INST. TYPE Academic
DESCRIPTORS Water supply, Eldoret
SUBJECT HEAD. Environmental Studies
FINANCE NORAD, Ksh. 50,000

	International Trade and Econometrics. M.A. University of Manitoba, Canada. 1976.
	Monetary Economics. PhD. University of Geneva, Switzerland. 1982.
SPECIALIZATION	Economics.
WORK. LANG.	EN. FR.
LANG. COMPETENCE	Speak, Read, Write.

Employment Record

CURR. EMPLOY.	Economist, African Centre for Monetary Studies (ACMS), Senegal, 1982 to present.
LAST EMPLOY.	Economic Affairs Officer, International, United Nations Conference on Trade and Development (UNCTAD), Switzhzerland, 1980-1982, Research.

***** PROFILE OF EXPERT *****

NAME	MAKANDA, D. W.
BIRTH	1957
NATIONALITY	KE
QUALIFIC.	Economics, Mathematics and Sociology. B.A. University of Nairobi, Kenya. 1981. Economics. M.A. University of Nairobi, Kenya. 1984.
SPECIALIZATION	Social Science.
WORK. LANG.	EN.
LANG. COMPETENCE	Speak, Read, Write.

Employment Record

CURR. EMPLOY.	Junior Research Fellow, University of Nairobi, 1985 to present.
LAST EMPLOY.	Planning Officer, Government, Ministry of Agriculture. 984-1985, Formulation of policy papers and analysis of agricultural policy issues within the Ministry.
ASSIGNMENTS	Kenya, 1986-1987, Member of a jointly Government and Austrailian mission group to assess the performance of Magarine Settlement Scheme in Kenya.

000004

Source: Laws of Kenya
Date: 1981
Title: The telecommunication tax Act, chapter 473, revised edition
Subject: An Act of parliament to impose a tax on the provision of telecommunications apparatus and services, and for matters incidental thereto
Contents: 1) telecommunication apparatus 2) telecommunication services 3) telecommunication tax

000005

Source: Laws of Kenya
Date: 1986
Title: The state corporations Act, number 11 of 1986
Subject: An Act of parliament to make provision for the establishment of state corporations, for control and regulation of state corporations, and for connected purposes
Contents: 1) establishment and powers of state corporations 2) boards and management of state corporations 3) control of finances, etc. of state corporations 4) the state corporations advisory committee 5) miscellaneous provisions

