

**Technological Response to
Telecommunications Development:
A Study of Firms and Institutions in Nigeria**

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Chapter One

Background to the Study

Introduction

The telecommunication sector has been identified as one, with a generic effect on almost all other sectors of the economy. In other words, the telecommunications function is a strategic one, and has linkages with other sectors. This is exhibited in several ways, through the facilitation of service supply on the one hand, and through its dependence on the products, information, knowledge and input materials from other sectors of the economy. The telecommunication sector is an industry at the center of the all-pervasive shift in techno-economic paradigm, which results in the widespread of a host of changes, (Freeman 1988).

Some advanced industrialized nations of the world owe their rapid growth to the early realization of the importance and provision of a good telecommunication sector, supported by the existence of capacity and capability in the private sector.

The research problem of this study attempts to understand the structure, capacity, and capabilities of telecommunication firms in Nigeria and their responsiveness to technological changes in the sector. The study proposes to examine the state of preparedness of the sector and the ways in which it is building up technological capability. This area of research has received little attention in Africa, and therefore needs to be explored.

The Research Problem

In Nigeria there are presently 0.7 telephones to 100 persons which is less than the International Telecommunication Union (ITU) stipulation of one telephone per 100¹ persons. This state of affairs makes urgent the need for private sector participation.

Empirical evidence from literature on some East Asian countries, India and Brazil brings

1. Compare with Japan, 64 per 100, USA 96 per 100, Taiwan 40.5 per 100 and Brazil 10 per 100 persons respectively.

into focus the difficult challenges of evolution that often follow liberalization of the telecommunications sector.

These include the transition from monopoly to multiple ownership, the idiosyncratic nature of technology acquisition, the differentiated paths from a rudimentary assembler to becoming a major exporter and player on the world scene, the differences in the nature of markets, firm strategies, patterns of investment and technological response from private sector electronic firms (Ernst et al (1992), Joseph (1989).

For many developing countries investment in telecommunications is based largely on imported and penultimate stage raw materials, and seems attractive because of their limited access to the high technology content and involvement, low capital costs, quick returns and low technical skills requirement (Joseph, 1989). Simon (1993), Frischtak (1993), observe that the way in which the state intervenes to promote the development of the industry will determine the real direction and ultimate success of liberalization, and perhaps change the structure of the sector. Much of the investment by the private sector has been in the areas of enhanced services and products.

The research problem in the context of Nigerian telecommunication development is put as follows:

- What, if any, has been the response of Nigerian firms to liberalization in the telecommunication industry?
- What is the intensity of this response? Is it strong or weak? For example, firm A that commits x million dollars to install a private network is considered to elicit a relatively strong response than another firm with equal resources that is waiting for more government incentives.
- What is the nature, and direction of this response? For example, are firms supplying parts (such as handsets, telephone poles, cables and software programmes). Are firms simply importing or are there any involved in manufacturing or assembly?
- What are the kinds and levels of technological capabilities presently found in the sector? What are the ways, if any, in which firms are acquiring technology?
- What is the magnitude of modernization and expansion programmes in the sector? Does it create opportunities for indigenous firms to invest in forward and backward linkage activities?
 - In particular, what is the content of the public sector telecommunication firm's (NITEL) investment programme?
 - What is the technology strategy of NITEL? Does NITEL technology strategy preclude or facilitate indigenous firm participation?
 - How receptive is NITEL to liberalization and competition? How competently has it articulated its position to potentially responding firms?

Research Objectives

The overall objective of this study is to examine the innovative behavior and technological response of telecommunication firms and related institutions in Nigeria. In particular, the study proposes to understand the ways in which liberalization of the sector has been able to elicit responses from the demands of both private and public sector firms.

Specific Objectives

The specific objectives of this study are:

- (i) To examine the extant structure, capacity, and capabilities of all identified telecommunication firms and related institutions so as to provide baseline information on the sector.
- (ii) To highlight the response dynamics and strategies of selected firms as a result of market and technological challenges. What is the nature of response and how competently are firms dealing within the changing and competitive environment of telecommunications?
- (iii) To examine institutions and government policies set for the development of the sector.
- (iv) To suggest policies to promote the development of inter-firm, intra-firm and of technological progress within the telecommunications sector.

Expected Results and Impact

The expected results and impact of the study are:

- i) To provide a starting point for accumulation of data for better understanding and more critical research questioning in the future.
- ii) To point the way to a direction for long-term planning for telecommunications development.
- iii) To inform decision-makers in government, and hopefully influence the nature and direction of policy-making for good.

Chapter Two

Conceptual Framework

Introduction

The telecommunication sector is among the world's fastest growing sectors but this is not the main reason why it is important. What marks out the sector are the phenomenal ways in which it has radically changed hitherto, "traditional" industrial sectors, altered cost structures of production, and redefined quality and productivity standards. Products of the telecommunication sector have found pervasive "functional inclusion" in virtually all other sectors but nowhere has this inclusion been as profound as it is in data processing and communications. Presently 50 percent of global electronics equipment is in data processing and communications. For Wellenius (1993), "telecommunications is the enabling technology of the information economy".

Application and use of telecommunication continue to fundamentally change the root of modern economic development in the same way that low cost steel, coal and steam-powered transport did in the past. This makes the telecommunication "revolution" qualify for what Freeman and Perez (1988) termed a "techno-economic paradigm", which they referred to "as a combination of inter-related products and processes, technical and organizational and managerial innovations, embodying a quantum jump in potential productivity".

What distinguished a new paradigm, apart from the cluster of new products and systems is the dynamism of the relative cost structure of the sets of inputs which Freeman and Perez (1988) described as the "key factor". These inputs must satisfy the following conditions:

1. Perceived low and rapidly falling relative cost;
2. Almost unlimited availability of supply over long periods; and
3. Potential for the use or incorporation of the new key factors in many products and processes throughout the economic system.

2.. In this context "a paradigm is defined as a radical transformation of the prevailing engineering and managerial common sense for the best productivity and most profitable practice, which is applicable in almost any industry".

Technological Response: A Framework

Lall (1989), Bell and Pavitt (1992), Ernst et al (1994), Hobday (1995) are some of the few studies that have provided empirical evidence on the subject of technological responses at firm-level in selected sectors of Newly Industrializing Countries (NICs). The study by Hobday (1995), for instance, shows how East Asian countries through technological response in an increasing number of industrial areas mastered modern manufacturing processes, started to design new products and created distinctive new organizational forms to compete in the international market. These responses are traced to a solid historical foundation of learning. Ernst et al (1994) discusses in great detail a six- stage-learning model that is employed in measuring technological responses of firms. The model comprises the development of a broad range of technological capabilities, which include production, investment, minor change, strategic marketing, linkage, and major change capabilities. *Table 2.1* shows a hypothetical typology of potential technological response segments in the telecommunication industry.

Table 2.1: Hypothetical Typology of Potential Technological Responses Segments in the Telecommunication Industry

Switching transmission	Nerve centre of public network (local, trunk, transit and international) gradual shift from analog cable and microwave and frequency division multiplex (FDM) to digital fibre optics, fiber systems, digital microwave and PCM multiplex equipment
Customer precise equipment (CPE)	PBX, KTS. Users now purchase directly and cheaply. New features such as least-cost routing, automatic call distribution and call accounting enable users to save on traffic changes and to maintain service
Cable links	Copper cable still in use but fiber optics is the new choice of growth market
Data communications and Value Added Services (VAS)	Fast growing segment. Fuelled by rapid proliferation of personal computers (PCs) in offices and especially banking automation networks (LAN and WAN) electronic mail, video-text, voice mail, electronic funds transfer services (EFTS) Value Added Networks (VANS)
Mobile telephony	Fast growing segment. New products all the time

KTS = Key telephone systems

PBX = Private Branch Exchange

PCM = Pulse Code Modulation (the basic technique for encoding information in digital form)

LAN = Local Area Networks

WAN = Wide Area Networks

Source: Adapted from: Ambrose W. W. (1993). "Telecommunications Equipment Markets into the 1990s." In *Developing the Electronics Industry*. Wellenius et al (eds). A World Bank symposium.

The present study recognizes the crucial importance of the telecommunication sector in economic and social development of any economy and also notes that private firms are now key players in the Nigerian telecommunication sector. The successes of these firms will in the long run reflect the sector's competitive strength. Among the factors that determine this strength include:

- The general economic and financial environment;
- The availability of technological capabilities to generate and manage technological changes;
- Availability of infrastructure support.
- Incentives (appropriate policies, institutions etc).

This study adopts a framework, which will allow a measurement of technological response as follows:

i. Stimuli

What forms or conditions the technological responses of firms?

- What is the stimulus from an external source, for example, developments in the technology frontier or international standards?
- Is it from internal sources, such as the macro-economic environment - the effect of policy dynamics, competition in the market, technical bottlenecks?

ii. Response

What exactly is this response? Can it be quantified?

- Is the response an "offensive" or "defensive" strategy? Static measurements of response at the firm level often include firm profit figures, capacity utilization and sales figures. However a more dynamic method for measuring technological response at firm level is to show "learning" is indeed going on (the Ernst et al model).

iii. Output

As a follow-up to the response identified, what is the effect on the firms' competitive ability?

- Is there a move to a new line of product?
- Are there prospects of export competitiveness?
- Is the firm retraining personnel?

The Incentive System for Telecommunication Development

The Incentive System is a set of external factors that seeks to have a strong bearing on the ability and extent to which firms are willing and able to invest in the acquisition and diffusion of productivity-enhancing activities (Ernst et al 1992).

These factors include three elements:

- (i) Policy dynamics (impact of specific policies on specific actors at a particular time)
- (ii) Market forces (size and nature of demand, competition patterns)
- (iii) Historical practices of firm (Tradition).

Brazilian and Korean telecommunications provide evidence on how the incentives provided through policy objectives interacted with market and firm histories. For example, CPqD³ in Brazil gave local firms a strong research and development support by transferring

3. The Brazilian Telecommunications Institutional Infrastructure for Research and Development

the products it developed to industrial firms for large-scale production. This strategy follows from the Brazilian telecommunications policy, which defined its primary objectives as the mastering of emerging technologies and development of core capabilities. It is in this respect that Mytelka (1994) argued, “to the extent that local firms consciously set out to master capabilities of a new technology, the process of technological development, *and indeed technological responsiveness* would accelerate (emphasis mine.)

Hypotheses

Following from the framework for thinking technological response, and the incentive system, this study has as its guiding hypotheses the following:

- (i) The technological response of a firm will tend to reflect the type of technological capability it acquired over time through learning, and hence the kinds of efforts and strategies pursued by the firm.
- (ii) The incentive system constitutes a significant source of influence in determining the technological response of telecommunication firms in Nigeria.
- (iii) The speed of technological response by telecommunication firms depends to some extent on the support and capabilities of regulatory institutions.

