The Impact of Information Technology on the Nigerian Economy: A Study of Manufacturing and Services Sectors in the South Western and South Eastern Zones of Nigeria

David Ola Kajogbola

ATPS Working Paper Series No. 39

Published by the African Technology Policy Studies Network, P.O. Box 10081, 00100 General Post Office, Nairobi, Kenya.

PUBLISHED BY ATPS COMMUNICATIONS DEPARTMENT

Printed by Newtec Concepts
P.O. Box 00800, Westlands
14180 Nairobi, Kenya
Tel: 4449849, Fax: 4450399
newtec@bidii.com

ISBN 9966-916-80-6

Table of Contents

ABOUT THE AFRICAN TECHNOLOGY POLICY STUDIES NETWORK

The African Technology Policy Studies Network (ATPS) is a multi-disciplinary network of researchers, policymakers, actors in the private sector and other end users interested in generating, promoting and strengthening innovative science and technology policies in Africa. With a regional secretariate in Nairobi, the network operates through national chapters in 17 countries, with an expansion plan to cover the entire sub-Saharan Africa.

One of the objectives of the network is to disseminate research results to policy makers, legislators, the organized private sector, civil society, mass media and farmers' groups through publications, dialogue and advocacy. Among its range of publications are the Working Paper Series (WPS), Research Paper Series (RPS), Special Paper Series (SPS) and the Technopolicy Briefs.

Papers published under the Working Paper Series (WPS) are those produced from the ATPS small grants process or from regional projects. The WPS are not subjected to the strict requirements of the RPS but this does not suggest that they do not have significant policy or methodological contribution to make to the work of ATPS. The Board supports all efforts aimed at improving the WPS, such as building skills that will make most of the ATPS research outputs to be published under the RPS. Researchers are encouraged to produce their final drafts in a publishable manuscript form that is shorter and easier to read.

ATPS is supported by a growing number of donors including the International Development Research Centre (IDRC), the Carnegie Corporation of New York, the Rockefeller Foundation, the World Bank, the OPEC Fund, Ford Foundation, Coca-Cola Eastern Africa, the African Development Bank, and the Royal Dutch Government.

List of Abbreviations

AC	A Current
ATPS	African Technology Policy Studies
CAD	Computer Aided Design
CAGR	Compound Annual Growth Rate
CAT	Centre for Adaptation of Technology
CAN	Computer Association of Nigeria
CPU	Central Processing Unit
CRS	Computerized Reservation System
DCs	Developed Countries
FTP	File Transfer Protocol
GSM	Global Service Mobile Communication
ICT	Information and Communication Technology
INEXSK	Infrastructure, Experience, Skills, Knowledge
ISPs	Internet Service Providers
IT	Information Technology
LAN	Local Area Network
LDCs	Less Developed Countries
NASENI	National Agency for Science and Engineering Infrastructure
NICs	Newly Industrializing Countries
NITEL	Nigeria Telecommunications Limited
OECD	Organization for Economic Cooperation and Development
PCB	Printed Circuit Board
R&D	Research and Development
UK	United Kingdom
USA	United States of America
WAN	Wide Area Network

List of Tables

List of Figures

Abstract

Information and communication technologies (ICT) refer to several forms of information exchange between two or more computers through any of the several methods of interconnection. These technologies provide speedy, inexpensive and convenient means of communication. The adoption of these technologies in many countries by different sectors of the economy have been found to have direct positive impact on the organizations's efficiency and have led to more rapid acceleration of development in these countries.

In Nigeria, however, preliminary investigations show that only a few organizations in the economy have adopted the ICTs, but there has not been formal study to determine the level of adoption and impact on the efficiency of the organizations and the consequent effect on the nation's economy. This study, is therefore, designed to determine the level of adoption in the Nigerian organizations, and the impact on the operations of these organizations as well as investigating the factors responsible for the present level of adoption of these technologies in the organizations.

Chapter One

Introduction and general issues

1.1 Introduction

The scope of the study was scaled down from the original proposal and limited to the South Western and South Eastern zones of Nigeria due to budgetary constraints on the part of the African Technology Policy Studies (ATPS). Thus, the survey covered extensively the manufacturing and service sectors in major industrial centres in the two zones.

1.2 Research problem

Nigeria is faced with enormous problems of information access. These problems, especially that of low level telephone penetration and uneven access, appear to be insurmountable. The penetration rate in Nigeria in the Twentieth Century was less than one line per 1000 population. Inspite of efforts made by successive governments in Nigeria to improve on the penetration rate, the country had continued to nose dive as a result of fresh challenges in terms of building information and communication technology (ICT) related management and communication infrastructure. This has resulted in almost negative benefit, both to the economy and the society as a whole.

It is quite evident that Nigeria at present lacks innovation, capacities and capabilities in information technology (IT) management and hardware maintenance. This notwithstanding, the country has been and will continue to import and use a wide range of durable consumer electronics, computers and telecommunication equipments. It must therefore begin to accumulate the capabilities to repair and maintain these vintages. Indeed, if Africa is not to be left behind in global trade and development, it must be able to master certain basic capabilities in ICT. In addition, the rate of technical obsolescence is likely to be much faster with ICT, compared with the natural technologies (such as steel, textiles and petrochemicals). The technological followers in Africa may therefore face the difficulty of sourcing for parts, components and peripherals, unless they begin to accumulate the capacity for component manufacture.

Available technology is largely obsolete — electro-mechanical switching system. Presently, some countries are engaged in massive modernization efforts; Nigeria for instance, has at present, about 500,000 lines with about 160,000 lines just added through the on-going digitalization programme. Technology absorption and mastery takes more than importation of technology; learning which demands explicit investment is a prerequisite for building the technical and managerial capabilities.

Given the foregoing, the diffusion of ICT will have widespread, albeit differentiated impact on all countries, industries and sectors. Policy must therefore begin to look at variables such as:

- change in the structure of industry and services;
- employment structure, training and manpower;
- industrial organization and management;
- production processes and products;
- telecommunication infrastructure and revolution of service delivery of existing infrastructure, especially power systems;
- information technology supply and
- how the accelerating growth impacts on trade and long-term competitiveness and maturation of African industry.

These are some of the key issues, which form the focus of this study. This study also examines the impact of ICT in the light of these variables, starting with the services and the manufacturing sectors. While the importance of manufacturing is generally accepted, the services sector has not always received as much attention. There are several reasons why a systematic study of ICT impact on the sector is important. First, the services are easily and more readily targeted for reforms (telecommunications and financial services are ready examples). Secondly, because of the routinized character of producer services such as accounting, banking and finance, they are also readily "programmed" and therefore impacted by ICT (especially computerization). Third, services have undergone tremendous technological transformation in the use of management-based and information intensive technologies. In the aviation industry, computerized reservation system (CRS) has led to the handling of higher volumes of cargo, greater complexity, large volumes of traffic and subsequent higher productivity. Computerized signaling system in rail transport has increased safety and raised traffic volume.

There is very little in terms of a systematic study on the impact of ICT adoption on these sectors in Nigeria. Hence, the decision to examine how ICT has been adopted and diffused in the two sectors. In manufacturing, the emphasis is on the petroleum, pharmaceuticals, textiles, foods and beverages, and metal working sectors, since these contribute significantly to value added. The services chosen are hotel and tourism, broadcasting, aviation, transport (railways), insurance and the capital market, as significant contributors to the quality of life of the people.

Issues of significant importance in ICT, especially in the area of computerization, include:

- How ICT has changed the composition and structure of knowledge and employment;
- How industrial and services organizations and management have been altered by emergence of ICT;
- How much of ICT is being employed in production and manufacturing services outputs, to make significant impact;
- The strategies adopted by different firms in services and manufacturing sectors to acquire ICT-based technologies;
- The role and attitude of the Nigerian State (using the proxy of state policies) in encouraging easy acquisition of ICT technologies by operating firms in the economy.

1.3 Study objectives

The general objective of the study is to examine the effect and impact of the new ICTs on the operations of selected manufacturing and services organizations in Nigeria. The study emphasis will be on computers, other information and communication technologies and selected peripherals.

The specific objectives not necessarily in order of priority are:

- to review the literature on the emerging ICT at the global and regional levels and to highlight their implications for Africa in general and especially, Nigeria.
- to assess the nature of technologies driving ICT, required technological capabilities and capabilities available to operate, maintain and adapt systems.
- to assess the status of ICT and the necessary technological infrastructure in Nigeria.
- to generate systematic data on the effect and impact of ICT on manufacturing and services sectors.

1.4 Expected result

- The study is expected to provide a basis for comprehensive information on the process of acquisition, availability and use of ICT gadgets in Nigeria.
- The study will attempt to document the available skills and capabilities to ensure sustainable diffusion of ICT in the Nigerian economy.
- The study will establish the advantages or otherwise of the adoption of ICT in the operations of the organizations in the industrial and services sectors in Nigeria.

The output of the research will serve as a blue print for policy makers and stake holders to chart the right course of action for the development of ICT facilities and infrastructure in Nigeria.

Chapter Two

Methodology and conceptual framework

2.1 Methodology

2.2.1 Information sources

Data used in this report was collected through primary and secondary sources. Secondary data sources include extensive desk research through library and different published and unpublished materials. Issues considered during this phase of the study included:

- a review of the development in information and communication technologies in Nigeria;
- trade and importation statistics on ICT component in Nigeria;
- profile of computer science, electronics or electrical engineering graduate manpower in universities and polytechnics in Nigeria; and
- a review of the position of Nigeria and Africa within the global context of ICT.

Primary data was collected through structured questionnaire and interviews with the users of ICT components in industries and the services sectors. Companies covered within the services sector included hotels, insurance, capital market, broadcasting and selected development and commercial banks. Banks were not covered extensively in this study to avoid duplication, since this sector was the focus of an earlier ATPS funded study (Odebiyi, T. 1998). Organizations sampled within the industrial sector included those in the chemicals, consumer and capital goods, pharmaceuticals, textile, electronic assemble, paints and automobile accessories.

The specific organizations for interview were selected at random using criteria such as ownership structure, experience in business, turnover, employment and relevance to ICT adoption. In the services sector, only hotels of five star standard were selected: insurance companies were selected on the basis of turnover and the volume of business, and broadcasting houses were selected on the basis of coverage. In the industrial sector, companies were randomly chosen using the Nigerian Manufacturer's Association's directory to ensure geographical spread within the South Western and South Eastern industrial areas of Nigeria. The companies were selected for interviews with a view to achieve maximum representation within the sector and the specific objectives stated earlier. To achieve this, data will be generated to show the trend in the utilization, acquisition and capacity building efforts on sectoral basis, over the years. Data will also be generated in the areas of capacity utilization in the firms in each sector, changes in operation efficiency and the contribution or otherwise of ICT adoption and diffusion on the fortunes of the firms.

2.1.2 Study coverage

The scope of the study, which was originally planned to cover all the industrial and service sectors in the country had to be scaled down due to financial constraints by the funding agency, the ATPS. The researchers, therefore, sought and obtained the approval of the funding agency, to reduce the scope of

the study, even when the concern of doing so may create a gap was expressed. Nevertheless, it was approved that the scope of the study be limited to the South Western and South Eastern parts of the country. The South Western part of the country (comprising Lagos, Ogun, Oyo and Osun states) was chosen, because of its high concentration of well established and successful industrial as well as services establishments. The South Eastern part of the country (comprising Enugu, Anambra and Abia states) was chosen to represent the crop of emerging new generation industrial establishments in Nigeria to achieve a balanced analysis.

The questionnaire administration was planned in two phases. The first phase concentrated on the service sector and the second on the industrial sector. During the first phase, questionnaires were administered on 40 establishments in the service sector to cover about 5 sub-sectors. As at the time of preparing this progress report, responses had been received only from about 25 establishments (about 62% response rate) covered during the first phase of the questionnaire administration. The analysis presented in this report is therefore partial, because it reflects the operations in the services sector.

2.2 Structure of the report

The report is in five chapters. Chapter one deals with introduction and general issues on the background of the study and chapter two defines the conceptual framework of the study. In chapter three, a review of the development of ICT in Nigeria in the area of trade and commerce and in the area of capacity building and the technology capabilities available, was undertaken. The same chapter looks at the development of ICT in Nigeria in a global context. The analyses of the research findings are presented in details in chapter four, while chapter five concludes with interim policy implications and policy issues.

2.3 Concept and definitions

In the emerging electronics complex, ICTs form part of a constellation of industries, which consist of various sub-groups such as semi-conductors, computers, components, telecommunications consumer electronics and office devices. Between 1980 and 1985, the world electronics market grew from US$200 to 400 billion, making it the second fastest growing sector after motor vehicles. The information technology and related sub-groups are expected to take first place in the 1990s with projected annual sales in excess of US$800 billion.

Expectedly, the developments in the electronics complex have had pervasive impact on the rate and direction of technological change, not only in that sector, but across virtually all sectors. In the process, it has brought about pervasive techno-economic and social changes. The growing applications of robotics, media electronics, optical fibres and digital networks, are generic radical technological innovations.