000006

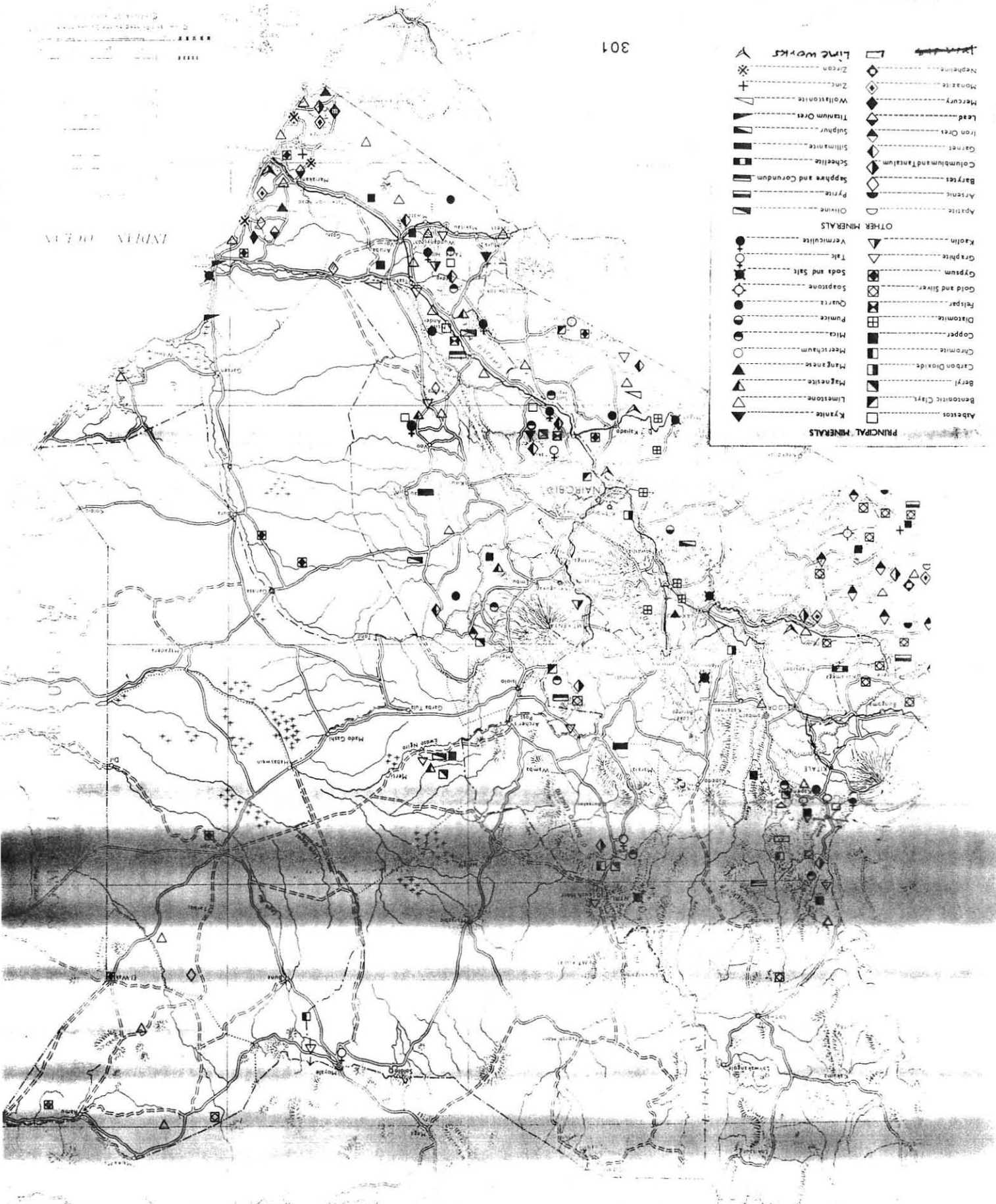
Source: Laws of Kenya
Date: 1989
Title: The Industrial property Act, number 19 of 1989
Subject: An Act of parliament to provide for the promotion of inventive and innovative activity and to facilitate the acquisition of technology through the grant and regulation of patents, utility models, rationalization models and industrial designs for connected purposes
Contents: 1) establishment of the Kenya Industrial Property Office 2) patentability 3) rights to inventions and naming of inventor 4) application, grant and refusal of grant of patent 5) international applications 6) rights and obligations of the applicant or owner of the invention 7) change in the ownership and joint ownership of applications and rights 9) utility models 10) industrial designs 11) rationalization models or technovations 12) contractual licences 13) exploitation of protected invention by government or by third persons authorized by the government 14) surrender, invalidation and revocation 15) infringement 16) industrial property tribunal 17) miscellaneous provisions