Research Methodology

Data Collection

The use of primary and secondary data was employed in this exploratory study. Secondary data source was sought from extensive library and desk research.

Some of the secondary issues revised included:

- Structural aspects of telecommunication firms (size, capacities, employment, complexities of technology etc).
- Inter-industry and inter-firm linkages.
- Institutions supporting growth of telecommunication firms.
- Technological learning and accumulation of technological capabilities.

Sources of primary data included Nigerian Telecommunication Limited (NITEL), Nigerian Communication Commission (NCC), Association of Telecommunication Companies in Nigeria (ATCON), the Centre for Adaptation of Electronics Technology (CAT) and selected private sector telecommunication firms for detailed survey.

NITEL is the government body responsible for telecommunications development in Nigeria. NCC is the government regulatory body in charge of telecommunications deregulation, while ATCON is the umbrella association of multinationals and indigenous private telecommunications firms in Nigeria. CAT has the mandate to accelerate the rapid development of the industrial base of Nigeria in electronics and other related fields, and therefore make the country less dependent on imported finished products. CAT was visited in this study to examine the role the centre can play in the innovative process of telecommunication development. These institutions were visited to conduct in-depth interviews with key personnel and to reveal the impact of the institutions on telecommunications and electronics development.

At firm level, a sample of ten ATCON firms was selected to serve as case studies. The choice of the ten survey firms was based on a number of parameters, which came up in the course of the study. In-depth interviews were conducted with relevant personnel at firm level to shed light on firm strategies and technological responses to developments in the sector. Some of the indices considered included:

- i) Historical data of firm.
- ii) Type of and channels of technology acquisition.
- iii) Activity profile
- iv) Research and development capability.
- v) Linkage activities with other firms in the sector.
- vi) Impact of government policies on firm performance.

Data Analysis

The bulk of the data derived from the study was quantitative in nature. This was analyzed in a simple manner using the computer to assist presentation and collation of research findings. Where necessary, tables and figures are used to explicitly capture the required information. The research questions raised in the research problem were provided with answers and the conceptual framework of the study was also linked to the analysis of research findings.

Chapter Three

Literature Review

The Interplay of Electronics and Telecommunications

By general definition the electronics industry consists of a number of product groups. Mody (1987) groups electronic products into four categories in terms of technology and scale levels, namely, advanced, skill intensive, medium technology and low technology. Joseph (1989) divides them into two categories on the basis of technical specificity: equipment and components. He further divides the two categories into three product groups.

- (i) Consumer electronics
- (ii) Professional electronics
- (iii) Components.

The professional electronics product group comprises telecommunication, defense computers and control instrumentation. Wellenius (1993), observes that technological innovations in electronics have brought about cost reductions in equipment. This new cost structure is sustained by high sales volume.

Functional inclusion of electronics components in telecommunication industry not only defines the competitiveness of the industry but also shapes the character of electronics itself. Functional inclusion also creates difficulty in arriving at clear product categories because families of products, which may be viewed as distinctively homogenous, are found scattered among other categories. Also because of the rapid changes in technology and markets, there tends to occur migration across categories. Typical is the increasing convergence of computers and digital telecommunications technologies "leading to a new generation of portable capabilities" that do not belong to either computers or telecommunications. Previous specialized telecommunication equipment (facsimile, machines and computer sets, for instance) is now regarded as consumer electronics sold in supermarkets.

These events have led to a fragmentation of the previously protected market of suppliers, to new market niches and changes in the pattern of product distributions. In addition to these basic structural changes, electronics has impacted on telecommunications in a number of

other ways by altering the cost structure, size of products and processes, capacity of information transmission, as well as operation and maintenance regimes.

The interplay of factors between electronics and the telecommunications sector is summarized as follows: (Ambrose, 1993):

- Cost - greater integration of electronic components allows telecommunication equipment to function effectively at reduced cost;
- Size - digital electronic switching exchanges that are the size of a modern refrigerator can now handle what once required a whole room full of older electromechanical equipment;
- Capacity - a greater volume of information can be transferred more rapidly through the use of digital technologies;
- Operation and maintenance - software control of remote computer-controlled equipment can be easily integrated with the telecommunication network.

Technological Trends in the Telecommunication Network

The telecommunication network consists of three basic components according to function: switching, transmission, and peripheral and terminal components:

- i) *Switching* or exchange equipment represents the technological heart of the telecommunications system, performing the central operating function of connecting calls within and between networks. Large capacity public exchange constitutes the bulk of the equipment, with the private automatic branch exchange (PABX) market growing rapidly.
- ii) *Transmission* equipment is responsible for carrying the signals between exchanges and terminals and includes paired wires, coaxial cables for long distances, microwave radio, satellite systems, VSAT, and more recently fiber optics.
- iii) *Peripheral* equipment is responsible for sending and receiving signals, and includes a wide range of terminal devices from simple telephone handsets to sophisticated multifunction intelligent terminals, e.g. modems and faxes.

Two major exchange systems, still in widespread use in the developed countries are the Strowger and Crossbar. Strowger exchanges comprise large banks of rotary switches connected in series, and until very recently were still being installed in some OECD countries despite being technologically obsolete. The Crossbar system is used as an intermediate technology between Strowger and fully electronic exchanges. Analogue electrical signals are transmitted between the main exchanges through media such as coaxial underground and undersea cables, and then routed to subscribers through paired wires.

Today, almost all current equipment production has shifted to digital microelectronic technology. This is due largely to two reasons.

- (1) the greater speed, efficiency and capacity of digital systems, combined with steadily declining costs.
- (2) the increasing demand for new IT services, which depend on digital, telecommunication networks.

The general acceptance of the superiority of digital over analogue electromechanical exchanges is gradually leading to the replacement of Strowger and Crossbar systems in both developed and developing countries. Digital exchanges are solid-state (no moving parts) which means they are less susceptible to breakdown and require less maintenance than

previous technologies. Advances in semiconductor technology have led to steadily declining real prices, and large capacity public exchanges are now cheaper than similar analogue units.

Table 3.1 presents estimates of the research and development costs for digital exchanges incurred by the leading manufacturers. Although the costing is very approximate they indicate the enormous dimensions of these investments in technology. The costs range from \$0.5b to \$1.4b (11 billion - 23 billion Naira).

Table 3.1: Estimates of Research and Development Costs of Digital Switching Systems (\$b)

Company Name	Headquarters	System Name	\$b Cost
ITT	U.S	System 12	1.01
Ericsson	Sweden	Axe	0.50
CIT-Alcatel	France	E10 and E12	1.00
Northern Telecom	Canada	DMS	0.70
GEC/Plessey/BT	U.K	System X	1.40
Western Electric	U.S	ESS-5	0.75
Siemens	Germany	EWS-D	0.70

Source: Dang Nguyen (1985). "Telecommunications: A Challenge to the Old Order" in M. Sharp (ed) Europe and the New Technologies. Frances Pinter. London.

A further major driving force for the adoption of digital exchanges is their key role in the provision of IT services. The expansion of many information telematics⁴ services, and the objective of many countries to provide the so-called ISDN (integrated services digital networks), depends crucially on the installation of digital switching. Modern exchanges are capable of simultaneously processing large volumes of voice, data, text and other forms of information in digital format at great speed and low cost.

Effect of Liberalization on the Telecommunication Industry

The decade of the 1980s was a decisive period in reshaping the technology and institutional basis of the telecommunication industry. The industry, which had existed for over a century, provided primarily a two-way voice conversation function. This function was evidently defined by the technological capacity available to the sector. With the coming of age of electronics (notably the convergence of computers and communications technologies) there emerged deep-going changes in the technical concepts and organization of providing information⁵. Hitherto, government monopolies provided telephone services while telephone

4. Telematics. Also known as tele-informatics and represents all those services based on digital technology which process data and employ the public telecommunications network for switching and transmission. Telematics is made possible by the fusion of computer and telecommunications technology around micro-electronics.

5. What in broad terms facilitated the convergence is the transition from transistors to integrated circuits (ICS). In the early 1960s, a score of transistors on a "chip" the size of a fingernail was considered remarkable advance over discrete components (transistor). Presently, hundreds of thousands of transistors on a chip has

equipment suppliers served public utility companies referred to generally as the post, telephone and telegraphy (PTT) ministries or agencies. The industry was in the main vertically integrated, while technological evolution had been incremental much of this time.

With deregulation and competition, the new socio-economic regime led to a multiplicity of customers, and the introduction of new services and products. Control of technology shifted from operating companies to equipment suppliers, while state monopolies and control gave way to liberalization and new structures of ownership. Clearly a lot of buying power has shifted from state utilities to end-users albeit in differing degrees across countries. Apropos of these shifts, users are demanding lower costs, greater capability to handle data, video, voice, and greater ability to manage own networks (Ambrose, 1993).

Technological Capability in Developing Countries

Three broad typologies of countries within the developing countries bloc have been identified:

- (1) Newly Industrializing Countries (NICs) comprising South Korea, Singapore, Hong Kong, Taiwan, Thailand and the Philippines.
- (2) Another group of (NICs) - the larger developing countries comprising Brazil, India, Mexico, China, and to a lesser extent Pakistan.
- (3) Middle-size and including oil-rich developing countries in Latin America, Asia, 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, components and peripherals. They also possess research and development capabilities in microelectronics and semiconductors. Brazil has considerable capabilities in telecommunications infrastructure. However, in the third group of countries, while there is little in terms of innovation and production capabilities, there is a significant penetration by, and adoption of a wide range of, computers and telecommunication usage capabilities in the different sectors of the industrial economy.

The success stories of Newly Industrializing Countries (NICs) notably South Korea, Taiwan, and Singapore in East Asia as well as Brazil and to a lesser extent, India, in developing their telecommunication sectors is now fairly well documented: Joseph (1989), Hobday (1995), Mody (1992), Frischtak (1990), Ernst et al (1992) and Boltheho (1992). A more recent study by Ganiatsos, Ernst and Mytelka (1994) examines the factors behind the export success of six Asian countries including "second-tier" NICs such as Thailand, Malaysia, Indonesia and Vietnam. The study in very broad terms examined the origin, timing and technology strategy of successful electronic firms among others at macro-level, and the incentive system that might have fostered or hindered technology acquisition. Some of the main conclusions arrived at in the study of the six countries, among others:

- That the electronics industry had no indigenous root in those countries and therefore had to be imported in the late 1950s in Korea and Taiwan. The second tier countries came later.

become commonplace - with millions of element chips. In effect, vast amounts of information can now be stored coupled with mass production of chips and the attendant fall in prices. Fiber optics technology has brought more dramatic gains. No thicker than human hair, a pair can give tens of thousands of telephone circuits with several pairs in a cable giving over fifty thousand telephone circuits.