The nature of response and the challenges of these technologies are equally fundamental, because generic technical innovations alter the fundamental nature of products and processes. An important feature of these technologies is that they are largely science-push innovations. Not surprisingly therefore, the major developments have come from the developed countries (DCs). However, the impacts of the developments in this sector have with different intensities been felt in all economies. The response to and the absorption of elements of the technologies, have also been necessarily different. Indeed, in trying to assess the impact of the ICT on developing countries, a clear distinction is necessary between the block of countries broadly classified as newly industrializing countries (NICs) and the less developed

countries (LDCs). The former comprises most economies of South East Asia (S. Korea, Hong Kong, Singapore, Taiwan and Malaysia); and countries such as Brazil, China, India, Indonesia and Mexico. The countries in the first group do not only have substantial inflow of direct foreign investment (DFI) in offshore electronics assembly, but they have also adjusted well to the new technological developments in micro-electronics and telematics. The second bloc, LDCs, with which this proposal is concerned, have more or less been on-lookers in the unfolding technological progress. Our focus, however, is specifically on the African countries, with specific reference to Nigeria.

2.4 Framework

The revolution in IT in recent years, aptly captured by the establishment and access to a global networking of information systems, has positively influenced time and space in the sending and retrieving of information, both within and across diverse organizations and also among diverse countries and regions. This development has brought about drastic changes in the way in which decisions are reached and policies implemented in those organizations. Countries that have electronic communication networks, arising from innovations in information technology, have made practicable on-line access to a variety of technical and non-technical information, and have turned the world into a virtual workplace. In facilitating the move towards a more open and inclusive global system, the global diffusion and utilization of innovations in IT, have no doubt made contributions to the global search for efficient and effective solutions to pressing and often complex, local, regional and global problems. This is a key element in the global quest for sustainable national and regional development in developing countries.

The diffusion of IT innovations, embodied in a vastly improved computing and telecommunications capacity, has generally been weak in Africa, especially in the sub-Saharan African countries. However, a strong interest in its adoption to provide information services, has emerged in recent years in the continent for two main reasons. First, the revolution in IT has resulted in computer hardware becoming cheaper and more widely available. Secondly, the substantial utility (value added) of IT in the provision of, and access to information services for improved planning and management, has become more widely recognized.

Technology diffusion in the recipient country is a multi-stage process which commences with acquisition of the technology and finally, the installation, utilization and assimilation of the technology. The assimilation process is the most crucial, because it involves adaptation to the local environment. In the past several decades, the failure experienced by many developing countries, including Nigeria, which have imported foreign technology worth billions of dollars, has been traceable to failure in the assimilation process. Hence, our framework is premised on the prevailing environment in Nigerian organizations and how the technology of electronic networking can be successfully adapted for the effective and efficient management of these organizations.

There are four broad classes of new emerging technologies that are exerting deep-ongoing impact on industry, services and society at large. These are: IT, biotechnology, and new materials and renewable energy technologies. Out of the four, only one has experienced the most rapid development and taken the field of micro-electronics, informatics, data processing and communications, into areas of life which only a few years ago were an exclusive preserve of space and advanced manufacturing systems. All of these emerging technologies share certain generic characteristics, one of which is their knowledge - intensiveness and research and development (R&D) intensiveness. In order therefore to provide a

framework for proper assessment, strategic planning and long term investment in R&D and production, a proper taxonomy is desirable and Dosi et al. (1988) provides such taxonomy of technical innovations, which are:

(1) *Incremental innovations:* These occur continuously in the industry over a long time and at different rates across innovations, but they are often associated with plant scale-up, product and process adjustments. Quite often, incremental innovation remain largely unnoticed, but their combined effects have dramatic effects on productivity growth.

(2) *Radical innovations:* They are discontinuous events and often as a result of deliberate R&D activities within firms and enterprises. When radical innovations occur, they provide the impulse for new markets. An example is the oxygen steel-making, with which the Japanese gained a decisive competitive market advantage over Europe and the USA after world war II.

(3) *Change of technology system:* The ready examples are the clusters of petro-chemicals and synthetic materials innovations — electrically driven household consumer durable electronics that were introduced in the 1930s to 1950s. Evidently, this category of innovation affects "far reaching changes in technology affecting several branches of the economy, and giving rise to entirely new sectors".

(4) *Change in "techno-economic paradigm" (technology revolutions):* This lies at the heart of Schumpeter's theory of long waves. Technological revolutions embody many clusters of radical and incremental innovations and in time, may create several technology systems. This exerts pervasive effect on the economy as a whole and brings about new technical and organizational modes. The introduction of the steam engine, electrical power and the electronic computer are typical examples considered together. IT can be described as a new techno-economic paradigm.

Much effort had been devoted to analyzing the potential employment displacement effect of new technologies, a valid concern, even now. We take a different view: just as electric power and steam engines revolutionized society several decades back, advanced and backward alike — so will IT — to the extent that it has assumed the character of a techno-economic paradigm. Taking the same view as Freeman (1989), we also regard IT: as both a range of products and services, and as a technology, which is capable of revolutionizing the process of production and delivery of all industries and services.

Viewed in this manner, we have a framework which does not consider just the employment impact, but captures the essential economic and social elements and consequences of IT. Evidently, the impact of IT will necessarily be differentiated, depending on a whole range of macroeconomic factors such as the overall macroeconomic and technological capacity of a nation, the available skills and technological capabilities of the workforce, general literacy levels, and the interventionist capacity of the state to move decisively and effectively in determining the rate and direction of technical progress.

We recognize three distinct, albeit broad typologies of countries within the developing bloc.

(1) NICs; South Korea, Singapore, Hong-Kong, Taiwan, Thailand and Philippines (the last two are the weakest ones).

(2) NICs (2), the larger developing countries comprising Brazil, India, Mexico, China and less so Pakistan.

(3) Middle-size and including oil-rich developing countries in Latin America, Asia, and North Africa, and a handful in sub-Saharan Africa.

The first two groups have considerable foreign and indigenous investments in production facilities for consumer electronics, computers and peripherals. To a large extent, they also possess capabilities in R&D in microelectronics and semiconductor technology. In Brazil, the advances in telecommunications infrastructure have been considerable. In the third group of the countries, there has been relatively very little in terms of innovation and production capabilities, but a significant generation by, and adoption of a wide range of telematics (computers and telecommunication clusters) in manufacturing and services such as banking, insurance and aviation. These typological characteristics suggest that the impact will be differential and as such, research must take this into account.

Following from this, we identify three kinds of technological capabilities and capacities, pertinent to the block of developing countries. These are innovation, production (manufacturing) capabilities and network/service capabilities. Innovation capabilities concern basic, applied research and development (R&D) prototype design, and manufacturing capabilities relate to design hardware and software, equipment manufacture and testing. Network/service capabilities and capacities can be resolved into network/service specifications and purchase, installation, adaptation, maintenance and operation. IT requires at a certain level, a range of knowledge — intensive skills; for instance digital systems and semiconductors. Modular software requires specialized electronic design engineers for the design of integrated grants, systems architecture and application software.

In effect, one must make a distinction between technological capabilities and production capacities. The latter refers to the resources, mostly equipment and machinery, required to "produce industrial goods at given levels of efficiency and input combinations". Technological capabilities on the other hand are the skills to initiate, manage and generate technical change, including human resources, and knowledge, experience and institutions. It subsumes production capabilities (Mythelka et al., 1994).

The distinction is important when considered in relation to given typology and the position of Africa in this scheme. It is quite evident that Africa at present lacks innovation and design capabilities. This notwithstanding, the continent has been and will continue to import and use a wide range of durable consumer electronics, computers and telecommunication equipments. It must therefore begin to accumulate the capabilities to repair and maintain these vintages. Indeed if Africa is not to be left behind in the global trade and development, it must be able to master certain basic capabilities in IT. In addition, the rate of technical obsolescence is likely to be much faster with IT, compared with the natural technologies (such as steel, textiles and petrochemicals). The technological followers in Africa may therefore face difficulty in sourcing for parts, components and peripherals, unless it begins to accumulate the capacity for component manufacture.

An important and fundamental technical requirement for an efficient network/ services growth, is telecommunication infrastructure. With digital technology, public networks link computer, telegraph and facsimile users, but dedicated lines are not yet a common feature of the sector in Africa. Many countries are beginning to adopt satellite communication, while radio links (over short distances) are already widespread. Basic telecommunication facilities like the telephone remain a luxury for homes and businesses in Africa. At present, there are seven lines per 1,000 population, while that of the USA is 700 lines per 1,000 population. Even at this low capital availability in Africa, utilization is no more than 50% in most areas. This is due as much to an acute shortage of technical skills as well as to weak telecommunication infrastructures.

Chapter Three

Literature review — review of developments in ICT trade and services in Nigeria

3.1 Introduction

In some parts of the world today, ICTs are major contributors to revolutionary changes in business, commerce and daily living. Ironically, there are yet other parts of the world, especially those lacking the capability to design, produce, use and maintain ICT components, that such impacts have been very minimal and in some cases non existent. Nigeria, unfortunately falls into the latter category. It is unfortunate in the sense that the enormous social and economic potentials of Nigeria, unlike other African countries, put her at an advantageous position among the countries in the former category, if she had utilized the enormous natural resources for meaningful development. The country's inability to do this had contributed immensely to her passive participation in the global information society. Nigeria today is a heavy consumer of ICT components without the capability to produce any.

3.2 Importation of ICT components in Nigeria

In 1997, Nigeria had between 500,000 and 650,000 computer systems, all of them imported — according to sources close to the Computer Association of Nigeria (CON).

A wide range of computers, communication equipment and other ICT peripherals are imported into Nigeria, both in whole units and in pieces. The most notable of imports made in whole units are radio receivers (motor vehicle radio and potable radio), radiotelephonic receivers and radio broadcast receivers. These items constitute 35.7, 15.3 and 14.0% of total imports in the last ten years.

Table 3.1 shows the imports between 1988 and 1995 of computers, communication equipment and other ICT peripherals in whole units. The highest imports, which constitute about 72% of total importation during this period, were made in 1990 (21.2%), 1992 (15.9%) and 1993 (34.3%).

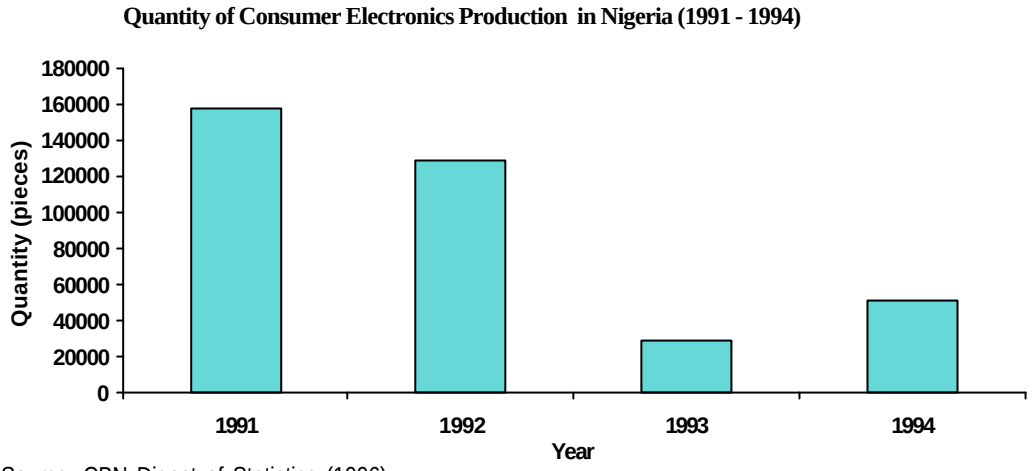
3.3 Electronics production efforts in Nigeria

Production efforts in ICT peripherals in Nigeria has been limited to assembly of consumer electronics household items such as television, radio, fridges and fans. In 1991, about 160,000 units of these household items were assembled in the country. This quantity dropped to about 130,000 units in 1992 and further to a record low of about 30,000 units in 1993. The quantity went up to about 50,000 units in 1994. The decreasing trend, according to Adeyinka (1996) could be attributed to the "Tokunbo syndrome", which allowed the importation of second hand electronic consumer items at relatively cheaper prices. The production trend is shown in Figure 3.1.

Table 3.1: Imports (Computers, Communication Equipment and Other ICT Peripherals), 1988 – 1995

Imports	1988	1989	1990	1991	1992	1993	1995
Analog Hybrid Computers	104,099	116,550	90,101	60,518	217,743	71,378	63,924
Digital Computers	1,048,886	530,878	888,411	1,271,611	1,363,794	874,414	1,421,443
Digital Central Processors	29,071	180,300	329,263	323,039	54,104	129,901	25,825
Digital Central Storage Units	26,294	42,445	107,055	121,348	61,281	114,690	63,273
ADP Peripherals Units	35,336	27,368	50,266	119,840	46,945	188,338	11,666
Off-line data processing equipment	173,344	200,725	405,354	138,251	41,958	41,070	162,385
Auto data processing equipment	-	-	1,870,450	-	1,785,825	1,439,791	1,748,516
Motor Vehicles Radio Receivers	8,082	24,141	28,290	74,484	3,458	3,412	34,571
Potable Radio Receivers	1,044,155	187,311	630,730	949,578	2,099,259	549,575	506,976
Other Radio Receivers	5,141,715	8,220,850	23,487,507	27,229,634	25,423,314	13,254,023	7,487,137
Radio Broadcast Receivers	-	-	24,146,527	-	-	13,807,010	8,028,684
Line Telephone equipment	650,186	1,368,863	5,156,939	2,640,145	6,551,305	10,194,919	2,605,624
Microphone, Loudspeaker, Amplifiers	314,363	320,045	278,523	528,209	295,049	577,523	172,429
T.V, Radio Transmitters	506,856	617,385	1,087,992	1,961,101	1,592,600	1,156,149	485,583
Radiotelephonic receivers	336,097	227,976	187,708	1,176,416	304,520	16,243,223	20,267
Telecommunication Equipment	-	-	9,226,375	-	6,948,004	29,452,817	3,963,311

Source: Nigerian Trade Summary (1988-1995), FOS.
Note: Data for 1994 is not available. All figures in whole units.