000007

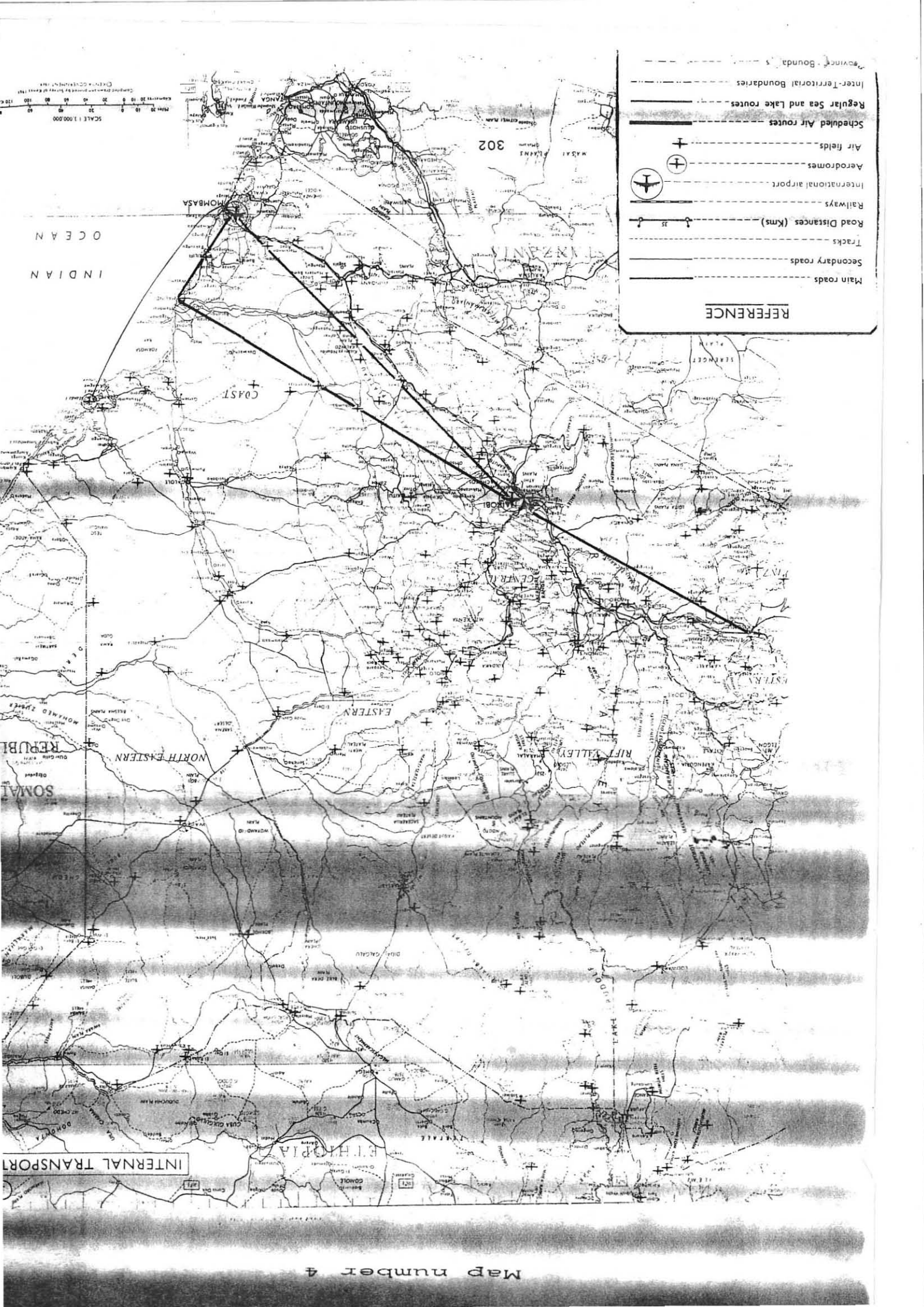
Source: Laws of Kenya
Date: 1989
Title: The capital markets authority Act, number 17 of 1989
Subject: **An Act of parliament to establish a Capital Markets Authority for the purpose of promoting and facilitating the development of an orderly, fair and efficient capital market in Kenya and for connected purposes**
Contents: 1) establishment of the Capital Markets Authority 2) objectives of the Authority 3) functions of the Authority 4) provisions relating to securities exchange 5) securities including licenses 6) securities transactions and registers 7) miscellaneous provisions

INDEX OF PLACES

- PRINCIPAL MINERALS**
- Abestos
 - Bauxite Clay
 - Beryl
 - Carbon Dioxide
 - Chromite
 - Copper
 - Diamond
 - Fluorite
 - Gold and Silver
 - Gypsum
 - Iron Ore
 - Lead
 - Mercury
 - Molybdenum
 - Nepheline
 - Other Minerals
 - Pyrite
 - Saprophytic and Corundum
 - Scheelite
 - Silimanite
 - Sulphur
 - Titanium Ores
 - Wollastonite
 - Zinc
 - Zircon
- LIME WORKS**
- Other Minerals
 - Vermiculite
 - Kaolin
 - Talc
 - Soda and Salt
 - Soapstone
 - Quartz
 - Pumice
 - Mica
 - Mercurium
 - Manganese
 - Magnetite
 - Limestone
 - Kyanite



MINERAL DEPOSITS



REFERENCE

- Main roads
- Secondary roads
- Tracks
- Road Distances (Kms)
- Railways
- International airport
- Aerodromes
- Air fields
- Scheduled Air routes
- Regular Sea and Lake routes
- Inter-Territorial Boundaries
- Province Boundaries

SCALE 1:1,000,000
 Kilometers 0 20 40 60 80 100 120 140 160 180
 Miles 0 20 40 60 80 100 120 140 160 180
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INTERNAL TRANSPORT

Map number 4