- It was a number of small local traders that first imported electronics and electrical appliances and components through which they acquired marketing and managerial experiences in repairs, maintenance and subsequent local assembly of the products, and linkage to the telecommunication sector.
- The timing and sources of technology differ for all the countries, while some encouraged export early, others pursued protection for much longer.
- Different technology strategies were used; in the second-tier NICs, foreign investment rather than local investors established the first assembly lines to produce mainly consumer electronics and electrical components. The Chaebols⁶ were the key players in S. Korea and their initial strategy was to master the production, investment and minor change capabilities for large, mass production lines for standard products.
- While S. Korea and Taiwan pursued an effective sequencing strategy, Brazil and India had no such policy. For this reason downstream electronic sub sectors did not develop adequate production scales.
- Both India and Brazil also have weak components base and weak institutional linkages between the sub-sectors. For instance the computer and components sub sectors in Brazil grew apart from each other, Mody (1992).
- Cost competitiveness had been mostly affected by product sequencing, market segments (export and domestic) degree of competition and institutional development. Volume of sale, (in particular Korea) has equally been a strong factor.
- After liberalization in Brazil, new kinds of partnership emerged in form of commercialization agreement, technology licensing and joint ventures.

From the above review on telecommunication development, the concept of technological capability can be defined to “consist of the resources needed to generate and manage technical change including skills, knowledge, experience, institutional structures and linkages” (Bell & Pavitt 1993). It becomes clear that the process of technical change is a dynamic one and requires explicit investment in technological capabilities (Ernst et al 1994). For acquiring these capabilities, a learning process is often a prerequisite. Learning however, requires explicit efforts and tends to demand from firm management, major investments in the build up of human capital. Following from this, technological response of a firm will tend to reflect the type of technological capability it has acquired over time through learning, and hence the kinds of efforts and strategies pursued by the firm.

Two components of knowledge (derived from learning) often manifest:

- (i) Technical and general knowledge about the system of production - often obtainable from codifiable items such as blueprint brochures, schedules, contractual agreements etc.
- (ii) Tacit knowledge about the system of production. This is knowledge acquired as a result of continuous operation of the system. Tacit knowledge is firm specific, non-tradable and relies on the learning processes. It ensures the essence of competitive advantages of firms.

For most developing countries, the sources of technological knowledge remain outside their borders, and as such international technological transfer arrangements (either through joint ventures and licensing) remain important sources. Foreign direct investment (FDI) is

6. Chaebols are big business conglomerates in South Korea (Samsung, Daewoo, Goldstar)

another source. The high technology content of electronics explains why FDI and joint ventures have been starting points for technological capability accumulation by electronic firms in many of the East Asian countries. These arrangements enabled foreign firms to act as demonstrators for local firms to imitate, while also giving assistance to local firms through subcontracting and licensing

Baptista (1994) observes that some of the effects of contractual arrangements are not always "positive". Some of these include:

1. Control of technology assets by foreign firms through wholly owned subsidiaries or in association with local capital;
2. Emergence of 'lean' de-verticalized firms with greater volume of sales coming from *software* services and commercialization of foreign-produced goods as opposed to manufacturing;
3. Decreasing local value;
4. Increased emphasis on user-producer relations;
5. In telecommunications, liberalization opened the entry to some consumer goods (telephone and facsimile machines) of lower quality than those locally produced.

To be active participants in the liberalized telecommunications market, a number of proposals have been made. These include the following:

- a) Investing in state-of-the art telecommunications infrastructure and discarding obsolete switching gears and wire-lines for satellite radio and wireless equipment;
- b) Breaking the monopoly and inefficiency of the traditional post and telegraph (P & T) parastatals by subjecting them to competition through licensing of international simple resale (ISR) operators;
- c) Separating the regulatory functions of the P & Ts from their operational functions;
- d) Opening infrastructure development to free competition, rather than clinging to government monopoly of these in the face of stringent budgetary constraints;
- e) Unrestricted and complete interconnection of both networks and services;
- f) Seeking uniformity in standards to eliminate proliferation of standards in equipment and peripherals, and
- g) Making deliberate and concerted effort to radically improve the availability and reliability of electricity supply, which is the most important vehicle to carry telecommunications to more users.

Chapter Four

Research Findings

Introduction

Development efforts are often context-specific as demonstrated by lessons from the telecommunication sector of the Newly Industrializing Countries (NICs) [(Ernst et al (1994), Amsden (1989)]. Wellenius (1977) gives an in-depth analysis of cases across the African, Asian and Latin American continents. In some of the countries governments provided support in explicit manners, for example, through subsidized credit, and government sponsored technical institutions which acted as conduits for the transfer of technology to local firms, consequently in the catalytic development of technological capabilities by these firms.

In general terms, government support would include the provision of appropriate legal frameworks (policies) on the one hand, and the setting up of appropriate institutions (agencies) on the other. Djeflat (1997) discusses government support for science and technology development in a study comparing Asian and African experiences. The legal framework is often a neglected aspect in many LDCs, but the East Asian case was different. The legal framework was accorded utmost importance, while the setting up of relevant agencies to direct the management of science and technology in very broad terms was taken seriously. For instance, the Korean Institute of Science and Technology (KIST) was set up to serve as the core research institution and supporting agency for the development of industrial technologies. Explicit policies and plans were also put in place. An outstanding feature of Asian institutions was autonomy, while receiving funds from the government. It is on record that the outstanding performance of KIST over the last decade assisted the development of technological capabilities at firm level and also promoted the creation of other research institutions following the same model of organization.

Bearing in mind that the success stories of other countries while containing important lessons cannot be readily replicated, the next sections in this chapter give detailed research findings on telecommunications and electronics development in Nigeria.

The management of telecommunication development in Nigeria is at three major levels:

1. Policy – Ministry of Communications
2. Regulation – Nigerian Communication Commission
3. Carriers and Operators – Public⁷ and Private⁸ investment.

This chapter highlights macro-level research findings from institutions representing the public sector investment (NITEL) and private sector initiatives in Nigeria (ATCON). The Nigerian Communications Commission (NCC), which is the regulatory body for telecommunication investment in Nigeria, is also examined. The Centre for (Electronics) Technology (CAT) located in Eastern Nigeria is studied to examine its potential for growing to collaborate with, and support telecommunication investment in Nigeria. Micro-level findings of ten private telecommunication firms are also highlighted.

Public Sector Telecommunications Investment

Telecommunications existed in Nigeria since 1851 in the form of a functional postal unit under the colonial British Postmaster General. By 1885 the Post and Telegraph (P & T) was constituted into a semi-commercial entity by Decree 22. The external arm of Nigeria's telecommunication came into existence in 1896 when the African District Telegraph (ADT) and Cable and Wireless Company (CWC) of London installed a submarine cable jointly. Two years after independence in 1962, the Nigerian Government acquired 51 percent equity share in the external services. Ten years after, the Nigerian Government acquired the remaining 49 percent share, leading to a restructuring of the company. A change of name was thereafter effected to Nigerian External Telecommunications (NET) and its function redefined to provide external services to its new owner, the Nigerian Government, after which the industry became a full state monopoly with two separate entities, the P & T and NET. In 1984, a merger was effected and the Nigerian Telecommunications Limited (NITEL) came into existence.

Nigerian Telecommunications Ltd (NITEL)

With the establishment of NITEL, the objectives of the industry were defined as follows:

- i) To increase the number of telecommunication lines;
- ii) To produce locally some of the telecommunications equipment;
- iii) To provide efficient and reliable telecommunication services;
- iv) To improve the image and revenue base of NITEL;
- v) To domesticate maintenance and management functions of NITEL; and
- vi) To improve the accounting and billing system of NITEL.

The 1986 reform exposed NITEL to greater competition and demanded of the organization greater level of service delivery. Specifically, NITEL was scheduled for commercialization⁹ as different from privatization. With reform came greater investment in modern technology.

7. NITEL had been the government/state monopoly until 1992 when the sector became liberalized

8. The private sector in this study focuses on ATCON – the umbrella group of registered telecommunication firms in Nigeria

9. Commercialization in the Nigerian programme means full or partial stoppage of government recurrent expenditure provision. Investment capital can still be provided or guaranteed by the state.

NITEL invested heavily (relative to its previous profile) in digital telecommunications. In addition to the economy-wide reforms that came with initial SAP and other subsequent changes, such as the revocation of the Nigerian Exchange Controls ACT, liberalization of the foreign exchange and financial markets, liberalization of imports and so on, government has carried out the following:

- (i) the content of NITEL commercialization; NITEL is charged with the overall mandate of ensuring telecommunications development in Nigeria. NITEL was incorporated as a private limited liability company in 1985. NITEL was one of the eleven public enterprises slated for commercialization in 1988. The definition of a commercialized enterprise meant the reorganization of such enterprise in a profit-making manner, to generate enough revenue to cover operating expenses and capital expenditure.
- (ii) establishment of a communications regulatory body, the Nigerian Communications Commission (NCC). The NCC was formally inaugurated in July 1993, and operates as an autonomous corporate body. It maintains close liaisons with the Ministry of Communications, which retains the role of policy making and frequency co-ordination.

Manpower Structure of NITEL

The status¹⁰ of NITEL as a fully commercialized entity resulted in a positive transformation of its organization, structure, and a well-defined scheme of service. This scheme of service identifies a clear job definition for workers.

NITEL operates a three-tier organizational structure - *corporate headquarters* (now located at Abuja - the Federal capital territory), five *zonal* and 32 *territorial*. The administration of NITEL is controlled by an executive board, which has the Managing Director/Chief Executive as Chairman. *Table 4.1* gives a breakdown of the manpower structure in NITEL between 1992 and 1996.

Table 4.1 Manpower Structure of NITEL

Manpower Structure	1992	1993	1994	1995	1996
1. Total Workforce	15,800	15,096	15,000	14,800	14,250
2. No. of Engineers	500	500	480	450	450
3. No. of Expatriates	-	-	-	-	-

The data in *Table 4.1* shows a gradual reduction in the total number of employees within NITEL between 1992 and 1996.

Source: Field Survey, 1997 (NITEL's PRO)

10. NITEL's status as a Plc was reversed in early 2001 to a limited liability company. The reason given is that NITEL is not quoted in the stock market and government has 100 percent equity.

The main reasons are given for these trends are:

- i) Digitalization of exchanges which resulted in laying-off some categories of employees, particularly in the administrative sections.
- ii) The de-regulated environment of telecommunications which resulted in the brain drain of staff to the private sector.