Source: CBN Digest of Statistics (1996)

Figure 3.1: Quantity of consumer electronics production TV, radio, fridges, fans, e.t.c.) in Nigeria (1991 - 1994).

This phenomenon is not limited to Nigeria as many African countries are also lagging behind in the domestic production of electronic items as shown in Table 3.2.

Table 3.2: Africa's Electronics Industry Production, Consumption and Trade, 1996 (US$ Million)

Region	Domestic consumption (demand)		Local production		Imputed (imports) or exports
		%		%	
Africa Developed	4,447	86.8	1,571	87.6	(2,876)
Sub-Saharan Africa	-	-	-	-	-
Mahgreb	-	-	-	-	-
Other North Africa	675	13.2	222	12.4	(453)
Total	5,122	100	1,793	100	(3,329)

Source: Adapted form Mansell et al. (1998), using Elsevier (1996).

Note: Africa Developed: South Africa, Jamahiriya and Sudan.
Mahgreb: Algeria, Morocco and Tunisia.
Other North Africa: Egypt, Libya and Arab.

It is apparent from Tables 3.1 and 3.2 that electronics production continues to be dominated by the industrialized countries. According to Elsevier (1996), estimates of consumption and the market for all types of electronics is widespread. The market is, however, smaller for less wealthy countries. Some developing countries are making efforts towards improving their electronics production capability. In Nigeria, a technical agency (Centre for adaptation of technology, located in Akwa) was created for electronics development in Nigeria. This was to develop the industrial base for the country and also make the nation less dependent on finished consumer electronic items. Some of the assignments undertaken by this centre in 1998 include the following:

(1) February 1998: launching of CAT-EC manufactured with 20% local content.
(2) March 1998: increasing the 20% local content of CAT-EC to 35% local content through the manufacture of :
    - power supply units,
    - casing,
    - introduction of CAT insignia into the operating system, and
    - printed circuit board (PCB) for realization of electronic circuits.
(3) By December 1998:
    - development of educational application software,
    - interface card between the keyboard and CPU, and
    - organizing computer appreciation literacy programme for National Agency for Science & Engineering Infrastructure (NASENI) staff.
(4) Other priority projects are:
    - production and marketing of film reversing machine — 30 January 1998,
    - production and marketing of Neva-Nepa lamp — 30 January 1998,
    - complete production model of power (AC) stabilizer for satellite industry — June 1998,
    - complete production model of television antennae and boaster — June 1998, and
    - complete production model of electronics toll-gate monitor — June 1998.

3.4 The Nigerian telecommunication industry

Nigeria does not have full Internet connectivity. At the time, only three categories of internet service providers (ISPs) exist namely: Domain Name Administrator; Database Internet Provider and General Service Providers. Six (6) operators have signed interconnectivity agreement with Nigeria Telecommunications Limited (NITEL) while there were nine ISPs in March 1997. NITEL's 64 kilobyte per second lease rate is the most expensive in the world at US$126, 000 per annum (ADCG, 1995). While the developed world has super highways, Africa is still struggling with links of 64 kilobyte (Massingue, 1998).

Table 3.3: Total Connected Lines in Nigeria

Year	Connected lines
1992	320,934
1993	363,285
1994	368,066
1995	405,073
1996	405,100

Source: CBN (1995). Annual Report and Statement of Accounts;
MOC Digest of Statistics, various issues, 1995; and ITU (1998).

In 1996, installed lines were 597,000, and 405,000 lines were available for immediate connection (Table 3.3 and Table 3.4). Teledensity was 0.4/100 or 4/1000. Abuja had the highest teledensity (2.2/1000); Lagos (2/1000) and three states namely Adamawa, Yobe and Bayelsa had the lowest (<0.1/100). In some areas, the nearest telephone point may be 30km or more away.

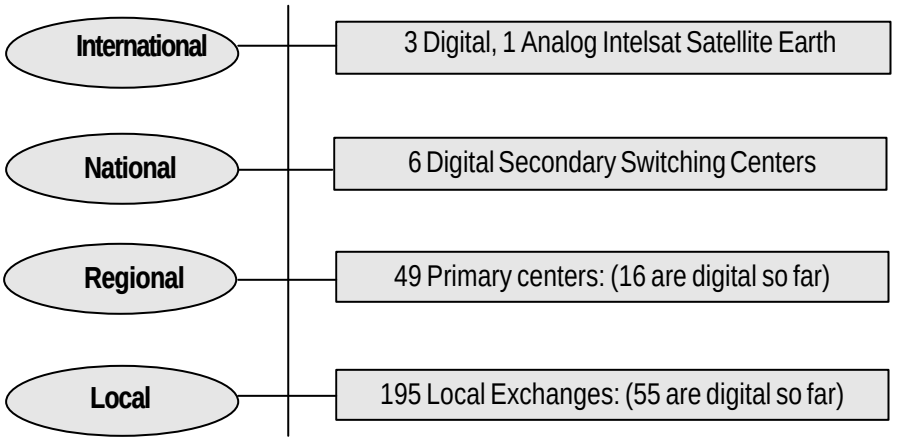
Table 3.4: Telecommunication Facilities in Nigeria (1990 - 1995)

Facilities	1990	1991	1992	1993	1994	1995
Telephone sets ('000)	492,204	497,975	1,000	376,151	405,586	405,991
Telex sets	7,402	9,282	7,310	6,935	7,280	6,767

Source: CBN Digest of Statistics (1996).

3.5 NITEL's telecommunication infrastructure

Telecommunication network is structured into four levels in Nigeria (international, national, regional and local) as shown in Figure 3.2.



Source: ADCG Industry survey, 1995.

Figure 3.2: NITEL's Telecom Infrastructure, 1996.

Indicators: According to Mansell et al. (1998; 35), literacy is a first indicator of the attainment of the skill levels needed to use ICTs productively. In the developing world, for every illiterate male, there are two illiterate females as shown in Table 3.5.

Table 3.5: Illiteracy in the Developing World, 1995

Region	Illiteracy rate % of population	No. of men (million)	No. of women (million)
LatinAmerica	13.3	26.6	33.0
Mahgreb	45.5	10.2	18.8
Other North Africa	49.2	16.6	28.7
Sub-Saharan Africa	45.3	83.8	139.4
West Asia	26.6	16.5	34.8
Central Asia	2.5	0.4	1.3
Southern Asia	46.0	238.0	423.7
China	18.9	60.1	169.1
Others	1.8	0.0	0.0

Source: Calculated from UNESCO (1995).
Note: Population of "other" region is less than 100,000.

Professional skills are needed to design and adapt to new uses. An indicator of this is the availability of these skills in the number of graduates of post-secondary education programmes in engineering and science (mathematics and computer science). A comparison of the data presented in Tables 3.6 and 3.7 shows clearly that the developing countries including Nigeria must do something quick in the area of skills development so as not to lose out completely in the information technology market. This fear is justified by the wide gap in Table 3.7. Regions like Asia and South America in 1995 were producing graduates in the relevant areas at the rate of 974 and 227 per million population, respectively and sub-Saharan African region was producing at the rate of 18 graduates in the fields relevant to ICT development per million population. It is no wonder therefore, that these regions today have become main exporters of ICT components, while Nigeria is still struggling to effectively adopt and maintain her imported ICT component stock.

Table 3.6: Graduates in Nigerian Universities and Polytechnics (1988 - 1992)

First degree awards in	1988	1989	1990	1991	1992
Engineering and Technology	1,570	1,954	1,543	1,975	1,397
Sciences	2,783	3,381	3,376	3,637	2,047
Diploma and Certificate awards in					
Engineering and Technology	22	34	N/A	28	140
Sciences	146	188	310	200	393

Source: FOS, Annual Digest of Statistics (1996).

Table 3.7: World Graduates in Engineering, Computer Science and Mathematics 1995

Region	Rate per million population
US and Canada	851
Europe Developed	748
Africa Developed	n.a
Mahgreb	151
Other North Africa	101
Sub-Saharan Africa	18
Asia Developed	974
SouthAmerica	227
China	238
West Asia	247
Other Asia	54

Source: Mansell et al. (1998).

The "footprint analysis" otherwise referred to as Infrastructure, Experience, Skills, Knowledge (INEXSK) approach as adopted by Mansell et al. (1998) is used in arriving at inter-country index values comparison. The index values for Nigeria was calculated and presented with figures arrived at by Mansell et al. (1998) for selected countries, such as France, Germany, United Kingdom, Japan and United States of America. The analysis is presented in Table 3.8. The same eight indicators used by Mansell et al. for the selected industrialized countries were also used for Nigeria. Ironically, the least technical and most diffused of all the indicators, that is, the number of television sets per 100 population, shows a very low rate of 5.5 for Nigeria when compared with 127 for the USA, 101 for Japan, 100 for UK, 95 for France and 90 for Germany. However, not surprising are the values of 0.38 for personal computers and 0.36 for main lines for Nigeria, whereas the least of these values are 60 and 72, respectively. It is obvious from the Table that Nigeria and indeed Africa is nowhere in ICT diffusion when compared with the rest of the world.

Table 3.8: Index Values for Nigeria Compared With the World

Index Value for	Nigeria	France	Germany	UK	US	Japan
Personal Computers	0.38	60	74	60	147	68
Main Lines	0.36	82	72	74	92	72
Electronic Production	n.a	19	19	27	32	44
Electronic Consumption	n.a	32	32	46	54	43
Technical Graduates	0.30	114	87	165	104	121
Literacy	51	n.a	n.a	n.a	n.a	n.a
Internet Hosts	0	27	60	78	238	22
Television Sets	5.50	95	90	100	127	101

Source: Mansell et al. (1998).ITU (1998); CBN Annual reports (1995).

Note: Different indicators were chosen based on availability of data. Measures of infrastructure and skills were adjusted for population. Main lines is per 100 inhabitants in 1996. Literacy for Nigeria represents adult literacy for 1990. TV sets index is per 100 inhabitants in 1996.

3.6 Africa within the global ICT context

3.6.1 Overview of the global production and use of ICT

During the past 30 to 40 years, rapid technological innovation fuelled unprecedented advances in digital computing capability in the fields of semiconductor technology (foundation on which the information industry is built), recording technology and telecommunication capability (Frenzel, 1996). Electronics, being the enabling technology in the information economy, has opened-up a vast range of new forms and concepts of handling information. Electronics has, thus, become one of the fastest growing industries worldwide.

Building up capacity in electronics is essential to the efficiency of any country's economy and its competitiveness (Table 3.9). It also enables a veritable resolution in communication and information that lies at the root of modern economic development. Output of global electronics reached US$700 billion in 1990 and is expected to reach about US$1.3 trillion by 2000 (Wellenius et al., 1993).

Table 3.9: Global Electronics Industry Production, Consumption and Trade by Region in 1996 (US$ Million)

Region	Domestic consumption		Local production (imports) or		Imputed (deamand) exports
	US$ m	%	US$ m	%	US$ m
US and Canada	334,927	35.6	283,423	28.3	(51,504)
SouthAmerica	34,477	3.7	32,548	3.3	(1,929)
Europe	241,186	25.7	200,613	20.0	(40,573)
Africa	5,122	0.5	1,793	0.2	(3,329)
Asia	283,306	30.1	445,311	44.5	162,005
China	30,199	3.2	33,369	3.3	3,170
Others	11,113	1.2	3,909	0.4	(7,204)
Total	940,330	100	1,000,966	100	60,636

Source: Calculated from Elsevier (1996), in Mansell et al. (1998).

Developing countries are following the export-led growth example of newly industrialized Asian economies by becoming suppliers and investors in ICT. However, these technologies continue to be exotic and inaccessible to people, especially, those in the Middle East and Africa. While ICTs, can be seen to contribute to economic growth, they also introduce new challenges in Africa, supporting the notion that growth in its use is often thought of as a cause of economic growth (Mansell et al., 1998). In societies that have higher levels of income, ICTs are used to reduce or cut-down on increasingly costly human imputs. They are also used to forge links between information resources and increases due to economic growth. Mansell et al. (1998) suggests that the challenge would be to develop and exploit these emerging opportunities.

Table 3.10: Worldwide Information Technology Market Breakdown (1985 - 1995)

	1985	1995	1985-1995 CAGR
By Geographical Area	%	%	%
NorthAmerica	59.2	43.5	9.4
LatinAmerica	1.5	2.0	15.6
Western Europe	22.1	28.3	15.6
E. Europe, Middle East & Africa	3.1	2.6	10.6
Asia Pacific	14.0	23.7	18.9
	100.0	100.0	
By Main Segment			
PCs and Workstations	20.9	30.5	17.2
Multi-user systems	29.5	13.0	4.0
Data communication equipment	3.0	4.3	17.0
Packaged software	13.5	18.4	16.3
Services	33.1	33.7	13.0
	100.0	100.0	

Source: Organization for Economic Cooperation and Development, OECD 1996b, in Mansell et al, 1998.
Note: CAGR = Compound Annual Growth Rate.

Korea and Taiwan have demonstrated that it is possible to achieve a major position as an exporter of ICTs with lower than average rates of domestic use of these technologies. Africa should also forge ahead and thus demonstrate that it can achieve a significant position in the domestic use of ICT in the new millennium. This is envisaging that Africa will have increases in economic growth, which will support its use (aided by its persistent price reduction and quality improvements).