Our survey revealed that NITEL has maintained over the years a constant engineering workforce of three percent to total employees between 1992 and 1996 emphasizing the role of the electronic and telecommunication engineer in hi-tech investment. The workforce has been devoid of expatriate participation in the past five years. Analysis of occupational distribution of staff for 1993 show that 9,028 (60 percent) were operational staff (engineers and technicians), while the remaining 6,068 (40 percent) were support and administrative staff. NITEL places value on "continuous learning". NITEL has two training schools, a management school in Kano and a technical school in Lagos. As at 1993, a total of 4,133 staff had participated in overall training programmes. Out of this number, 2,232 (54 percent) were management trainees, while the remaining 1901 (46 percent) participated in in-plant technical programmes. In the same year, 34 personnel were sponsored to participate in courses, seminars and factory tests outside Nigeria.

Services Provided by NITEL

The telecommunication services provided by NITEL include:

- i) Telephony
- ii) Telex
- iii) Telegraph
- iv) Leased circuit, specialized and other services
- v) Data transmission

Table 4.2 shows the market segments for some of these services in Nigeria. As can be seen from the table, telephone is the most active service provided by NITEL. Also the special business subscribers and the special institutional customers are the major clients of NITEL's services. This trend is attributed to the following reasons:

- i) Telephone service has always been NITEL's initial mandate;
- ii) The high cost of telephone service makes it exclusive commodity for those who can afford it. However, the recent introduction of payphones at strategic locations through special business and/or institutions is gradually widening access to telephone services, and extending the use to a larger market, although cost of telephone is still relatively high.

Table 4.2 Market Segments for Various Telecommunications Services of NITEL

Market Segment		General Private Subscriber	General Business subscriber	Special Business Subscriber	Special Institutional Customer
Example of Service					
Public Service Special service	Telephone	X	X	X	X
	Telex		X	X	X
	Telegraph	X	X		X
	Data services			X	X
	Facsimile		X	X	X
	Wide Area Services		X	X	X
	Private line		X	X	X
	Private switched services			X	
	Digital Data			X	X
	T.V. & Radio transit				X
	Special customer application			X	X

Source: NITEL, 1996.

Revenue Generation in NITEL

Table 4.3 shows that the telephone segment of the sector generated the highest percentage of revenue over the years; with a gradual decline in particular in telegraph services. Following the partial commercialization of NITEL in 1992, the concurrent revision of tariffs, and the deregulated environment of telecommunications, there was a marked increase in 1993 revenue from 3,394 to 10,353 billion naira, which was maintained for the year 1994, to increase again to approximately 19.6 billion naira by 1995.

Deregulation of the sector increased the number of business ventures that depend on telecommunication services for effective operations. Thus one can safely assert that following the partial commercialization of NITEL in 1992, and the concurrent revision of tariffs and the liberalization of the sector, there has been a marked increase in revenue.

Table 4.3: NITEL's Revenue from Telecommunication Traffic (1992-1995 (billion Naira)

Major Source	1992	1993	1994	1995
Telephone	2.932	9.823	6.012	16.98
Telex	0.172	0.28	0.543	0.19
Telegraph	0.237	0.032	0.009	0.002
Others*	0.053	0.212	3.74	2.232
Total	3.394	10.353	10.309	19.477

Source: ADCG Database 1997

Note: * "Others" include foreign traffic, cellular, leased circuits and other traffic debtors.

Evidence of Expansion of Telephone Lines

The number of telephone lines available in 1980 was 169,000 growing modestly to 202,000 (1982), 244,000 (1984), and 265,000 (1986). Currently the nation's telephone network stands at about 600,000 lines, expandable to 950,000 but only about 400,000 lines are actually connected to subscribers. With reference to industrialized economies as models, there is a clear, almost functional relationship between the wealth of a country, and the telephone density. The current Nigerian teledensity is approximately 0.7 (NCC, 1996). *Table 4.4* shows the accomplishment of a cumulative percentage change of about 19.5 per cent and an increase in teledensity from about 0.17 to 0.70 in 16 years. This is however yet to meet the ITU stipulated teledensity of 1:100 persons.

We note that deficiency in telecommunication lines, while it translates to some form of imbalance in the development process, could also afford the opportunity to leapfrog¹¹ older vintages of telecommunication infrastructure. It could also afford the opportunity to attempt to catch up with advanced economies by concentrating investment in newer vintages, and movement towards a multi-actor participation in the sector. *Table 4.4* gives the data on telephone lines.

11. Leapfrogging is consistent with Schumpeter's notion of gales of creative destruction, where radical innovations give rise to opportunities of investing in new technologies, with a spectrum of learning activities. The current deregulated environment of telecommunications investment in Nigeria could allow for this.

Table 4.4 No. of Telephone Lines (1980-1996)

Year	Total Number of Telephone Lines	Tele-density %	% Growth Rate
1980	169,000	0.169	
1982	202,000	0.20	19.5
1984	244,000	0.24	20.8
1986	265,000	0.26	8.6
1989	385,800	0.39	45.6
1990	404,190	0.40	47.7
1991	450,516	0.45	11.5
1992	600,000	0.60	33.2
1993	634,750	0.63	5.8
* 1996	700,000	0.70	10.3

Source: (1) NITEL News (Various Issues)

(2) NCC (1996)

* PRO (NITEL)

Technological Capabilities of NITEL

The public switched telephone network was originally established to carry voice traffic (Plain Old Telephone) but is increasingly being used to carry data traffic.

Data communication allows for the expansion of the range of services to include value-added ones such as electronic mail, database access, and protocol conversion which allows different computer languages to communicate. Over the years, there has been a number of distinct generations of telecommunication networks, with each succeeding generation making improvements in terms of operation, maintenance, economics and functionality. *Table 4.5* gives the taxonomy of telecommunication network generation.

Table 4.5 Taxonomy of Telecommunication Network Generation

Generation of Network	Remarks	Communication speed
First	Analogue exchanges	9.6 kb/sec
Second	Analogue, combined with digitalized exchange	64Kb/sec
Third	Complete digitalized exchanges	40 - 140 mb/sec
Fourth	Network based on broad-band transmission (Option-option) micro-waves	02mm

Source: Akinbinu (1997). *New Improved Technologies and The Performance of Nigerian Telecommunications*. Unpublished Individual Research Project. NISER.

NITEL's technological capabilities are located within the first to third generations of network, with some minimal efforts gradually finding place in the fourth generation.

In the last one decade NITEL's technological changes can be summarized as follows:

- (a) Digitalization of many of its exchanges. To date NITEL has installed 27 digital switch exchanges, and from 1993 to date, about 162,220 additional direct exchange lines have been added to the network.
- (b) A total of 19,200 transmission trunks have been added to the national network.
- (c) Tremendous progress in the use of optical fiber cable and digital microwave radio as links to serve as backbone transmission system, in the national network.
- (d) Integration with the international community via satellite.

The overall objective of these technical changes is to modernize the telecommunication sector, and ensure effectiveness and efficiency of the telecommunications network. It will be recalled that over the years, public criticisms of NITEL had ranged from delayed tones at peak periods, shortage of exchange lines, poor attendance to faults, and in-particular inaccessibility to other networks. Digitalization of the telecommunications network has reversed some of these criticisms and newer vintages of telecommunication services are becoming easier to manage.

4.2.7 Technology Investment and Acquisition in NITEL

Table 4.6 gives a summary of NITEL's investments for the years 1985-1993. These investments include the cost of project expansion and modernization of network and also the value of NITEL's international telecommunication operations.

Between 1985 and 1988, NITEL invested between 1.535 million naira and 1.429 million naira respectively. It rose to 1.715 million naira in 1989, and maintained an increasing trend, to reach the 9.5 million naira mark in 1993. In eight years, NITEL investment as per cent of GDP rose from 2.0 per cent to almost 10 per cent in 1993. NITEL has succeeded in funding some of its investments from its own earnings (following commercialization).

Table 4.6 NITEL Investments (1985-1993) (Naira '000)

Year	Investments	Growth Rate (%)	Investments as % of GDP
1985	1535331	N/A	2
1986	1454065	-5.29	2
1987	1467528	0.93	2.1
1988	1429841	-2.57	1.8
1989	1715266	19.96	2.1
1990	2018758	17.69	2.2
1991	4332381	114.61	4.6
1992	5528473	27.61	5.7
1993	9509623	72.01	9.9

Source: 1) *NITEL Annual Reports*
 2) *Computations from Data*

Table 4.7 shows that the supply of telecommunication equipment has remained outside the borders of the economy. Training of local personnel (engineers) in their operations and maintenance often follows the delivery of the equipment.

NITEL highlights the following as reasons¹² for acquiring technology outside Nigeria.

- i) Telecommunications is highly technological and capital-intensive;
- ii) Technological capabilities for manufacturing core modular components still lacking.

With digitalization of telecommunications, economies of scale come to play in the utilization of telephone exchanges. This is attributed to the one-time purchase of the equipment, and the long lead period of use. Also there is only the need to replace components, which are modular in nature.

12. *Discussions with NITEL's PRO during field survey*

Table 4.7 Technology Information on NITEL's Digital Programme

Technology Supplies	Year of Award	Contract/Assignment	Value (M)
1. ITT	1985	US \$200 million for the provision of system 12 digital switches in South-West Zone. (Ibadan, Abeokuta, Akure, Benin, Warri, Sapele).	4,400
2. Marubeni/NEC	1985	80,000 digital lines	n.a
3. Siemens	1986	500 million DM for ESWD Digital switching systems for North-West zone and Lagos	7,857
4. L.M. Ericsson	1986	Lagos (Ikoyi, Lagos, Isolo and Odunlami)	n.a

Legend

n.a = not available

Exchange rate US\$1 = naira 22.00

*Source: National Planning Commission (1994). Nigerian Perspective Plan. S & T Sector Study.***Research and Development in NITEL**

NITEL has an in-house research and development section charged with the mandate of ultimately ensuring the gradual local development in commercial quantities of products for the telecommunications sector. Consequently, there has been a shift¹³ in emphasis from purely theoretical to applied research, and this has enabled NITEL to design and fabricate prototype products that are tailored to Nigeria's environmental conditions (Technology Adaptation).

Some of these products include the following.

1. A 32-Channel digital PABX code-named Eagle
2. A cable theft alarm device
3. Manhole water level detector
4. Loop converter module.
5. A 256 Channel Digital Exchange
6. A 1 to 1 subscriber carrier line unit
7. A multi-access subscriber radio.

The collaborative efforts with some universities, and other research bodies were acknowledged in the design, development and fabrication of the products. It is however sad

13. The NITEL research and development team believes that without indigenous capabilities, the rapid changes in telecommunications will render acquired infrastructures obsolete and total dependence on industrialized countries will continue (Oguntoyinbo, 1994).

to note that the products have remained as inventions, yet to be commercialized.

A major reason attributed to the situation is that research and development activities in NITEL are grossly under-funded. In 1991, a total amount of approximately US\$21,309.5 was voted for research and development in NITEL. This was increased to US\$38,558.4 representing a 0.6 percent increase.

At the global level, world telecommunications leaders expend an average of US\$200 million every year on research and development, covering cost of basic, applied and experimental research. For instance, the main contributors to research and development telecommunication in Sweden are Ericsson and Televerket. While Ericsson devotes about 8 per cent of its turnover to research and development, Televerket spends two percent of its turnover.

Using 1991 and 1992 NITEL revenue figures, we observe that what is spent on research and development is less than 0.1 percent. Suffice to say, that the world leaders have an effective strategy for managing telecommunications development, and thus a positive contribution to major improvements in telecommunications productivity and returns.

Nigerian Communications Commission (NCC)

Introduction

NCC was formally established in 1992, but did not become operational till September 1993. NCC operates as a corporate autonomous body. The overall objective of NCC is to set the rules and enforce compliance in the deregulated environment of telecommunication in Nigeria.

The specific objectives of NCC include the following:

- (i) License telecommunication operators and facilitate private sector participation and investment;
- (ii) Ensure the improvement of the penetration of telecommunication services in Nigeria;
- (iii) Establish and supervise technical and operational standards and practices for network operators, oversee the quality of service provided by operators, and set terms for the interconnection of different carriers networks;
- (iv) Ensure the interest of the consumer of telecommunication services is protected by promoting competitive pricing of such services and to combat the abuse of market power.

NCC-Minimum Conditions for Participating in Nigeria Telecommunication Services

To participate in telecommunication service delivery in Nigeria, some minimum conditions need to be satisfied:

- i) A corporate body registered in Nigeria. This requirement however does not exclude foreign investor firm participation, but rather encourages joint ventures.
- ii) The possession of NCC license.

Some of the constraints to achieving NCC's mandate are as follows:

1. Inadequate local sources of funding for the high capital requirements for telecommunication market.
2. Absence of the capacity to implement, manage, operate and maintain existing infrastructure at acceptable levels of services, quality and availability.

3. The problem of dealing with NITEL's monopolistic attitude, and support for deregulation.

NCC and Deregulated Telecommunications in Nigeria

The Chief Executive of NCC is a seasoned telecommunication expert, who shares a deep concern about developing the Nigerian telecommunication sector. "Telecommunication professionals will have to re-orient themselves from mainly technical issues to the business economic and social needs of the community."

NCC initiated a move in this direction by organizing open fora to bring together various participants involved in the telecommunication sector. The objective of these fora is to encourage critical evaluation of the present situation of the telecommunication industry in Nigeria, and clear indications of where to be in the next few years, and how. Output of fora are some publications credited to NCC.

The following areas of telecommunication investment are now open for private sector participation, breaking down the hitherto monopoly structure of telecommunication investment in Nigeria.

- installation of terminals and other peripherals
- telecommunication equipment
- mobile communications
- rural communications
- repair and maintenance of telecommunication facilities
- cabling.

The provision of public switched network of exchanges, however, still remains within the monopoly of NITEL.

Figure 4.1 gives a graphical representation of the emerging segmentation of the Nigeria telecommunication sector.

Fig 4.1 Telecommunications Business Segments in Nigeria

Telecommunications (NCC – as Regulatory Body)

Segment A

- Switching
- Transmission

Segment B

- Data communication
- Mobile telephony
- Value added services
- Cabling
- Customer premise equipment
- Network management

Note

- * Segment A remains largely in the public domain
- * Segment B is the area that has been most open to liberalization and competition.

Three main reasons are offered to explain the above picture of telecommunications investment. First, telecommunications investment is a very expensive and highly knowledge-based business, and as such firms tend to start with relatively simpler technological segments

of the business. Secondly, enhanced telecommunications services promise quick financial returns and relatively high dividends. Third, the state monopoly is yet to divest itself of provision of public switched networks of exchanges and trunks. Our investigations reveal the possible privatization of the state monopoly and a concurrent appointment of a second local and international carrier to energize the competition that will ensue.

Centre for Adaptation of Technology (CAT)

Introduction

The centre for adaptation of electronics located in Akwa, Eastern Nigeria, is the technical institutional structure established for electronics development in Nigeria. The centre was created in 1993 and has the overall objective of developing the industrial base of Nigeria in electronics, and its related industries¹⁴ to make the country less dependent on finished goods. The centre is supervised by the National Agency for Science Engineering Infrastructure (NASENI).

CAT's mandate is to research into, design, adapt, develop and manufacture electronic products in Nigeria. Such systems include those for the production of electronic components circuits, devices, solar cells, communication equipment, computers etc. and thereafter enter into manufacturing partnership agreements to transfer the systems and plants production to private-sector industries. A pertinent question to ask is "To what extent has CAT's mandate been achieved?" The next sections on CAT will attempt to answer this question.

Manpower Structure of Cat

CAT has a total number of 40 staff on its payroll. The centre comprises two divisions: Administration and Engineering, each of which is made up of directorates, department and units. Specifically there are eight engineers representing 20 per cent of total staff number. The remaining 80 per cent are located within the administrative function of the centre. The chief executive and his deputy are seasoned electronic engineers of outstanding repute in computing.

Table 4.8: Manpower Structure of CAT

	No.	Percentage
Total No. of Employees	40	100
Administrative	32	80
Engineers	8	20

Source: Field Survey, 1997

14. This study conceptualizes the development of manufacturing capabilities in Nigeria telecommunication sector to be determined ultimately by the type of capabilities that could emerge from endogenous firms and institutions like CAT.

Our survey investigations reveal that the centre has a higher number of administrative employees, who are actually field staff. These field staff represents CAT at exhibitions and trade fairs where they display the products of the centre. Eight engineers do the core of the centres' technological activities.

Technological Capability of CAT

Technological capabilities of the centre¹⁵ are being demonstrated through the following activities.

- a) Design and production of electronic encasements using flat sheets.
- b) Production of printed circuit boards (PCBs).
- c) Sourcing of input materials locally through research and development efforts.
- d) Reverse engineering; and
- e) Maintenance and servicing of electronic equipment.

The limitation of CAT in respect of its technological capabilities is the non-commercialization of any of its products to date. In a bid to commercialize its products, CAT occasionally exhibits the prototypes of its product at trade fairs and exhibitions. Imported brands of CAT's products however exist in the market, and this perhaps explains the slow rate of commercialization or non-commercialization, as the case may be. In the direct context of the present study there is no demonstration of direct capability in the field of telecommunication by CAT. Current activities are limited to components of the computer and computer repairs.

Private Sector Telecommunication Investment

General Information on the ATCON group

This section gives detailed research findings on firms within the Association of Telecommunication Companies of Nigeria (ATCON), which is an apex unit, bringing together under one umbrella, all registered private telecommunications firms in Nigeria. ATCON was inaugurated on December 19, 1993, and its membership cuts across indigenous and multinational telecommunication companies operating in Nigeria.

A total number of 96¹⁶ firms are currently registered with ATCON. There were however only 78 financial members as at the time of this survey. ATCON is financed mainly by subscriptions from members [membership fees (25,000.00Naira), and annual registration (10,000.00Naira)].

Manpower Structure of ATCON

ATCON's activities are directed through the overall control of an executive council made up of eminent professionals in telecommunications development. Specifically the board is made up of eight professionals, five of whom are electronic engineers. One of these five engineers is an expatriate, thus ensuring the representation of multinationals within the administration

15. Interview with deputy director as recorded in the centre's brochure

16. We do acknowledge that there may be other firms existing who are not members of the ATCON. More so, ATCON does not have an enabling decree to enforce the registration of all telecommunication companies in the country.

of the Nigerian private telecommunication sector. The secretariat is currently run by a graduate in social science, but with some years of experience in the telecommunication sector.

ATCON's challenge is to understand the idiosyncratic problems of members, and assist in solving them, through the imaginative and innovative application of telecommunications, in line with the increasing importance of the information age. Some of the activities of the ATCON secretariat to achieve this challenge include organizing telecommunication fairs, seminars and exhibitions from time to time to create awareness and promote unity among telecommunication companies in Nigeria and abroad.

Objectives of ATCON¹⁷

ATCON has the following as its objectives:

1. To bring together under one umbrella all companies in the field of telecommunications and auxiliary companies for purpose of achieving greater heights in the telecommunications industry.
2. To actively promote organized private sector participation in the development and expansion of the nation's telecommunications infrastructure.
3. To encourage professionalism and evolve adequate training programmes for the staff engaged in the industry.
4. To assist its membership in evolving progressive programmes in tune with current deregulation policy of the Federal Government of Nigeria.
5. To promote fair competition in the provision of telecommunications services and thereby improve standards and accelerate network expansion.
6. To facilitate a cordial relationship between members and the government through the Ministry of Communications whose responsibilities include the development of the telecommunications industry in Nigeria.
7. To encourage the use of locally based companies and expertise in implementing sensitive and lucrative telecommunications projects.
8. To be a credible forum for articulating national telecommunications policy formulation.
9. To encourage the establishment of a telecommunications network in continental Africa in order to promote intra-African business links and co-operation.
10. To provide a forum for members to share their expertise and to co-operate in generating trade and investment opportunities.
11. To speak for members formally and informally to government departments and major business organizations in Nigeria and overseas.
12. To organize international telecommunications seminars, workshop and exhibitions.
13. To co-operate with the National Communications Commission (NCC) to ensure effective and efficient co-ordination and regulation of telecommunications services in Nigeria.

17. As recorded by the ATCON Secretariat, 1995.

Technological Achievements by ATCON Firms

The formation of ATCON attests to a growing investment of technological capabilities among member firms. The technology acquisition strategy employed by firms has been that of direct import coupled with operational and maintenance contractual agreements. Firms are involved in learning through the numerous seminars, workshops and conferences organized by ATCON. Also from inputs submitted by firms for publication in ATCON's newsletter, there is a noticeable knowledge base of telecommunications issues entrenched at firm-level. For instance one firm claims to have achieved substantial substitution of local raw materials for satellite dish manufacturing, while another utilized tacit knowledge of several years of telecommunication network management to adequately set up rural telephone network systems based on radio communications.

Two of ATCON member firms recently co-installed a type-approval facility commissioned by the Nigerian Communications Commission (NCC). The 30 million naira (\$0.36m) facility has to have the capacity to test all analogue cellular equipment in use in Nigeria, and detect cloned sets. The facility is also designed to test all forms of customer premises equipment (telephone, fax machine) to ensure compliance with NCC approved standards.