3.6.2 Telecommunication infrastructure development

Telecommunication infrastructure is more broadly dispersed and developed than other measures of ICT, and the second measure (main lines) are available for virtually all countries. In North African countries such as Egypt, Libya and Sudan (largely Egypt), the significant increase in main lines is remarkable given stagnant revenue and a decline in revenue per mainline. In sub-Saharan Africa, almost all the trends are negative. There is also very high cost per main line of capacity additions in sub-Saharan Africa. Factors contributing to high cost are:

- cost allocation and reporting methodologies.
- geographic and climatic conditions, and distance factors.
- procurement practices of operators.
- equipment design and architectural issues.

The convergence of computing and telecom and the prevailing movement towards deregulation, seem to have fostered an increasing wave of takeovers, mergers and alliances. Infrastructure financing has also been one of the most active areas in international financing in recent years. IDRC has taken

the lead in financing African electronic networking initiatives (Computers and Communication in Africa, 1994).

In Africa, investment trends may be constrained by available revenue or buoyed up by rapid economic growth. Also, the pattern of telecommunication infrastructure investment may fail to contribute to convergence. Sub-Saharan Africa and Central Asia are envisaged to await 50 to 100 years for convergence (Mansell et al., 1998). Africa is also dominated by single state-run post and telecommunications monopolies (with two-thirds still having telecom monopolies in 1995), but the structure is now changing as increasing number of countries are permitting private sector participation. Thus, the trend now is towards privatization.

3.6.3 World telecommunication equipment trade

Africa makes the least export (0.1%) and import (1.8%) of the world's telecommunication equipment (Table 3.11). Europe has the largest trade in exports (48.8%) and imports (38.0%) and is the only continent with a positive trade balance of US$7,164.7 million (ITU, 1998).

Table 3.11: World Telecommunication Equipment Trade (Millions (US$)

	Export (US$ m)	%	Import (US$ m)	%	Trade Balance
Africa	65.1	0.1	1,265.3	1.8	- 651.4
Americas	16,566.1	24.1	19,021.0	26.6	- 14.4
Asia	18,129.8	26.4	22,180.2	31.1	- 3,252.0
Europe	33,550.9	48.8	27,136.9	38.0	7,164.3
Oceania	434.5	0.6	1,773.6	2.5	- 1,331.7
World	68,746.4	100	71,377.0	100	1,914.8

Source: ITU (1998).

3.6.4 Deregulation of African telecommunication

The pace of deregulation has increased. In Ghana (government sold 30% stake in Ghana Telecom-GT to a strategic investor in December 1996); Zimbabwe (public sector monopoly terminated); Senegal (30% of Sonatel sold to Telia, Sweden); and Cote D'Ivoire (51% of Telecom sold to France Telecom in January, 1997); South Africa (30% of Telkom sold in March, 1997). In Nigeria however, the full impact of privatization of the telecommunication sector has not been felt, because of the lip service being paid to the policy by the government. Lessons from a number of developing countries that privatized their telecommunication operators from the 1990s show that privatization has helped in increasing teledensity. In Latin America, for example, Argentina doubled its teledensity from 9.5 to 17.7; Chile and Venezuela lifted their teledensity to over 10 each; while in Eastern Asia, China lifted its teledensity from less than one to over five, within a period of 10 years.

The conditions set out to facilitate Africa's telecommunication sector deregulation and enhance competition as well as the future plans of selected countries as set out in the ITU African Green Paper for Telecommunication Policies in Africa, include:

- the separation of postal and telecommunication functions;
- separation of regulatory and operational functions;
- creation of a national regulatory authority;
- granting of financial and managerial autonomy to the public telecoms operators; and
- gradual opening up of the telecom market segment, where demand is high.

The future plans by some African countries to facilitate ICT diffusion through infrastructural facilities development are presented in Table 3.12

Table 3.12: Future Plans of Selected African Countries

Country	Future Plans
Nigeria	1 million installed telephone lines by 1998 and 3 million by 2005 — gradual modernizing and expansion of telecoms infrastructure.
Tunisia	1 million lines by 2000 (raising teledensity from 6 to 10).
Ghana	Provide a minimum of 225,000 new telephone lines within 5 years, beginning 1997.
South Africa	Increase main lines to 6 million by 2002. Install 120,000 public pay phones by 2002.
Cote d'Ivoire	Install 300,000 telephone lines over a 5-year period (quadrupling number at the time of privatization).
Malawi	Expanding infrastructure — Mitsui to install 40,000 telephone lines.

Source: ADCG industry survey, 1995 and ITU (1998).

3.6.5 Connectivity in Africa

In a number of African countries, public telecommunication operators are establishing full Internet services (Benin, Central African Republic, Djibouti, Mauritius, Madagascar, Senegal and South Africa). Others (Angola, Ethiopia, Gambia, Gabon, Guinea, Mali, Sierra Leone, Tanzania and Zimbabwe) are in the preparatory stages (Jensen, 1996b). The question thus arises whether networking technology — the Internet and its applications, will begin to reduce the 'access' gap in Africa. The highest numbers of Internet host per 10,000 inhabitants in Africa is for Gambia (26.38), with South Africa having the highest number of users (618,000). Finland tops the world with 613.08 Internet hosts per 10,000 inhabitants (or 61.3 Internet host per 1000 inhabitants), while 53 countries (25.7%) in the world have no Internet hosts (ITU,1998).

Table 3.13: Internet Users and Connectivity for Selected African Countries and the World, 1996

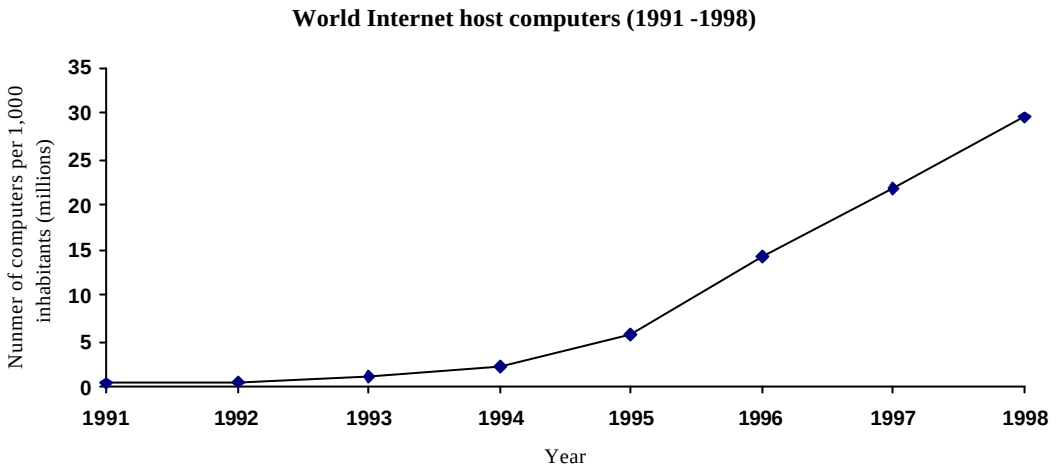
			Connectivity	
African countries	**Total number of Users**		**Number of Users per 10,000 inhabitants**	**Internet hosts per 10,000 inhabitants**
Gambia	220		1.93	26.38
Ghana	1,000		0.56	0.11
Kenya	2,500		0.79	0.09
Nigeria	500		0.04	-
Sierra Leone	N/A		N/A	N/A
South Africa	618,000		145.78	23.42
Tanzania	500		0.16	-
Zambia	850		1.03	0.21
Zimbabwe	2,000		1.68	0.15
By Continent		**%**		
Americas	24,434,982	48.78	315.64	139.18
Europe	13,455,435	26.84	169.76	45.69
Asia	9,209,732	18.39	29.08	3.04
Oceania	2,304,748	4.60	808.94	208.71
Africa	648,445	1.29	9.93	1.44
World	50,089,342	100	91.89	28.14

Source: ITU (1998).

Table 3.13 at a glance shows that the Americas have the highest number of Internet users (48.78%), and Africa lags behind with only 1.29%. According to Mansell et al. (1998), while places like the USA is racing ahead with the next generation infrastructure to support advanced ICT applications (Internet II), the affordability of services offered on a commercial basis is the second major factor for least developed countries to consider. Even where networks are accessible, they may simply be unaffordable. A factor that is contributing to cost in many developing countries is the fact that their main access route to the Internet is through Internet service providers in other regions, resulting in high access rates.

3.6.6 Internet hosts computers (world connectivity)

The number of computers directly connected to the worldwide Internet network has grown from less than one million in 1992 to almost 30 million by January 1998 (ITU, 1998).



Source: ITU (1998).

Figure 3.3: Computers Connected to the Internet (World).

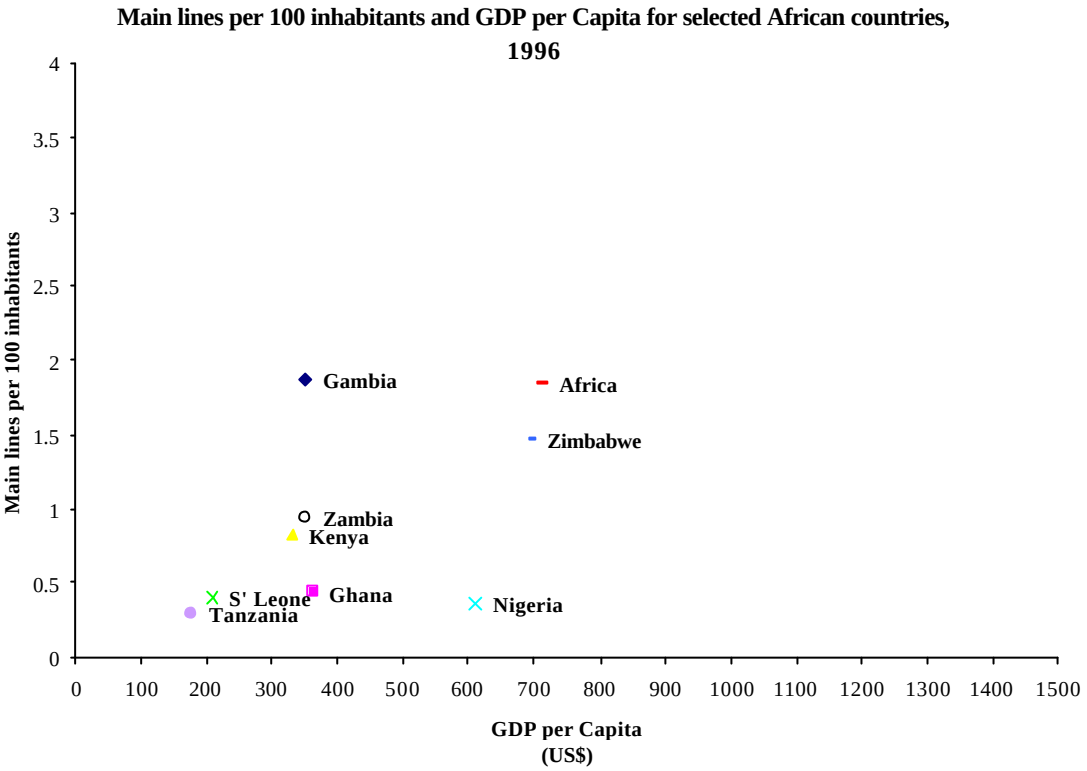
Figure 3.3 shows that there has been a significant growth in the number of computers per 1000 inhabitants connected to the Internet from 1996 to date. The big question, however, is where the sub-Saharan African countries, particularly Nigeria, stand in this scheme of things. Also, measuring the host computers per one million inhabitants by country income level, the entire population is dominated by those in the high income level (96%). This could indicate that universal access to information services remains a luxury to developing countries as they constitute middle to low income levels. This realization according to ITU (1998), seems to have brought about the redefinition of universal access (reasonable telecommunication access for all), by developing countries.

3.6.7 Teledensity in Africa

(1) Relationship between teledensity and income per capita

Figure 3.4 shows the relationship between main lines per 100 inhabitants and national income measures as gross domestic product (GDP) per capita as these two measures are closely related.

The relatively strong performance of Gambia (Figure 3.4) are indications of the parallel development of economies and telecommunication infrastructure. All countries except Gambia (1.87), have their teledensity less than Africa's average of 1.85 per 100 inhabitants.



Source: Adapted from Mansell et al. (1998) and ITU (1998).

Note: Teledensity is based on 1996 figures and gross domestic product (GDP) per capita is based on 1995 values.

Figure 3.4: Main Lines Per 100 Inhabitants (1996) and GDP Per Capita (1995 in US$) for Selected African Countries.

Table 3.14: Teledensity in Selected African Countries

Countries	Teledensity
Cameroon	0.52
Angola	0.47
Mauritania	0.43
Nigeria	0.36
Central African Republic	0.29
Uganda	0.24
Guinea	0.22
Somalia	0.15

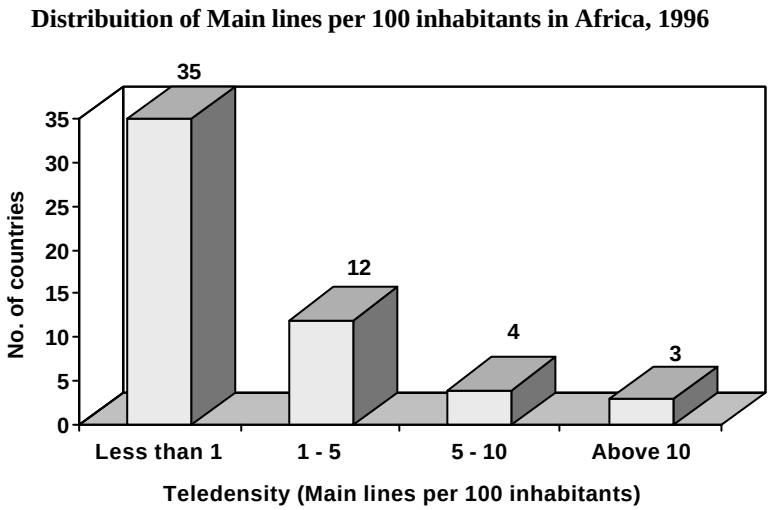
Source: ITU (1998).