Firm-Level Studies

As at the time of this survey, NCC had licensed quite a high¹⁸ number of firms in different aspects of telecommunication investment. However, we note that only a few¹⁹ of these firms are actually in business. This is due in part to the interconnectivity problem of NITEL.

- Pay phone operators
- Fixed cellular telephone services (community-based)
- Value-added services such as e-mail, internet, and paging services.
- VSAT services in satellite communications areas.
- Sales, repair and maintenance of telecommunication facilities.
- Mobile cellular telephone services

It was observed that there is a concentration of capabilities in the provision of value-added services, particularly in the aspect of data communications, which has allowed for the expansion of a broad range of service, hitherto not provided by NITEL. These include electronic mail, database access, internet service providers, cellular telephone and wireless telecommunications. It was also observed that firms combined the provision of these services within the mandate of their licenses.

There is a move towards private satellite business networks, which provide point-to-point, national or international coverage to subscribers using a shared satellite network. Capabilities of private telecommunications firms are now very apparent in the banking system, creating an almost painless banking atmosphere for customers with the global networking of banks

18. As at March, 1998, a total of 155 licenses had been issued to operators in different categories of telecommunication investment (Orakwe, NCC 1998).

19. For example, presently, 24 firms have been licensed as internet service providers (ISP) in Nigeria but only three of them are currently known to have activated service. In some cases, NCC revokes licenses due to non-use. Further investigations reveal some political undertones.

achieved through the on-line real time banking system where accounts can now be accessed nationwide by the banks and customers. The carriers are NITEL leased lines and very small Aperture Terminals (VSAT), which are very small satellite dishes (1.5 - 3M) located at subscribers site to connect the hub (remote earth station). Fraud cases due to the length of time taken to reconcile accounts are one of the problems that have been reduced through VSAT technology.

Two companies handling the connection aspects of this venture are Cyberspace Ltd and Sistems Worldwide Ltd. Installation cost was put about 90m naira. Banks presently networked include All States Trust Bank, Zenith International Bank Ltd, Diamond Bank Ltd, United Bank for Africa Ltd, Citizens International Bank Ltd and Equatorial Trust Bank Ltd. Other business transactions have also been boosted with the increased use of private radiophones. An example of the radiophone is the Briscoe Technical Actionet Compact Trunked Mobile Radio, developed by Nokia. It operates in the Ultra High Frequency (UHF) wavelength.

A new telecommunications policy was launched in November 1999. The new policy document prescribes new rules for telecommunication development, and recognizes the importance of investing in wireless telecommunication infrastructure for accelerated development of telecommunications in Nigeria. NITEL, through its mobile subsidiary M-TEL was the first to establish a strong presence in the wireless telecommunication market in Nigeria. Between 1992 and 1993 Mobile Telecommunications Services (MTS) Ltd (now defunct) was a joint-venture between NITEL and Digital Communication of Atlanta in the provision of mobile cellular networks, and also some value-added services with a total of about 12,500 subscribers. The analogue European system (E-TAC) was the technology in use. In 1995, MTS shut down its operations on account of a dispute between it and its partner, over non-payment of interconnection charges.

When EMIS was the first private sector firm to settle for a cellular license, it secured the radio frequency for operation, and made an impression to educate potential subscribers on the technology it proposed to offer [Global System for Mobile Communication (GSM)]. It however turned out that because of the potentials of the technology, it became the choice of NCC for operators of cellular phones on a nationwide scale. As a marketing strategy, EMIS offered a price slash that caused a force in price drop in the services of the then only national cellular provider (MTS²⁰ - which is government owned, but run as a private enterprise i.e. fully commercialized).

Profile of Surveyed Firms

The choice of 10 survey firms in this study was based on the consideration of the above picture of the private sector investment. More specifically, the following parameters were considered:

- The politicized issue of inter-connectivity with NITEL, and the strategies employed by firms that have scaled the inter-connectivity hurdle.
- Another consideration was the measure and impact of investment of the firm. Here the assistance of the ATCON secretariat was sought to determine from their records, which firms were actually performing as compared to others.

20. The country awaits the take-off of at least three GSM operators in the next three months. A sub-committee on the award of GSM licenses has put together some conditions for GSM operators.

The line of activity license was also considered in the choice of survey firms, such that there was a spread in representation of almost every activity present within the private telecommunication sector.

1. Intercellular Nigeria Limited (Fixed Cellular telephone operation)

This is Nigeria's first wholly indigenous privately owned telephone company. The company began operation on February 27, 1998 with a two-week test-run for 100 "intercellular friendly subscribers." Intercellular has a license for national private telephone operation (also referred to as fixed cellular services). The company installed (contract through Motorola of USA) a \$4 million worth wireless system based on the Code Division Multiple Access (CDMA) technology. The current network capacity is 10,000 subscribers, made up of 7000 - Lagos, 2,000 - Port Harcourt, and 1000 - Abuja. There are plans to expand the capacity.

Intercellular is into the business of telecommunication with a clear understanding of the telecommunication problems in the country. The company is constantly on the drawing board, evolving solutions that will help in the optimization of telecommunication delivery in Nigeria, for example, Intercellular has entered into strategic allowance with Telipoint, a licensed payphone operator, currently operating in Lagos. The alliance is tuned at improving the level of telephone penetration in the country.

2. General Telecom Limited (Sales Services & Repairs)

The firm was set up in 1962 with the principal objective of supplying the Nigerian market with an impressive range of well-established telecommunication equipment. Products and services span supply of basic telephone sets, and PBXs, to the latest digital exchanges for fully integrated networks, digital microwave systems, satellite (VSAT) systems, two-way HF voice/data radio communications systems and wireless networks.

General Telecom is a major contractor to the Ministry of Communications and Nigerian Telecommunications Ltd. (NITEL), and has over the years established a reputation for technological leadership and product innovation with the backing of reputable international telecommunication companies, with several years of experience in the design and manufacture of telecommunications systems for government, private organizations and telecommunications authorities around the world. The company's headquarters is in Lagos. There are four branch offices, located in Lagos, Abuja, Port Harcourt and Ibadan.

3. Payphone Cards Nigeria Limited (Payphone Services)

Payphone Cards Nigeria Limited (PCNL) is a subsidiary of General Telecom PLC (GT). PCNL was established in March 1997 to provide card phone services. It is a wholly indigenous company. Presently, the company is licensed to provide its services to designated areas. Its license presently covers Lagos mainland. However arising from its wide acceptance by the people and excellent services being rendered, the company is seeking to extend its license to cover other western and eastern states. At the moment, PCNL has a total of 138 installations spread all over its area of operation. The company is adjudged to be making enormous efforts in making the provision of telephone access to a large percentage of the population.

4. Emmanuel Electronics Limited (Sales and Repairs, Equipment Supply)

A private Nigerian company owned 100 per cent by Nigerian investors. The company was incorporated in 1985 as a radio telecommunications service provider with ICOM products as a trademark. ICOM Inc. is a world ranked radio communication manufacturer of over 50 years and has produced quality radios for marine, aviation, land mobile-use, etc., throughout the world. Products and services expand from sales and installation of radio systems for marine, aviation and land mobile-use to sub-assembly of modems and rural telephone systems. The company has over the years established a reputation for technological innovation in the field of long distance rural telephoning with the backing ICOM (UK) associate company. The company employs Nigerian engineers, technologists and artisans and trains for proper orientation and adaptation. Emmanuel Electronics Ltd has sponsored over 50 undergraduates in various Nigerian universities to enhance future manpower requirements annually. Headquarters of Emmanuel Electronics is located in Lagos, with a branch office in Akwa-Ibom, Eastern Nigeria.

5. EMIS - EM-International Systems Nigeria Limited (Fixed Cellular Telephone Operation)

The firm was established in 1992 to operate as a private telephone operator (PTO). In 1992, the Ministry of Communications (MOC) issued a license in principle to EMIS to operate a wireless telecommunication network in Nigeria. The Nigerian Communications Commission (NCC) ratified this license in 1993. In 1994 the MOC issued frequency in the 900MHz band to EMIS to enable it install a national GSM mobile telephone network. EMIS signed a contract with Motorola, USA, in 1994 to implement a national mobile telephone network. Plans are in advanced stages to deploy and expand the network throughout the country.

Nigerian investors hold over 80 percent of EMIS shares. EMIS' initial plan calls for the installation of a nationwide network to support at least 500,000 subscribers within five years. EMIS equipment is based on the Advanced Mobile Phone System (AMPS) technology. EMIS believes that the liberalization and deregulation of the telecommunications industry in Nigeria will result in increasing the teledensity of telephones in the country.

6. Omnes Communications Nigeria Limited (VSAT operations)

Omnes Communications Nigeria Limited, was given provisional approval in May 1995 by the NCC, as a provider of private network links for VSAT services. It commenced operation in January 1996. It has a satellite earth station in Lagos, built in September 1996. It has completed a trial test and now has a final operating license from the NCC. It presently makes use of the PANAMSAT satellite and does not require leased space segments from NITEL (as signatory to INTELSAT). Prospective clients for its VSAT services are growing in the banking sector. Omnes Communications Nigeria Limited draws on the technical experience of its parent company, Omnes, and has technical relationship with VITACOM and Cisco Systems. It is also a Motorola reseller, handling spread spectrum radio systems. Omnes clientele covers the oil and banking sector of the economy.

7. Sistems Worldwide Limited (SWL)

A wholly owned Nigerian Company that pioneered VSAT test services in the country in 1992, using an external hub in South Africa owned by Telkom. However, it plans to have its hub

in Nigeria since the present regulatory framework does not approve of external hub for VSAT services. It installed the VSAT network for All State Trust Bank, comprising a star configuration of four sites with one more planned site. Other activities of Sistems Worldwide Limited include wireless mobile communications services, data transmission services and Internet services. Its VSAT equipment is manufactured by Hughes Network Systems, the pioneer of VSAT technology. Hughes Network System, a division of Hughes Electronics, controls about 70 per cent of VSAT equipment market. VSAT equipment provided by the SWL is from equipment manufacturers in Europe, Asia and the USA with whom the company has technical relationships. SWL offers data or voice intensive applications or both. The equipment supports many protocols, with continuous, reliable operation and employs DAMA (Demand Assigned Multiple Access) and voice activation to maximize satellite transmission bandwidth and providing, in the process, significant cost saving advantages over other systems.