Also from Table 3.14, countries like Somalia, Uganda and Central African Republic, have less than 0.4 main lines per 100 inhabitants (or less than one main line per 250 inhabitants). These countries have experienced civil strife in recent years and are amongst the least developed by most measures. In such places, telecommunication infrastructure is simply not part of everyday's life or experience (Mansell et al., 1998). Also, the economic growth of Cameroon, Mauritania, Guinea, Nigeria and Angola have been weaker, with civil turmoil and strife influencing the recent performance of Nigeria and Angola.

Looking at the distribution of mainlines per 100 inhabitants in Africa (Figure 3.5), 35 of the 54 countries in Africa (65%), still have less than one mainline per 100 inhabitants. With the world average being 12.88, only three African countries, namely Seychelles (19.56), Mauritius (16.21), and South Africa (10.05) have their teledensity above 10.

(2) Telephone main lines

According to Drucker (1992), there is no greater impediment to economic development than poor telephone service and no greater spur than good telephone service. Dramatic growth is occurring in the world telecommunication infrastructure in all countries, except those with high income (Table 3.15). The reason for this is that the market for telephone services has matured in such places as the USA and Canada.



Source: ITU (1998).

Figure 3.5: Estimated Teledensity in Africa, 1996.

Table 3.15: Telephone Main Lines Growth by ITU Income Grouping

ITU Income group	Main lines CAGR %		Main lines/ 100 CAGR %		Main lines/ 100 inhabitants		
	1990-1995	1990-1996	1990-1995	1990-1996	1990	1995	1996
Low income	27.4	28.5	24.9	26.1	0.61	1.98	2.45
Lower middle income	8.2	8.5	6.6	7.0	6.48	9.09	9.71
Upper middle income	8.2	9.0	6.4	7.2	8.80	14.51	13.36
High income	3.5	3.6	2.8	2.9	45.56	53.16	54.06

Source: ITU (1997) in Mansell et al. (1998).

Without China, the compound annual growth rate (CAGR) of low income group between 1990-1995 would have been 13.8 and 11.1% for main lines per 100 inhabitants. The impressive performance by the CAGR was made possible by the 34 million lines addition made by China during this period, which boosted the estimated growth of the entire 'low income' group to 27.4% (main lines CAGR %) and 24.9% for main lines per 100 inhabitants. Europe has the highest telephone lines per 100 inhabitants (highest teledensity). On the average (excluding South Africa), Africa has 1.66 telephone lines per 100 inhabitants. Average in sub-Saharan countries is 0.29 (ITU, 1994). Africa thus lags behind every other region of the world in telecommunication infrastructure.

Intense competition in global telecoms market in advanced countries has lowered the cost of telecom services and fostered the development of new services. The deregulation of telecom within most EU in 1998 would have wide implications and result in massive investment in infrastructures and lower prices.

(3) Telecommunication development in Africa

Telecommunication development in Africa remains the poorest when compared with the rate of development in other continents. What is more, the sub-Saharan Africa rates are highest among the least developed in 1992, 1994 and 1996 as shown in Table 3.16.

Telecom coverage in Africa is the lowest in the world. Teledensity varied from 0.08 in Chad to 0.34 for Nigeria on the average, 0.46 in 1995 (ITU, 1998). Total density was 1.66 for Africa. International telephone traffic per subscriber is over 200 minutes per year, but overall traffic per inhabitant is less than one minute. Factors contributing to this rather poor coverage include the following:

- growing debt burdens,
- high population growth, and
- civil disturbances.

Table 3.16: The Least Telecoms Developed Selected African Countries

Economy	Teledensity		
	1992	1994	1996
Zambia	0.88	0.87	0.94
Kenya	0.77	0.88	0.82
Cote D'Ivoire	0.66	0.79	0.88
Angola	0.49	0.52	0.47
Ghana	0.30	0.30	0.44
Nigeria	0.28	0.34	0.36
Burkina Faso	0.21	0.26	0.32
Liberia	0.17	0.16	0.16
Rwanda	0.16	0.19	0.28
Chad	0.07	0.10	0.09

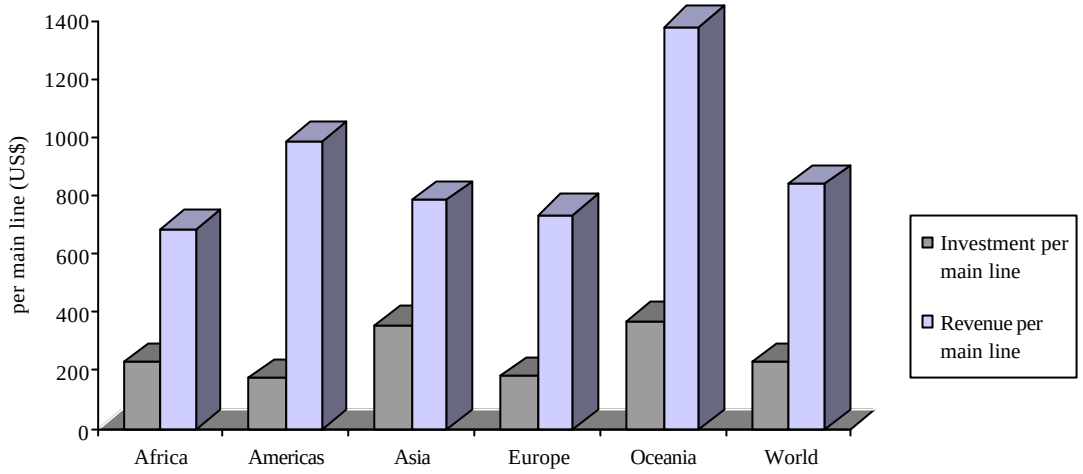
Source: 1992 and 1994 figures from Mansell et al.(1998); 1996 figures from ITU (1998).

(4) Telecommunication investment and revenue

Table 3.17: Telecommunication Investment and Revenue for Selected African Countries and the World, 1996

Selected African countries	Telecom Investment (US$)		Telecom Revenue (US$)	
	Per inhabitants	Per main line	Per inhabitants	Per main line
Gambia	8.1	434	16.1	864
Ghana	0.4	94	5.6	1,283
Kenya	2.3	276	9.4	1,139
Nigeria	1.7	465	6.9	1,904
Sierra Leone	2.0	504	3.6	896
South Africa	20.2	201	89.7	893
Tanzania	0.2	55	2.3	775
Zambia	1.4	145	13.1	1,393
Zimbabwe	11.1	753	11.6	789

Source: ITU (1998).



Source: ITU (1998)

Figure 3.6: World Telecom Investment and Revenue, 1996.

Figure 3.6 and Table 3.17 show that there are significant returns in telecommunication investments throughout the world. In Africa, about 204% return was made from telecommunication investment in 1996.

Chapter Four

Research and Analysis

4.1 Introduction

This chapter sets out to analyse the research findings in line with the set objectives of the study. The analysis is based on a response rate of 78% of the organizations covered in the research study. This means that out of the 70 organizations sampled, about 51 responded fully to our interview. Out of these 51, 26 were from the industrial sector and 25 from the services sector. Sub-sectoral coverage in the industrial sector included the leaders in the pharmaceuticals, chemicals and paints, textiles, consumer and capital goods, automobile accessories and electronic assembly. In the services sector, leading companies in insurance, hotels, broadcasting, banks and the capital market were covered.

4.2 ICT in industry and services sectors

Manufacturing: According to Mansell et al. (1998,1991), the manufacturing sector is witnessing the widespread adoption of ICTs in planning and control, factory automation, and general business management. Freund et al. (1997), also submitted that: application of ICT in manufacturing has brought about a situation whereby whole processes are being sped-up rather than just accelerating single steps. These facts are mostly relevant to the developed economies where adoption of ICT at all levels in industry and services sectors are taken for granted.

At all stages of design and marketing, ICTs also facilitate the systematic capturing of information, thus bringing a situation whereby important inputs are supplied to the following:

- general business management,
- control and logistics,
- strategic planning, and
- total quality management.

Further improvements extend to waste, pollution, energy reduction and the efficiency of a manufacturing plant. Environmental issues have become a strategic issue of importance to all organizations, especially those operating globally, because of the growing realization that environmental damage is no longer acceptable to a wide range of stakeholders. The scope of environmental concerns is thus widening.

The benefits of all products of ICT from computer aided design (CAD) and interactive graphics in the design stages of both machine tools and manufactured parts, are enormous. Its uses and benefits in the manufacturing sector include the following:

- Virtual reality and simulation can be used to explore design alternatives in an easily manipulated model world. The potential of virtual reality simulation also reaches far beyond industrial use.
- CADs can limit designers to working on manufacturable parts and eliminate time-consuming unfeasible designs.
- Used to achieve reductions in the product development cycle with design-to-prototype services, which allow the designs of manufacturable parts to be sent to a computer controlled milling machine for immediate fabrication.
- Simulation tools allow a degree of customer participation in the design process, and demonstration models can be available to end users for comments on a company's web site.
- Remote and accurate process control. Controlled process sensors technology incorporates ICTs for evaluating the sensor data and processing the final results, taking imputs from various sources (optical and capacity sensors, additional laser interferometers and thermal compensation).
- Suppliers real time access to a manufacturer's CAD, CAM and/or CIM facilities can greatly improve product development, reducing time-to-market for new products. This, according to Harvey et al. (1996), brings about a reduction in travel time to suppliers of designers and engineers, thus leading to significant cost savings.

In addition, CAM incorporating robotics is spreading rapidly, linking material handling machines, lathes, grinders, sprayers and assemblers to computers.

Tourism and travel industry: Tourism and the travel industry is another area in which there has been major changes as a result of the application of advanced ICTs, according to Mansell et al. (1998). The travel industry has especially, proved to be one of the fastest growing segments of the Internet. Poon (1987) also opined that there is now a strong impetus for a new tourism, brought about by heavy dependence on ICTs through consumer preferences for flexible travel and leisure services.

Information needs of international tourism is enormous. The potential uses of ICTs in the tourism industry for developing countries or economy in transition, is also enormous. These technologies (as stated in Mansell et al., 1998), are associated with frequent flyer programmes, flexible holidays, ticketless travels, cyber offers, video brochures, web site and on-line travel agency services. The components of the system of interrelated computer and communication technologies employed in the tourism industry are: computerized reservation system (CRS), teleconferencing, videotex, videos, video brochures, management information systems, airline electronic information systems, electric funds transfer systems, digital telephone networks, smart cards, satellite printers, mobile communication, e-mail, and Internet.

Computerized reservation systems (CRS), have emerged as the dominant technology and the Internet is also a very powerful emerging technology in the industry. Taking an example of the USA, by 1988 (10 years after deregulation), 96% of travel agencies were automated (a clear evidence of speed of diffusion).

4.3 Research findings

4.3.1 General information

The breakdown of the companies in the services sector covered in this analysis include three leading development banks and three commercial banks for a total of six banks, eight five star hotels, six broadcasting corporations, four leading insurance companies and one in the aviation industry for a total of 25 organizations. The industrial sector on the other hand had seven companies in the pharmaceutical, five in the chemicals and paints, three in the textiles, seven in the capital and consumer goods, two each in the electronic assembly and automobile accessories, for a total of 26 firms as respondents. The companies selected in each subsector were carefully chosen to represent at least 60% of the activities in their respective sectors in terms of sales turnover, profitability, employment structure, assets, shareholders fund and other financial indicators. The variables used in measuring the impact include: profitability, operational efficiency, investment profile, capacity utilization and human capacity building. The impact will be measured using the time frame of pre and post adoption.

4.3.2 Ownership structure

Analyses indicated that about 80% of the companies on the average are wholly owned by Nigerians and about 20% have varied degrees of foreign participation. It was also shown that in the service sector, about 18% of the companies were established and started operation in the 1940s, another 20% were established and started operation in the 1960s, 29% came on board in the 1970s and 18% was added in the 1980s. In the 1990s only 15% were established and commenced operation in different business areas. In the industrial sector on the other hand, about 29% of the companies were established in the 1940s, 38% in the 1960s, 25% in the 1970s, only 8% in the 1980s and no new additions in the 1990s as shown in Table 4.1.

Table 4.1: Year of Establishment, Dates Services Started and Percentage of Companies

	1942-1959		1960-1969		1970-1979		1980-1989		1990-1998	
	S	M	S	M	S	M	S	M	S	M
Date of establishment of company (%)	18	29	23	38	32	25	18	8	9	0
Date services/ production started (%)	17	25	17	33	26	25	17	8	22	4
Average	18	27	20	35	29	25	18	8	16	2

Note: S = Services Sector.
M = Manufacturing Sector.
Source: Survey result.