8. Telnet Network Services Limited [(TNSL) (VSAT)]

Telnet provides wide-ranging telecommunications engineering and consultancy services. Its foreign technical associates include Telia SwedTel AB, MFS WorldComm and Hughes Network Systems, as equipment manufacturers. The company has interest in the provision of private network links and VSAT services, for which it has a full license. It is also actively involved as an Internet service provider for which it has a full license.

Telnet offers the star, mesh and other specialized configurations of the VSAT system. Although it has an external hub for network control at present, it is currently installing its own network control center in Nigeria. It has earth stations located in Lagos, Port Harcourt and Warri. Its VSAT equipment is manufactured by Hughes Network Systems. Its service clients have cut across sectors such as oil and gas (Shell, the NNPC, Mobil, Texaco); banking (Guaranty Trust Bank, Zenith International Bank, ECOBANK and Diamond Bank); transportation (Ministry of Aviation, Nigerian Ports Plc) and manufacturing (Nigerian Breweries Plc). The company is one of the respected private network link providers, on account of its level of experience, financial strength and technical reputation.

9. Cyberspace Nigeria Limited

Cyberspace is 100 per cent Nigerian owned. The firm is based in Lagos, but has clients located in Lagos, Abuja, Jos and Port Harcourt. The company was established in July 1995 to provide telecommunication services including Internet services, for which it has a full license, VSAT satellite communications services and wireless and mobile communications services. It has provisional approval from NCC to offer VSAT services.

The company deploys Hughes Personal Earth Stations (PES) in a Star network. It has completed the implementation of VSAT networks for two commercial banks, the Zenith International Bank and the Equatorial Trust Bank. Presently, it does not own a hub, but relies on an external hub for network control. The company has a staff strength of 12, made up of three managers, four technicians, four marketing personnel and one secretary. Within the company, training is given utmost importance - challenges are posed at individuals, which are solved through active learning on the job. In 1997, three members of staff benefited from training abroad, while two are currently undergoing some training abroad.

10. The Nigerian Mobile Telecommunications Ltd. (M-Tel)

The Nigerian Mobile Telecommunications Ltd. (M-Tel) is primarily involved in the business of providing cellular mobile services. It is currently, the only cellular (mobile) carrier in the country. It is 100 per cent government owned, but is run as a commercialized entity.

A cellular system is made up of two main subsystems:

- The switching subsystem of subscriber databases, management and mobile switching centers (MSC), which route calls in the core network; and
- A base station subsystem of intermediate switching or base station controllers (BSC), and a radio base stations (RBS), which define how the air interface is established between the mobile handset and the switching components.

M-Tel has three mobile switching centers (MSC) located in Lagos, Enugu and Abuja. A total of 17 states out of 36 states in the country are covered by these three MSCs. M-Tel's services, include:

- Mobile cellular telephone
- Wireless voice and data
- Mobile satellite services
- Enhanced network services (paging, voice mail, etc).

These services are made available in major parts of State Capitals covered by the MSC, through private telecommunication firms who serve as vendors.

Table 4.9 General Information on Surveyed Firms

ID	Name of Firm	Year of Estab.	Licensed Activity	Ownership	Loc.
1	Intercellular Nig. Ltd	1998	Private Telephone Network Operator(Fixed Cellular)	100% Nig.	Lagos
2	General Telecoms	1962	Sales & Repairs	100% Nig.	Lagos
3	Emmanuel Electronics	1985	Sales & Repairs	100% Nig.	Lagos
4	Payphones Nig. Ltd.	1997	Payphone	100% Nig.	Lagos
5	EMIS	1992	Private Telephone Network Operator	100% Nig.	Lagos
6	Omnes Nigeria Communications Ltd.	1995	VSAT	100% Nig.	Lagos
7	Telnet	1995	VSAT	Joint Venture	Lagos
8	Sistems	1992	VSAT/(Internet Service Provider (ISP)	100% Nig.	Lagos
9	Cyberspace	1995	Internet Service Provider	100% Nig.	Lagos
10	Nigerian Mobile Telecomm. Ltd.	1996	National Mobile (Cellular) Telecommunication	100% Nig	Lagos/ Abuja

Source: Survey Data 1998

Year of Establishment of Firms

Table 4.10 gives the summary of the year of establishment of surveyed firms.

Table 4.10 Year of Establishment of Firm

Year of Establishment	No. of Firms	% Representation
1960 to 1990	2	20
1991 to date	8	80

Source: Field Survey, 1997

Using the data on the entire ATCON population of 96 firms, it was observed that very few firms came into existence within the sector during the mid-through late eighties, due to the effect of the Structural Adjustment Programme. The survey that only two firms were established between 1960-1990, with the remaining eight coming up between 1991-1997. Precisely the two firms were established in 1962 and 1985 respectively. The birth of the "nineties" batch of firms is not unconnected with the liberalization of the telecommunication sector in Nigeria, and the response of private sector firms in their bid to participate in the deregulation environment. The birth of firms in the telecommunications sector of Nigeria has thus witnessed an increased growth over the years.

Ownership of Firms

The sum of ownership forms (foreign direct investment strategic partnership joint ventures and licensing) and 100 percent wholly Nigerian owned are observed within the formation of private sector telecommunication firms. This has allowed for the acquisition of newer vintages of technology, development of some measures of endogenous competences, overseas training and generally improved the telecommunications sector in Nigeria. However, only joint venture and 100 percent Nigerian owned forms and structures are observed within the 10 survey firms.

A high percentage of 90 per cent is observed for wholly Nigerian owned firms. This can be linked with emerging development of local competence in some aspects of telecommunications investments. It is also a measure of increasing technological entrepreneurship among the business class. The technical and capital-intensive nature of telecommunications investment is attributed to the contribution observed for joint ventureship.

Number of Employees

The number of employees in a firm is sometimes used as a criterion to determine firm size as to whether the firm is small, medium or large [Little et al (1987); NISER (1987); and Oyelaran-Oyeyinka (1996)]. For this study, we employ Oyelaran-Oyeyinka's (1996) categorization of firms, which concluded that firm size is correlate with product group and therefore technology. Specifically we employ the taxonomy of firm size as follows:

Firm Size	No. of Employees
Small	1-49
Medium	50-199
Large	200 and greater

Table 4.11 shows the representation between employee number and category of firms as observed in this study.

Table 4.11: Employee Size

No. of Employees	No. of Firms	Classification
1 - 49	9	Small
50 - 199	1	Medium

Source: Survey Data 1997

The structural composition of firms, as shown on the table is as follows: small (90 percent), and medium (10 percent). The composition shows that small firms, employing between 1 - 49 employees, dominate the telecommunications sector in Nigeria. Closer investigations reveal that total employee number in many of these small firms hardly exceeded 10.

Location Characteristics of Firms

All the firms under survey are located in Lagos State. Even within the ATCON group only one firm out of 96 was observed to be located outside Lagos. One reason for the evidently skewed location of firms can be attributed to the presence of the gateways for telecommunications services in Lagos. Business activities thrive better, and faster in Lagos. The spread of a new business is often concentrated in the large cities, within remote sub-urban areas where their services can be afforded. Until very recently (1996), the seat of telecommunications development used to be in Lagos, and firms located in Lagos were the first to respond to the technological challenges posed by the deregulation of the sector. The choice of coverage of private telecommunication firms, though justifiable from a business perspective, defeats the purpose of increased penetration and universal service in Nigeria.

The firms argue that coverage of the real "rural" areas will not guarantee a quick return on their investments. Mansell & Wehn, (1998) posits that if telecommunication provision is based solely upon commercial returns, the rate and direction of investment may be insufficient to meet development and access goals.

Chapter Five

Analysis of Findings

Introduction

Guided by the specific context of telecommunication and electronic development in Nigeria as we now know it, this chapter seeks to analyze the various research findings in line with theory. To do this, we re-visit our research problem questions and hypotheses. Issues arising from our literature review will also form part of the analyses.

Technological Response in Nigerian Telecommunications

A variety of stimuli is present within the Nigerian telecommunications sector at various levels, and has contributed to firm responses. These include the effect of the macro-economic environment new developments in the technology frontier and technical bottlenecks. The reform of the telecommunication sector in part stimulated public investment to adopt digital systems, which subsequently resulted in investment in the development of new technological competencies, to be able to use, manage and maintain the new systems. Attendant to the adoption of digital systems was also the development of new lines of products and services, in particular value-added services.

Response to opportunities offered by the private sector by investing in value-added services can be rated as strong. The strategy is to offer value-added services, which enable them to take full advantage of the global telecommunication revolution. For example, an indigenous firm (intercellular) recently signed a \$6 million contract agreement with Motorola Inc. USA., for telecommunication infrastructure within the wireless spectrum. A private firm recently launched a subscriber system, which enables international calls to be made to as many as 65 countries, through the firms' international network. Another firm has launched a two-way pager service, as opposed to NITEL's one-way service. The two-way service permits the instant reception of messages, which can be replied to almost immediately.

Private firms are evidently responding to technological advances in telecommunications

through the “third” generation of telecommunication revolution (fiber optics, satellite, radio links) and facilitating the establishment of new communication systems. The first and second generations were the analogue and digitized exchanges respectively.

Telecommunication development in the private sector has been under-girded by a constellation of technical changes. Mobile communication, satellite, software control, the convergence of computing and communication technologies, and the provision of value-added services are some of these technical changes and responses.

The consciousness of a competitive structure has also been created within the sector. The era of deregulation and liberalization in Nigerian telecommunications has brought a wide range of reform to the sector. This confirms received theory of market-led deregulation proponents, which shows that the challenges of multi-actor participation in the telecommunication sector of economies are often times an incentive to improvement in productivity and efficiency.

Technological Capability in Nigerian Telecommunications

Telecommunication capability in Nigeria fits within the Ernst Mytelka & Ganiastos (1994) learning model in the following ways:

- i) Endogenous involvement in the process of technical change. Technical change refers both to the creation of new techniques and to a change in the technical specifications that define an existing system, its components and relationship to each other. Workforce in all the four institutions studied shows that no expatriate is involved. Nigerians wholly own many private telecommunication firms.
- ii) Carrying out research and development activities (though still at a very minimal level compared to world leaders). Suffice to say, that the world leaders have an offensive²¹ strategy for managing telecommunications development, and thus a positive contribution to major improvements in telecommunications productivity and returns. On the other hand telecommunication development in Nigeria displays a defensive strategy.
- iii) Training and education of personnel to upgrade technological skills.
- iv) Hiring in technical assistance and ensuring the transfer of technical knowledge to local personnel. We note that telecommunication investments in some key aspects are therefore high-tech. Some private firms have technical collaboration.
- v) Carrying out “searches” for new techniques. This underscores the value of continuous research and knowledge generation in technology frontier.

Mytelka’s (1994) concept of “first” in the market is amply demonstrated by the investment capability at the firm level in the Nigerian telecommunication sector. Firms try to outdo each other in the marketing of new products and services within the sector. Some private firms are observed to be NITELs’ vendors for supply of different products from cordless phones to PBXs. These products often come with “distinguished” and “unique” features to enhance their competitiveness over other products.

21. An offensive strategy is designed to achieve technical and market leadership by being ahead of competitors all the time. It involves a combination of the following: adequate funding for research and development, recruitment of competent personnel, good information system, consultancy and continuous learning. Achievement of these combinations is something that continues to elude the sector.

Technological Acquisition Strategy in Nigerian Telecommunications

Observations from research results suggest for the following broad statements to be made in respect of the Nigerian telecommunication technology acquisition strategies.

- (i) Entrants to the investment scene are trying to address the apparent “deficit” of telecommunication infrastructure – albeit to a limited extent in the face of inter-connectivity difficulties – the optic-fiber network, wireless microwave, and satellite. Dial-up networking is owned by large companies like Shell-BP, NNPC, banks, travel agencies making use of the average 1200bps.
- (ii) New kinds of partnerships are emerging in form of technology licensing and joint ventures to address the highly technical and capital-intensive nature of telecommunication investment. Collaboration in the form of joint ventures and cross licensing had always existed in one form or the other. Collaboration can take place between firms of approximately equal strength or it can involve firms with unequal market share and financial strength (Mansell 1993). Several reasons are given in literature for the growth of collaborative ventures:
 - The need to recover high development costs. Collaboration often occurs in highly concentrated industries, where competition is among a relatively few large rivals (oligopoly).
 - With the increasing rapid pace of technical change in sectors, collaboration is seen as a way to share high costs of innovative product development.
 - Technical collaboration can provide access to new knowledge and techniques. Richardson (1972) observes “firms form partners for the dance today, but when the music stops, they change them”. This statement tends to describe the failed partnership that existed between NITEL and the defunct MTS.
 - Endogenous technology mastery efforts are going on to reduce the import content of the telecommunication sector. As observed, most of the content of the technology had been acquired through direct import coupled with operational maintenance and contractual agreements.
 - The new socio-economic environment of telecommunication in Nigeria has brought with it new skills and approaches, transforming the sector into one that offers communication as an incidental part of a host of other services and products.

The Inter-connectivity Issue

Given the fact that telephone services is the major activity in the sector, and that NITEL controls more than 90 per cent of operational telephone lines in the sector, inter-connectivity of new entrants to NITEL lines becomes a necessity, if they are to be relevant. Though NCC has granted some private investors licenses, the right to interconnect is difficult, because NITEL, which owns the only Public Switched Telephone Network (PSTN) in Nigeria, is not subject to regulation by the NCC. Private operators, if they are to interconnect also have to pay some arbitrary fees to NITEL. NITEL has a parallel inter-connectivity framework

running contrary to that put in place by NCC, thus contravening the provisions of the NCC (Decree I Section 15j) which states that: "the Commission will determine in writing, principles which shall apply in agreed terms and conditions about charges payable between inter-connectivity of facilities to networks of the other party and matters related to inter-connectivity generally".

The situation is thus that "while the telecommunication investment field has been thrown open to all players, it is yet to be a level playing ground for new entrants who find their investment enthusiasm dampened by the unfair deal of the state monopoly".

Network inter-connectivity would ultimately be to the benefit of all players, in the following ways:

- i) It would stimulate the modernization of the PSTN, encourage inward investment and promote the reform of the national regulatory regime.
- ii) It would benefit customers through lower prices, and more choices of operator and service.
- iii) It would promote cross-border trade in goods and services other than telecommunications. In actual fact international trade volume would increase attendant to improved quality of telecommunication services.
- iv) For the state monopoly, the interconnection of other private networks will significantly increase the traffic roam, and thus boost revenue.

Historical evolution of telecommunication development in some industrialized economies reveals that the initial problem of inter-connectivity did occur. However a unique combination of forces of finance, government, regulation and technology solved the problem in idiosyncratic manners. For example in the USA, the AT & T strategy was "not to sell, but to lease". It was an economic strategy to keep all trade secrets, which later became justified, technically to prevent poorly designed and maintained equipment. One key attribute of the AT & T strategy was that ownership of the US telecommunication industry did not become concentrated in its formative days.

The solution to ending the NITEL monopoly may well be in taking some decisive steps in the light of following the direction of development patterned after world leaders. A starting point is what is already happening: NITEL in an attempt to activate all its redundant lines, is leasing lines in wholesale manners to private operators who are then retailing such lines in various modes of telephone deployment.

Rate of Investment in Nigerian Telecommunications

In 1992, the total size of the telecommunication worldwide reached US\$535 billion, with services accounting for over 75 per cent of total market estimated at US\$415 billion (WTO 1996). In 1995 investment levels in telecommunication infrastructure were estimated at US\$14 billion, of which over \$8 billion are for Asia and the Pacific, \$4 billion for Latin America and the Caribbean, and \$2 billion for Africa.

Statistics (NCC, 1996) show that Nigeria ranks 49 among the least developed countries. Nigeria presently contributes almost nothing to the international infrastructure market, and has only about US\$0.5 billion contribution to the total telecommunication services market, which is less than 0.1 per cent of the total telecommunication services market (Iromantu, 1996).

A major limiting factor to achieving the real rate of investment in the Nigerian telecommunication sector has been the absence of a local manufacturing base for telecommunication equipment. The vision 2010 committee on science and technology recently made a recommendation for government approval that by 2005, Nigeria should be in a position to contribute a minimum local content of 30 to 50 percent input to telecommunication equipment manufacture. The committee gave the results of a recently completed survey on Nigerian cable makers. A total of seven active cable and wire producers with product range wide enough to satisfy the market currently exists in Nigeria. Three companies have registered as being capable of manufacturing telecommunication cables, two of which are currently engaged in carrying out orders for NITEL.

Findings from other studies (NISER 1996) reveal some of the potential investments that are yet to be tapped by the telecommunication sector in Nigeria. It was observed that the country is currently technically capable of producing the passive electronic components requirements such as resistors and capacitors. These components find very wide usage in the production, assembly and repairs of domestic electronics, telecommunications, computer, and some accounting machines. The major raw materials required, mostly minerals, are extensively available locally. The technology of production envisages a joint-venture partnership because of its very technical nature. A short learning phase to diffuse, adopt and adapt the technology of production is envisaged, with the nature of skilled manpower that exists in the country. The total estimated cost for the project (1996) was approximately 36 million naira (US\$1.64m). A working capital of 8million naira (US\$0.36m) was also estimated.

In the light of evidence of the technological capabilities and potentials of the Nigerian telecommunication sector, and also in particular, the opportunities that an institution like the Centre for Electronics Technology (CAT) has to offer, it could be beneficial, and indeed in the interest of the country, if some form of collaboration could be worked out between CAT and the telecommunication sector. The ultimate aim is to ensure the domestication of future production of telecommunication equipment and parts. CAT may well be Nigeria's own indigenous Bell laboratory - if it is allowed to grow. Public procurement using NITEL's extensive demand could be used to promote CAT.

Chapter Six

Summary, Conclusions and Policy Recommendations

Summary and Conclusions

This study has provided empirical evidence to show that telecommunication development in Nigeria has undergone significant changes, and elicited responses from both public and private sector investment, in the past one decade.

1. There has been evident technological response by telecommunication firms in Nigeria in the following ways:
 - (a) Adoption of new technologies to enhance productivity and effectiveness, a move to innovate segments of telecommunication businesses by both the public and private sector telecommunication firms. This has been made possible by the third generation of telecommunication revolution: wireless spectrum, fiber optics, satellites, etc.
 - (b) New kinds of technology partnerships (joint venture technology licensing strategic alliances) to address the highly technical and capital-intensive nature of telecommunication investment.
 - (c) Build-up of technological capabilities particularly that of investment and marketing capabilities. The concept of "first" in the market was observed in the private sector (products with distinguished and unique features).
 - (d) Endogenous mastery of technological development. We observed that no expatriate was found in any of the institutions studied. However, compared to the NICs, engineers in the Nigerian telecommunication sector in the institutions records a low percentage (3 percent of total workforce in three years).
2. Private sector participation is definitely an urgent requirement in Nigerian telecommunication. With a capacity of 169,000 lines (in the public sector) in 1980, it increased to 700,000 in 1996. Our research investigations give 400,000 lines as the number of lines effectively in use, translating to only 20 per cent change over 16 years.

3. Setting up of institutions at both government (public) and private levels would seem to be a prominent aspect of Nigerian telecommunication development. However, the observation is that these institutions need to be properly co-ordinated, and given strong legal framework (policies). There is yet to be a desirable linkage among principal actors (firm, institutions) in the telecommunication sector in Nigeria.
4. The public sector investment (NITEL) owns the gateway, and about 90 per cent of accessible telephone lines to date. The issue of inter-connectivity between NITEL and private sector initiatives is one of the major factors limiting the real rate of investment in the sector.
5. Another limiting factor to the real rate of investment is the absence of a local manufacturing base. Major inputs to the sector are still obtained through direct imports. It was however observed that opportunities do exist for developing capabilities to produce components and peripherals as a way forward.

Policy Recommendations

1. Following from our research findings and analysis, there is an urgent need for the re-formulation of Nigeria's telecommunication policy with special emphasis on further liberalization to allow a market-driven sector. This hopefully will impact positively on economic development, technical performance, equipment and development of local capabilities in specific niches of operation.
2. The regulatory framework for telecommunication development and investment in Nigeria need to be re-appraised. NCC should be given more powers to carry out its assignment, and NITEL should be subject to regulation.
3. Privatization of the public investment (NITEL) is being given prompt consideration. However there is a need to ensure that realistic conditions are set that provide for healthy competition and a market-driven telecommunication sector.
4. There is a strong need for sustained training and endogenous capability build-up of telecommunication personnel. New categories of technical personnel need to be trained in adequate numbers to cope with the growth in technological innovations.
5. Empirical evidence from the Newly Industrializing Countries (as observed from the section on literature review) shows that some countries with approximately 200,000 telephone lines have established some domestic production of peripheral and transmission equipment. Some with over 500,000 lines have major manufacturing capacities. This is recommended for Nigerian telecommunication, but it will need to be matched with an equal sound balance of technological capacity and capability in terms of finance, competence, research and development, and human capital requirements.
6. Promotion of Foreign Direct Investment (FDI) through appropriate government policies to encourage technological skills development in an endogenous manner is a challenge to the country to be able to cope with competition and demands of the global world. In this regard, the adoption of the Global System of Mobile Telecommunication (GSM) should be expedited.

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