4.3.3 Available facilities

In terms of hardwares in use in the responding companies in the industrial and services sectors, telephone facility topped the list with between 100 and 90% having functioning telephones and only 8% without the facility, but utilizing it through a third party. The category of companies that fall within this group are those who operate in an area which lacks telephone infrastructure. Telephone facility is closely followed

by fax facility, which is presently enjoyed by between 84 and 100% of the respondents in the services and industrial sectors, respectively and 8% each, either have non functioning facilities or enjoy the facilities through a third party or do not use the facility at all, because it is not relevant to their operations. The use of micro and mini computers in the industrial and services sectors is also significant, between 81 and 68%, respectively use micro computers and between 62 and 56%, respectively use mini computers. This also means that between 19 and 34% of the respondents in both sectors do not enjoy these facilities, either because they do not consider them relevant to their operations or are still in the process of computerization. Also, between 35 and 52% of the companies in the industrial and services sectors have and make use of telex facility and between 15 and 24%, respectively, do not have the facility. Ironically between 50 and 24%, respectively are indifferent. Details are shown in Table 4.2(a).

In terms of software availability, between 100 and 84% in the industrial and services sectors, respectively, make use of word processing packages and only 16% are not familiar with the package, because they are yet to computerize their operations. Also, a significant 80 and 60% possess and use spreadsheets and data management system packages, respectively in the services sector compared to 96 and 85% in the industrial sector. On the other hand, between 28 and 31% of the companies neither possess nor utilize statistical packages in their operations and between 48 and 57% in both sectors, do not consider the package relevant to their operations and as such do not respond to the question. Details of the analysis are shown in Table 4.2 (b).

The story is, however, different when considering the ICT related services available to the companies in the industrial and services sectors. Out of all the expected services, only E-mail service showed some encouraging level of adoption at 65 and 56%, respectively. Other services such as file transfer protocol (FTP), web offset (WWW) and gopher, showed abysmally low level adoption of 27 and 24%, 23 and 16%, and 4% each, respectively. Details are as shown in Table 4.2(c).

4.3.4 Purpose and frequency

Analysis of data in this area showed that the companies, both in the industrial and services sectors, utilize their computers very often for data analysis (89 and 86%), information processing (92 and 85%), storage and retrieval of data (89 and 96%), information dissemination (50 and 80%), CD-ROM searches (23 and 68%), peer-review group (0 and 30%), teleconferencing (0 and 28%) and for general management (58 and 70%), respectively. Also, in both sectors, between 92 and 96% agreed that telephone is indispensable and therefore make use of it often, between 85 and 72% use fax machine very often and E-mail was used very often by between 54 and 40%, respectively as detailed in Table 4.3(a).

When the adoption of ICT is put in ranking order for the two sectors as shown in Table 4.3(b), information processing topped the list and was closely followed by data analysis and then data storage and retrieval, information dissemination, forecasting, modelling and simulation, conferencing, peer-review and graphics/edition, in that order. In the service sector, information storage and retrieval ranked highest, closely followed by information processing and then data analysis, information dissemination, forecasting, conferencing, modelling, peer-review and graphics/editing, in that order.

Table 4.2(a): Facilities Available in Organization

Facility	In use (%)		Not In use (%)		Not Applicable (%)	
	S	M	S	M	S	M
Mainframe computer	12	19	32	19	56	62
Mini computer	56	62	24	15	20	23
Micro computer	68	81	12	4	20	15
Telephone	92	100	8	0	0	0
Fax	84	100	8	0	8	0
Telex machine	52	35	24	15	24	50
Local area network (LAN)	52	66	12	11	36	23
Wide area network (WAN)	16	19	20	31	64	50
Radio messaging	32	58	16	23	52	19
Others (specify)	12	13	4	10	84	77
Average	48	55	16	13	36	32

Note: S = Services Sector.
M = Manufacturing Sector.
Source: Survey result.

Table 4.2 (b): Software(s) Available in Organization and Actually in Use

Facility	In use (%)		Not In use (%)		Not Applicable (%)	
	S	M	S	M	S	M
Word processing packages(WP, MS-word)	84	100	0	0	16	0
Spreadsheets (e.g. lotus, excel)	80	96	12	4	8	0
Database management systems (e.g. DB4)	60	85	20	8	20	7
Statistical packages (e.g. SAS, SPSS)	24	12	28	31	48	57
Others (specify)	20	27	20	23	60	5

Note: S = Services Sector.
M = Manufacturing Sector.
Others include: users written program, fault diagoniser, microbanker, insurance accounting and oracle.

Table 4.2 (c): Services Available in Organization and Currently in Use

Facility	In use (%)		Not In use (%)		Not Applicable (%)	
	S	M	S	M	S	M
E-mail	56	65	8	8	36	27
WWW	16	23	4	0	80	77
File transfer protocol (FTP)	24	27	8	0	68	73
GOPHER	4	4	0	0	96	96
Others (specify)	4	8	0	0	96	92

Note: S = Services Sector.
M = Manufacturing Sector.
Others include: TCP/ IP and dial-up networking transmission.
Source: Survey result.

Table 4.3 (a): Frequency of Usage of Facilities Within an Organization

Facility Computer for:	Very Often (%)		Occasionally (%)		Never (%)		No Opinion (%)	
	S	M	S	M	S	M	S	M
Data analysis	86	89	4	0	0	0	10	11
Information processing	88	92	8	1	4	0	0	4
Storage, retrieval of data	96	89	4	0	0	0	0	11
Information dissemination	80	50	12	23	0	0	8	27
CD-ROM searches	68	23	20	27	4	12	8	38
Peer-review group	30	0	4	8	20	8	46	84
Teleconferencing	28	0	0	4	30	8	42	88
General management	70	58	20	12	0	0	10	30
Telephone	96	95	4	4	0	0	0	4
Fax	72	85	20	8	0	0	8	7
Telex machine	46	27	30	15	4	4	20	54
Radio messaging	56	46	18	8	10	4	16	42
E-mail	40	54	4	12	0	4	20	30
FTP	32	23	0	12	40	4	28	31
Others	8	12	0	0	0	0	92	88
Average	60	51	12	9	7	3	21	37

Note: S = Services Sector.
M = Manufacturing Sector.
Source: Survey result.

Table 4.3 (b): Ranking Order of ICT Functions in the Organization

Facility for:	Sectors	
	Services (%)	Manufacturing (%)
Storage, retrieval of data/ information	88	92
Information processing	84	100
Data analysis	72	96
Dissemination of information	72	65
Forecasting/ prediction	44	65
Electronic conferencing	20	12
Modeling and simulation	16	19
Peer-preview group discussion	12	12
Others (graphics and editing)	4	8

Source: Survey result.

4.4 Impact Analysis

4.4.1 Profitability

Factors that enhance profitability were considered in measuring the impact of ICT adoption on the fortunes of the organizations covered in this study. These factors include: cost of ordering (processing) raw materials and other inputs, sales, inventory keeping, and other product costs. It should be noted that the cost of raw materials was not considered, because analysis has shown that ICT impact in this area is more on the side of the supplier than the users.

The manufacturing sector for example, recorded enhancement of profit level, since the adoption of ICT than before, as a result of significant savings in cost of ordering raw materials and other inputs. Ordering of raw materials and other inputs, before the advent of information technology was done manually, involving a lot of paper work and personnel to physically follow up materials. This at that time, would lead to machine down time and wastage of human resources, which ultimately added to the cost of production. However, with the adoption of ICT by these organizations, ordering has been made less labourous and time drastically reduced through the use of computers and telephones. In the same vein, cost of sales have been reduced significantly since ICT adoption has now made communications between the sales depots in the hinterland and the factory easier and direct. The sales representatives can liaise more easily with the head offices to pass useful information about customers requirements, the status of the market and their periodic reports to the concerned officers. It took days and the physical movement of human and material resources to achieve these, at significant costs to the organizations. The adoption has also reduced the cost of product in the sense that the use of computers has facilitated product design, packaging and quality control process, which in the past had taken time to accomplish, thereby adding to the product cost. This has also helped these organizations to keep inventory of raw materials at a reasonable level, thereby minimizing pilferage, spoilage and other loses since the order lead time and materials requirements, can be more accurately determined by use of computers. This has helped to avoid unnecessary high inventory build-up, which could not be avoided during the pre-ICT adoption period.

Analysis of data collected, revealed that the levels of these factors in the manufacturing sector during the pre adoption period of five years (1980 – 1985), was on the average about 38% per year. This means that the period before the adoption of ICT in the organizations, these factors put together accounted for as high as 38% of cost of operation. However, between the period of 1995 and 1997 when the adoption reached a significantly high level in these organizations, the proportion of these factors in total cost of operation was reduced by as much as 11%, from 38 to 27%. This implies that profitability of the organizations has been enhanced by an average of 11% per year as a result of adoption of ICT by the affected organizations as shown in Table 4.4.

The services sector shared the same experience as the manufacturing sector as the analysis of data received from the responding organizations in the sector. This revealed that the profitability enhancing factors, as identified, contributed as much as 55% on the average per year, for the period before full adoption of ICT to the production cost of the product. However, after the adoption of ICT between 1995 and 1997, the average contribution to production cost went down to 41% per year for the responding organizations. In other words, it could be concluded that the adoption of ICT increased the profitability prospects of the service sector by as much as 14% per year on the average during the period under consideration.

Details of the factors considered and the average rate of contribution are shown in Table 4.4.

Table 4.4: Profitability Level in Organizations Before and After ICT Adoption

Production Factors	Manufacturing Sector		Services Sector	
	Pre Adoption (1980-1985) (%)	Post Adoption (1995-1997) (%)	Pre Adoption (1980-1985) (%)	Post Adoption (1985-1997) (%)
Raw Materials ordering costs	12	8	10	6
Cost of Sales	15	11	30	25
Inventory Costs	6	4	5	3
Product Costs	5	4	10	-
Total Contribution to Operating costs	38%	27%	55%	41%
Contribution to Profit Margin	-	11%	-	14%

Source: Survey result.

Note: Raw materials for the services sector represents cost of input materials and consumables.
Cost of sales refers to cost of business developments, discount and advertisements.
Product cost is taken as cost of packaging the services.

4.5 Operation efficiency

More often than not, increased profitability in the organization is assumed to be synonymous with increased efficiency in the organization's operation. Experience has, however, shown that this may not necessarily be so. In the case of a monopoly in the market, an organization that is grossly inefficient in

its operations may cover up with arbitrary price, increase of its products and services that may make the organization appear very profitable. This phenomenon informs our resolve to examine the areas of operations of these organizations that have been impacted positively by the adoption of ICT. Our mode of measuring efficiency was quantitative to the extent that the organizations were asked to respond in the affirmative or otherwise, if the adoption had in any way improved their operational efficiency.

Responses from the companies in the industrial and service sectors indicated increased efficiency due to adoption of ICT on their operations as shown in Tables 4.5 to 4.6. The adoption of ICT as shown in Table 4.5 has resulted in more effective use of time as agreed by the majority of respondents, (89-95%). Adoption has also led to higher productivity as confirmed by 88-90% margin. As many as 88% of the respondents, equally indicated that adoption has led to higher quality products and services, and subsequently higher revenue as confirmed by between 85 and 88% of the respondents. In all these instances, the impacts have in quantitative terms not less than 20% increase in efficiency over what obtained before the adoption of ICT. However, the impact of adoption on diversification of products was rated low by the organizations in the two sectors, as only between 24 and 42% rated this positive. On the effect on improved product and service quality, 73-83% of the respondents rated the impact positive, while in the area of impact on sales per employee, between 60 and 65% rated it positive and high. Details of the rating are shown in Table 4.6.

Table 4.5: Impact Analysis on Operation Efficiency

Operation Indices	Yes (%)		No (%)	
	Service	Manufacturing	Service	Manufacturing
More effective use of time	95	89	5	11
Increased productivity	88	90	12	10
Higher product and serv. quality	88	89	12	11
Increased revenue	88	85	12	15
Diversified product mix	24	42	76	58

Source: Survey result

Table 4.6: Degree of Impact on Operational Efficiency

Effectiveness Indices	High (%)		Average (%)		Low (%)	
	Service	Manufac.	Service	Manufac.	Service	Manufac.
Improved quality of products/ services	83	73	16	18	1	9
Increase in sales/employee	60	65	13	25	27	10
Reduction in processing/ services delivery time	48	70	5	18	47	12
Reduction in time for producing reports/proforma invoices and others	69	79	13	21	18	0

Source: Survey result.

4.6 Impact on investment

It is expected that adoption of ICT by both the industrial and services sectors will result in new investments, which no doubt will have a remarkable multiplier effect on the economy. Adoption of ICT stimulated substantial and unavoidable investments in these sectors in the area of acquisition of new and modern equipments, upgrading of existing facilities and development of adequate infrastructure.

Analysis of data collected, showed that substantial investment has been made by the two sectors in acquiring and updating of ICT facilities between 1995 and 1997 in Nigeria. As shown in Table 4.7, between 53 and 64% of the companies sampled, invested up to Naira 10 million in ICT facilities within a period of 3 years. Another 11-20% invested between Naira 11 and Naira 50 million, while only 7-9% and 6-13% invested between Naira 51 and 100 million and above Naira 100 million, respectively. It must also be noted that these investments are mostly in hardware and infrastructural facilities.

Table 4.7: Investment on ICT Facilities (1995 – 1997)

Investment (N m)	Services (%)	Manufacturing (%)
Less than 1	7	10
1 – 10	53	64
11 – 50	20	11
51– 100	7	9
Above 100	13	6
Total	100	100

Source: Survey result.

4.7 Impact on capacity utilization

Low capacity utilization which for sometime had become a perennial problem to organizations in Nigeria, especially those in the industrial sector, had been attributed to raw materials availability, while we often ignore some factors that contribute to the shortage. Such factors include communication gap due to problem in information transmission and red tapes in order treatment, which often extend the order lead time for raw materials. Indications are that ICT adoption had contributed significantly to closing of communication gaps, as users and suppliers can now communicate more easily and faster, through electronic mail (E-mail) and web site, when placing orders or sourcing for raw materials. Companies in the services sector also having been able to increase their volume of business by means of electronic devices, which help banks for example, to transact inter-bank operations, clear cheques and serve customers faster. It also enables hotels, aviation, insurance and others to speedily reserve accommodations, confirm bookings and process premiums, respectively.

Analysis of data on the two sectors as presented on Table 4.8 shows that adoption of ICT by the sector, changed the operating horizon of the affected organization in terms of utilization of their capacities.

The analysis shows that between 60 and 70% of the respondents indicated that ICT adoption had led to an increase in their capacity jump in their utilization by more than 50%, over what it was before adoption. Between 20 and 29% experienced between 21 and 50% increase in capacity utilization,

while only 10-11% enjoy below 20% increase in capacity utilization. Interestingly, none of the respondents indicated a negative or stagnant capacity utilization as a result of ICT adoption.

Table 4.8: Impact on Capacity Utilization

Per cent Capacity Utilization	Services (%)	Manufacturing (%)
0 – 20	10	11
21 – 50	20	29
Above 50	70	60

Source: Survey result.

4.8 Impact on capacity building

Contrary to fears often expressed by labour that adoption of modern information and communication technologies will lead to job losses, the opposite was discovered to be the case. Rather, it has opened more opportunities not only for employment of more staff, but also, for training and retraining of existing staff in the mastery of the new and sophisticated equipments. It has also led to acquisition of additional capabilities by the employees in these organizations.

The employment profile in the industrial and service sectors in ICT, according to the respondents, is shown in Table 4.9. The industrial sector employed a total additional ICT staff of 118 and the service sector with additional staff of 193 between 1993 and 1997. There were additional staff of 2,535 for middle management cadre of ICT employed by the industrial sector, while the service sector recorded additional staff of 981 during the same period. A total additional staff of 2,039 junior ICT staff cadre, were employed by the service sector compared to a total of 490 additional staff by the industrial sector.

Table 4.9 Employment Profile in ICT

Category	1993		1994		1995		1996		1997		Total	
	S	M	S	M	S	M	S	M	S	M	S	M
Management staff	15	21	24	17	45	20	49	29	60	31	193	118
Senior ICT staff	173	60	171	54	211	766	210	799	216	856	981	2,535
Junior ICT staff	356	92	358	82	390	113	425	113	510	108	2,039	490

Note: S = Services Sector.
M = Manufacturing Sector.
Source: Survey result.

Also, in an attempt to build up adequate capacity in ICT to the service and industrial sectors in Nigeria, various companies have updated the knowledge of their ICT staff by providing training opportunities in relevant areas, which include the following:

- Database management programs (Dbase and SQL);
- Computer appreciation;

- Word processing;
- Spreadsheet (Excel);
- Windows NT 4.0 and Windows '95 and '98 Application;
- Hardware and software maintenance;
- Operating systems;
- Microbanker training;
- Novel Netware 4.11;
- AUTOCAD application;
- System administration;
- Microsoft Office (Word, Excel, PowerPoint, Access and Binder);
- Programming languages (COBOL, UNIX, LAN based on TCP/ P protocol and Oracle);
- PABX telephone system;
- X2000Bug training;
- E-mail;
- Financial management; and
- Various other courses (not specified).

The mode of providing training varied from company to company in both sectors. In the service sector, 39% of the respondents provided the training in-house, 35% through independent consultants, and 23% through the vendors that supplied the ICT components. In the industrial sector on the other hand, 32% provided the training in house, 58% utilised the services of consultants and only 9% relied on the equipment vendors to provide the training. Further analyses showed that as many as between 90 and 96% of the respondents in the two sectors agree that training received is relevant and effective. However, the result of the capacity building efforts in specialized areas in the two sector vary widely. In the service sectors between 80 and 90% of the companies require foreign technical assistance in the initial installation and operation of the ICT gadgets, whereas in the industrial sector, only between 17 and 22% of the companies, required the services of foreign experts. It follows therefore that between 78 and 83% of the companies in the industrial sector had acquired the capability to render such services in-house. Details of these analyses are shown in Table 4.10 (a-c).

Table 4.10 (a): Who Provided the Training?

Training providers	Services (%)	Manufacturing (%)
In-house	39	32
Independent consultants	35	58
Vendors	23	9
Others	3	1

Note: Others are through books and magazines.

Table 4.10 (b): How Do You Consider the Training?

How do you consider the training	Services (%)	Manufacturing (%)
Very Effective	40	42
Effective	50	54
Not Effective	10	4

Table 4.10 (c): Did You Require Foreign Technical Assistance for Installation and Operation?

Required Foreign Technical Assistance	Yes (%)		No (%)	
	Service	Manufacturing	Service	Manufac turing
For Installation	80	17	20	83
For Operation	90	22	10	78

Source: Survey result.

The adoption of ICT in the service and industrial sectors of the Nigerian economy has been of tremendous benefits to the two sectors. These benefits according to our respondents, are given in Table 4.11.

Table 4.11: Benefits Derived From ICT Adoption

Benefits	Service (%)	Manufacturing_(%)
Leads to increases in productivity and competitiveness	96	92
Provides better recording	92	89
Provides more timely and accurate information	91	89
Provides better financial control	88	85
Improved operations procedures	88	96
Provides better accounting system	87	96
Enhances organization's image	87	89
Speeds up decision making process	78	96
Provides better communication network	76	81
Facilitates growth in research activity	64	54

The proportions of those who either disagree or offer no opinion on the matter range from 4 to 46% depending on the relevance of the question to their sector. Details are in Table 4.12.

Table 4.12: Benefits Derived From the Application of IT

Benefits	Strongly Agree (%)		Disagree (%)		No Opinion (%)	
	S	M	S	M	S	M
Provides more timely, more accurate and expanded information	91	88	0	8	9	4
Provides better recording	87	89	0	0	13	11
Provides better accounting system	88	96	4	4	8	0
Improves operational procedures	92	96	0	4	8	0
Increases productivity and competitiveness	96	92	0	4	4	4
Boosts institute's image	87	89	0	4	13	7
Enhances management control	84	92	0	0	16	8
Provides better financial control	88	85	4	7	8	8
Is cost effective	76	73	8	12	16	15
Provides better communication network	82	81	9	4	9	15
Facilitates right decision making	64	96	0	0	36	4
Facilitates growth in research activity	78	54	9	12	13	34
Others (specify)	4	0	0	0	96	96

Note: S = Services Sector.
M = Manufacturing Sector.
Source: Survey result.

4.9 Constraints against ICT adoption

Majority of the respondents were in agreement with the fact that irregular power supply poses the greatest constraint to the level of adoption of ICT in the industrial and service sectors, indicated by a 75% margin in the service sector compared to 58% in the industrial sector. The reason for this disparity is that majority of the companies in the industrial sector have alternative source of power, especially to support their production system. Other constraints include:

- Lack of training opportunities in ICT — 48% service sector and 46% industrial;
- Lack of adequate technical information concerning specific technologies — 44% service sector and 36% industrial sector;
- Lack of adequate financial support for local development of technology — 39% service sector and 46% industrial sector;
- Lack of vision and support on the part of top management level — 33% service sector and 39% industrial sector; and
- Lack of adequate in-house expertise in ICT — 30% service sector and 31% industrial sector.

Detailed analysis is shown in Table 4.13.

Table 4.13: Constraints in the Application of ICT

Constraints	Strongly Agree (%)		Disagree (%)		No Opinion (%)	
	S	M	S	M	S	M
Irregular power supply	75	58	17	27	8	15
Lack of training opportunities in IT	48	46	9	42	43	12
Lack of financial support for local development of technology	39	46	22	39	39	15
Lack of in-house IT experts	30	31	35	62	35	7
Lack of compatibility with existing systems	18	35	41	46	41	19
Lack of vision and support by top management.	33	39	35	46	35	15
Lack of technical information concerning specific and appropriate technologies	44	36	30	46	26	18

Note: S = Services Sector.
M = Manufacturing Sector.
Source: Survey result.

4.10 Infrastructural requirement

Ranking on a scale of 1 to 10 for least important to most important, the respondents in both industrial and service sectors gave adequate supply of electricity, a 10 point ranking as an indispensable infrastructural facility required for high adoption level of ICT in the service sector. Closely followed is telecommunication equipment facility, which the industrial sector gave a 10 point rating, while the service sector gave an 8 point rating. Telephone facility is also rated 7 and 8 points by each sector. Educational institutions for effective training for ICT experts and availability of computer facilities, were also rated high among the necessary infrastructural facilities. In the opinion of the respondents, the under-development of these infrastructural facilities have been largely responsible for the low level of adoption of ICT in both the industrial and service sectors of the Nigerian economy. The ranking order is presented on Table 4.14.

Other opinions offered by the respondents as necessary factors that will expand the adoption of ICT in Nigeria in general, include the following:

- ICT components should be made available at moderate costs;
- Workers to be more remunerated for better encouragement;
- Government to make funds available for local development of ICT components and parts;
- Government to pursue policies that will enhance growth of the industry;
- Inclusion of computer studies in the curriculum of primary schools;
- Ensure proper inspection of computer items entering into the country to avoid the dumping of outdated and non year 2000 compliance systems;
- Focus on manpower training in ICT;

- Allocation of substantial funds to research on ICT by companies;
- Management and control of the industrial systems by local experts; and
- Deregulation of NITEL to facilitate the provision of Internet services.

Table 4.14: Infrastructural Facilities that Should be Adequately Developed to Enhance the Availability and Application of IT in Nigeria

Infrastructural Facilities	Ranking (Points)	
	Services	Manufacturing
Adequate power supply facilities	10	10
Telecommunication equipment	8	10
Telephone facilities	8	7
Training and educational institutions	6	4
Computer facilities to facilitate computer education for all	6	2
Modern ICT systems	5	1
Computer laboratory for research into new technologies	5	2
Computers	5	2

Source: Survey result

Chapter Five

Conclusions and Policy Issues

5.1 Conclusions

The study has particularly provided empirical evidence that indeed the adoption of ICT in the Nigerian economy is beneficial, going by what the analysed data collected on both the industrial and service sectors have revealed. It has been shown that adoption level in 1997, in terms of availability and utilization, is presently at an average of about 52% (Table 4.2a). The frequency of use is also at an average level of about 56% (Table 4.3a). According to sources close to the Computer Association of Nigeria (CAN), there were between 500,000 and 650,000 computer systems in Nigeria as at 1997 (Vanguard, 26 August, 1998). This will translate into a rate of 6.5 computers per 1000 population. This low computer availability rate understandably accounts in part for the low per capita level adoption.

Before drawing lessons from the analyses, it will be useful to examine the major impact of the adoption of ICT on the service sector on the one hand and on the manufacturing sector on the other. The adoption of ICT in the service sector of the economy has positively impacted the sector. Analyses have revealed that the operating efficiency has improved greatly since the adoption of ICT. Capacity utilization in the majority of the companies in the service sector, for example, increased by more than 50%, resulting in increased production and profitability. This is made possible by the drastic reduction in operation time and the high increase in sales per employee as revealed by the analyses. Information processing has been faster, more accurate and reliable. In the industrial sector on the other hand, adoption of ICT has had an appreciable positive impact on the sector. Analysis revealed that adoption rate is very high in the areas of telephone facilities, word processing, fax and e-mail services. Other areas of application include information processing, data analysis and record keeping, especially for inventory control and accounting. The fear that adoption will lead to redundancy of staff was debunked by the analyses, which revealed that the adoption opened up training and employment opportunities for many employees in both sectors. The adoption opened the employment door to about 700 and 800 skilled workers in the service sector and training and retraining for existing workers in this sector. The impact of ICT adoption was noticeable in the areas of profitability which as revealed by the analysis went up to an average level of 14% per year for the post adoption period considered. Other areas where the impact was significant, were improvement in the operating efficiency; investment opportunities were several millions of Naira, better business prospect and a more friendly business environment.

In the industrial sector, the impact of ICT adoption is equally significant, increasing the profitably prospects of the companies by an average of 11% per annum during the post adoption. Adoption of ICT, as earlier shown, had a general significant investment, training and retraining opportunities for Nigerians. Many industrial outfits which were at a state of comma during the pre adoption period, had

life brought back, when input sourcing were made less cumbersome by use of electronic devises, which subsequently resulted into increase in capacity utilization of the companies. Also, within two years (1996 and 1997) of the adoption by the industrial sector, there were employment opportunities for 941 and 1000 Nigerian skilled workers in 1996 and 1997, respectively.

The training opportunities offered by the adoption of ICT afforded Nigerians to acquire expertise in the following area:

- Hardware and software maintenance;
- Systems administration;
- AUTOCARD administration;
- Microbanker training;
- Operating systems;
- Word processing;
- Computer appreciation;
- PABX telephone systems; and
- X2000 Bug training.

The overall conclusion, however, is that the adoption level of ICT in Nigeria has been directly influenced by the availability of information and communication gadgets. The inadequate level of computer availability, for example, was found to be a limiting factor to computer application for many functions in industries. The situation is the same for telephone lines, which due to low density, has made acquiring telephone facilities a luxury to many factories and business establishment in Nigeria.

Policy issues: The study raised pertinent policy issues, which should be accorded priority attention for development. However, in drawing up these policy issues, we will be guided by the following critical success factors of ICT in Nigeria in particular:

(1) Government policies and strategies that support the ICT sector growth and competitiveness.
(2) Education and training programmes to build up the base of human resources. Investment should be long term.
(3) Fiscal policies, productivity level and quality of products to meet international standard.
(4) Flexibility in the public and private sectors — institutions to adapt to changes in markets and technologies.

This set of factors, according to Wellenius (1993), is of value in deriving the benefits of a modern electronic industry. The implications of these issues are critically examined as follows:

Government policies: have been found to act as catalysts in the adoption of information and communication technology in Nigeria. Only recently, the government blue print on economic development sought to achieve a teledensity rate of one telephone line per 1000 population and to increase electricity supply and coverage from its present rate of 30 to 60% by year 2003. These are important policy issues that should be implemented beyond physical provision alone; they must be made to be functional.

The study had shown that the adoption level for telephone in the industrial and service sectors is almost 100%, but the efficiency rate or utilization is by far less than 50% in most cases, as revealed by data analysis.

The physical facilities, that is, the gadgets and equipment have been installed, but the constant functioning of these facilities could not be taken for granted due to constant power outrages, equipment breakdowns and poor maintenance culture. In other words the non-reliability of electric power has grave consequences on ICT's full adoption to the level of its potential in the industrial and service sectors. Since the development of infrastructural facilities in Nigeria has always been the responsibility of the apex government, it is imperative therefore that government policy be directed at encouraging the reliability of electric power, to avoid total collapse of NEPA facilities in the country.

Adequate technical capability in the area of manufacture and maintenance of ICT components is another area that must be of utmost interest to policy makers. Telecommunication facilities in many states in the country are poor or non-existent and where available, they are obsolete. These situations are skill prevalent, because the rate of capacity building in these areas are equally poor and not taken seriously. It must also be noted that the present policy of upgrading and modernizing the existing telecommunication facilities will not lead to sustainable growth, unless backed with serious capacity building effort. A situation where capacity building is relegated to the background, and the desire to move along with the level of globalization, will only make the ICT sector in Nigeria perpetually dependant on the developed world for survival.

It follows therefore that a reliable power system and a feasible capacity building programme are some of the critical success factors in the high adoption of ICT in Nigeria.

Education and training programme: An essential element of development in any nation, is its level of literacy and the training opportunities made available to its citizenry. There is no doubt that a well-educated society will be a direct beneficiary of technology development. Empirical evidence had shown that the more educated societies have higher rates of technology adoption and diffusion than the less educated ones. The patterns of investment in education in such countries have also been noticed to be long term in nature and consistently at a reasonable level of GDP.

The point must be made again that qualitative education is very expensive and a long term investment requires the active involvement of the state. The state must lead the way by initiating policies that will encourage other operators in the economy to invest in both formal and informal education. Empirical evidence has also shown that there is presently a dearth of engineers and technicians relevant to the development of ICT components in Nigeria. In other words, there is need for concerted efforts to initiate a programme that will build to a comfortable level, the base of human resources in Nigeria. It follows again that development of education is a critical success factor in the adoption and diffusion of ICT in Nigeria. The shortage of trained and experienced managers to lead the introduction of complex and rapidly evolving technology will have limited effect on the progress in the sector.

Fiscal policies, productivity level and quality of products to meet international standard: The role of fiscal policies in encouraging increased consumption of ICT cannot be over emphasized. A fiscal policy of foreign exchange restrictions will adversely affect technology inflow and availability of imported raw materials and ICT accessories, majority of which are still imported. At the same time, a regime of free trade without regards to some protection for the local industries, will lead to dumping of goods and obsolete technologies and a greater tendency to discourage innovation. It is obvious that the low level of computer spending per GDP, (estimated at less than 0.5%), low telephone density and ridiculously low telecommunication investment per GDP, are some of the setbacks.

Installation of global service mobile communication (GSM) system into the country will not be worth all the efforts of the policy makers, unless the beneficiaries are ready to accept and utilize it. It must also be noted that, while the introduction of the GSM system is being considered here, a more efficient telecommunication system (CDMA) which is already in operation in other parts of the world, will find its way into this country as long as the demand for it exists. In other words, it could be said that the rate of adoption and diffusion of these new technologies would be a function of the attitude of the public and private sector operatives to the new technologies, as they emerge.

5.2 Policy focus

Policy focus should be targeted at the following listed areas, which have been identified as very critical and strategic to the successful and increased levels of adoption and diffusion of ICT in Nigeria. These issues are germane to the success and performance of ICT managers. They should also be focused on as follows:

(1) *Business management issues:* The focus will be to:
- attract and retain highly skilled people,
- operate within organizations and cultural norms, and
- improve ICT productivity.

(2) *Strategic and competitive issues (long range):* Focus will be to:
- provide leadership in technology application, and
- educate the management team about the opportunities and challenges surrounding technology introduction.

(3) *Planning and implementation concerns:* Focus will be to:
- provide effective communication channels, so that plans and variances are widely understood, and
- establish partnerships with other international organizations.

(4) *Operational items:* Focus will be to:
- deliver service on schedule and within planned cost,
- provide reliable and available customer service, and
- maintain a management process that aligns with operational expectations of ICT capabilities.

References

ADGC (1997). *The Nigerian Telecommunication Industry*. African Development Consulting Group, ADCG and Macrocon Systems Ltd.

Adeyinka, F. M. (1996). *An Exploratory Study of the Structure, Capacity and Capabilities of Electronic Firms in Nigeria*. Nigerian Institute of Social and Economic Research (NISER), Monograph No. 8.

Aiyepeku, W. O. (1992). "Developing Information Technologies in Africa", *Presentation to PAN/ NAN Monthly Forum*, Lagos.

Behan, K. and Holmes, D. (1990): *Understanding Information Technology*. New York: Prentice Hall.

Brown, R. (1983). "New Technologies in Communication: A General Description", *Media Development.* Vol. 30, No. 4.

Central Bank of Nigeria, CBN (1995). "Annual Report and Statement of Accounts" *CBN Report* Vol. 6 No. 1.

Deeson, E. (1987). *Managing with Information Technology*. London: Logan Page.

Domatob, J. K. (1991). "New Communication Technologies and African Culture: Preservation or Pulverization?" *CAEJEC Journal.* Vol. 3, pp. 60-73.

Dosi, G. et al. (ed.). (1988). *Technical Change and Economic Theory.* Pinter Publishers, London.

Drucker, P. F. (1992). "Where the New Markets are": *Wall Street Journal*, April 1992, A14.

Dunn, P. D. (1987). *Appropriate Technology: with a Human Face.* London: Macmillan Press Ltd.

Elsevier. (1996). *Yearbook of World Electronics Data,* Amsterdam: Elsevier.

Ernst, D., L., and Ganiatsos, Mythelka (1994). *Technological Capabilities. A Conceptual Framework.* Chapter 1 of Final Draft. UNCTAD, Geneva.

FOS (1986 - 1996). *The Nigerian Trade Summary*. Federal Office of Statistics, Lagos, Nigeria. ISSN 0078-0650.

Frenzel, C. W (1996). *Management of Information Technology:* Second Edition, CTI, USA.

Freund, B., Konig, H. and Roth, N. (1997). "Impact of Information Technology on Manufacturing". *Technology Management,* Mansell et al., eds. vol. 13(3), pp. 215-228.

Harvey, M. and Gavigan, J. (1996). "Agile Enterprises", *The IPTS Report*, Mansell et al., eds. vol. 3, pp. 14-19.

ITU (1998). World Telecommunication Development Report: *Universal Access: World Telecom Indicators,* ITU, Switzerland.

Jensen, M. (1996a). *Bridging the Gaps in Internet Development in Africa*, Mansell et al., International Development Center, Ottawa, 31 August (1998).

Mansel, R. and Wehn, U. (1998). *Knowledge Societies Information Technology for Sustainable Development:* Oxford University Press. New York.

Massingue Venacio. (1998). "ICT in Africa, A Critical Case in Point". *Conference on Science and Technology for African Development: Partnerships in a Global Economy*: The New York Academy of Sciences.

Odebiyi, T. (1998). *Impact of Computerization on the Finance Sector in Nigeria*. ATPS Project.

OECD (1996b). "Global Information Infrastructures - Global Information Society (GII-GIS): Statement of Policy Recommendations made by the ICCP Committee, Paris", OECD/GD (96)93. In Mansell et al., (1998).

Wellenius, B. (1993). "Electronics and the Developing Economies: Innovation and Overview". In *Developing The Electronics Industry: A World Bank Symposium.* Wellenius, B. et al., eds. Washington, DC.

ATPS Working Paper Series

No.	Title	Publication	Author(s)
1	The Effect of Economic Reform on Technological Capability		T. Adeboye M. S. D. Bafachwa O. A. Bamiro
2	Methodological Issues in Science and Technology Policy Research		T. Adeboye N. Clark
4	Rehabiliation in the Manufacturing Sector in Tanzania		S. M. Wangwe
5	Agricultural Policy and Technology in Sierra Leone		C. Squire
6	Effectiveness of Agricultural Research Extension in Sierra Leone		A. K. Lakoh
8	Generation and Utilization of Industrial Innovation in Nigeria		O. Oyeyinka G. O. A. Laditan A. O. Esubiyi
9	Irrigation in the Tuli Block, Botswana Water Conservation Techniqes or Optimal Strategies		I. N. Masonde
10	Endogenous Technology Capacity and Capability Under Conditions of Economic Policies of Stabilization and Structural Adjustment		S. E. Chambua
11	Technology and Female-Owned Business in the Urban Informal Sector of South-West Nigeria		R. O. Soetan
12	Technology Innovations Used to Overcome the Problem of Resource Scarcity in Small Scale Enterprises		C. W. Ngahu
13	Financing of Science and Technology Institutions in Kenya During Periods of Structural Adjustment		M. Mwamadzingo
14	Impact of Economic Liberization on Technologies in Enterprises Processing Agricultural Produce		P. Madaya
15	Technology and Institutions for Private Small and Medium Firms		B. Oyeyinka
16	Institutiona Reform, Price Deregulation and Technological Change in Smallholder Agriculture		E. C. Eboh
17	Adoption of Agricultural Technologies by Rural Women under the Women-in-Agriculture Program in Nigeria		D. S. Ugwu
18	Electrical Power Utilities and Technological Capacity Building in Sub-Saharan Africa		Brew-Hammond
19	Investigation into Factors that Influence the Diffusion and Adoption of Intentions and Innovations from Research Institutes and Universities in Kenya		Bwisa, H. M. and Gachui
20	The effects of Economic Reforms on the Quality on the Quality of Technological Manpower Development in Nigeria		H. E. Nnebe
21	Issues in Yam Minisett Technology Tranfer to Farmer in Southern Nigeria		Michael C. Madukwe Damain Ayichi Ernest C. Okoli
22	Technological Respone to Telecommunication Development: A Study of Firms and Instituions in Nigeria		Adeyinka F. Modupe
23	Gender Differences in Small Scale Rice Farmers' Access to Technological Inputs in Enugu State of Nigeria		David Nwoye Ezeh

24	Adoption of Sustainable Palm Oil Mini-Processing Technology in Nigeria	Nkechi Mbanefoh
25	Domestic Energy Situation in Nigeria: Technological Implications and Policy Alternatives	Olabisi I. Aina
26	Technological Capability in the Nigerian Leather Industry: A Firm-Level Case Study	Uka Enenwe, Enwere dike, Anthony Ihuoma, Mike Duru.
27	Agricultural Research and Delivery in the South-Eastern Highlands of Ethiopia: A Case Study of the SG-2000 Approach in Hitosa District	G. Yiemene
28	Impact of Computer Technology Adoption on Banking Operations in Nigeria	A. I. Odebiyi
29	Agricultural Technology Adoption on Small-Holder Farmers: Policy Policy Options for Nigeria	J. O. Olusi
30	Donor Funding and Sustainability of Rural Water Supply and Sanitation Technologies in Swaziland	Aja Okorie, M. Mabuza, U. Aja-Okorie.
31	Promotion of Production and Utilization of Ceramic Roofing Materials in the Informal Housing Industry in Sierra Leone	Tamba Jamiru
32	Technology Transfer and Acquisition in the Oil Sector and Government Policy in Nigeria	R.I. Chima E.A. Owioduoki R.I. Ogoh
33	Acquisition of Technological Capability in Africa: A Case Study of Indigenous Building Materials Firms in Nigeria	Yomi Oruwari Margaret Jev Opuene Owei
34.	Analysis of Indigenous Knowledge in Swaziland: Implications for Sustainable Agricultural Development	Musa A. Dube Patricia J. Musi
35.	Analysis and Comparison of the Agricultural Development Programme and University Agricultural Technology Transfer Systems in Nigeria	M.C. Madukwe E.C. Okoli S.O. Eze
36.	Extension Services and Enterprise Development: Study of Technology Extension Services to Small nd Medium Size Manufacturing Firms in Naiorbi	Frederick U. Ngesa Justus M. Ombati Milcah Mutuku
37.	Women and Engineering in Nigeria: Towards Improved Policy Initiatives and Increased Female Participation	A.J. Badekale
38.	The Gender Variable in Agricultural Technology: A Case of Rural Farmers in Machakos District-Eastern Kenya	Esther Njiro

KAJOGBOLA, DAVID OLA is Associate Professor at Nigerian Institute of Social and Economic Research (NISER),P. M. B. 5, UI Post Office, Ibadan, Nigeria.