

**A STUDY OF TECHNOLOGICAL INNOVATIONS IN THE
INFORMATION AND COMMUNICATIONS TECHNOLOGY
INDUSTRY IN NIGERIA**

BY

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DEFINITION OF TERMS USED IN THE STUDY

For the purpose of clarity and to avoid ambiguity, some of the terms that are used in the study are defined operationally below:

Technology

Technology in this study refers to tools and machines that may be used to solve real-world problems. It also refers to material objects of use to humanity, such as machines, hardware, software, systems, methods of organization and techniques (Wikipedia, the free encyclopedia)

Technological

In the study, the term Technological is an adjective meaning ‘based in scientific and industrial progress’. It also means ‘of or relating to a practical subject that is organized according to scientific principles (The American Heritage® Dictionary of the English Language, Fourth Edition Copyright © 2007 published by Houghton Mifflin Company. Also WordNet 1.7.1 Copyright © 2001 by Princeton University)

Innovation

The term is used in the study to refer to both radical and incremental changes to ICT products and processes. In the organisational context, innovation is linked to performance and growth through improvements in efficiency, productivity, quality, competitive positioning, market share, etc. (Wikipedia, the free encyclopedia)

ICT

Generally referred to as Information Communication Technology and includes all electronic technologies and equipment used in facilitating information processing and communication. However, the study shall focus mainly on global system for mobile

communication (GSM), computer technology and its associated peripherals such as printers, speakers, scanner, and the uninterrupted power supply (UPS).

Firms

Firms are generally known as any registered business set up or venture. The term is used in the study as a privately owned commercial business venture.

ICT Firm

The term as used in the study refer to any privately owned commercial business venture that is into manufacturing, assemblage, exporting/importing, repairs and maintenance of GSM, computers and its associated peripherals such as printers, speakers, scanners, UPS, servers, switches, network adapters and cables, modems, routers etc.

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CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Information Communication Technology (ICT) has proved to be a catalyst to fundamental changes in the world's economies and societies. It creates more avenues to earn income, allows access to useful information, enhances the world of work and makes the world a global village. The ICT industry spans broadcast, electronics and print media, computers, telecommunications and e-commerce activities. As put forward by Oyeyinka et al in 2007, ICT infrastructure is made up of all physical facilities and technologies engaged in delivering and disseminating information and communication services in telecommunications, broadcasting, cable television service, postal service, publishing, printing, computer networks, and a wide range of terminal equipment. The minimum composition of an ICT infrastructure that would bring about social and industrial development include: a functional telecommunications network with voice, data and video transmission to enable an information base that is adequately networked; local production of ICT equipment and materials; a pool of human resources with capacity in telecommunications and other related aspects of the rapidly growing ICT industry; and software development and production of information technology (IT) applications.

No doubt, the country is thriving in the production of functional telecommunication services especially with the deregulation in the industry and the participation of private players. In the light that telecommunication activities continues to play a lead role as a central component of the ICT sector in Nigeria, one can say that

the industry is competitive with a mix of service providers in the private and public sectors in their respective domains.

The recognition of the pivotal role of Information Technology (IT) for development became eminent in Nigeria with the formulation and approval of the National Information Technology (IT) Policy in March, 2001. The formulation of the IT policy was a consultative process that brought together major IT stakeholders such as Computer Association of Nigeria (COAN) now known as Computer society of Nigeria, National Information Technology Professional Associations (NITDA), Association of Licensed Telecommunication Companies in Nigeria (ALTCON) as well as all Nigerians in the Diaspora. The IT policy has very clear-cut policy goals on the development of the national information backbone to engender seamless interconnectivity in ICT infrastructure development in Nigeria. The policy document has it that the government, through the National Information Technology Development Agency (NITDA), shall establish and develop a National Information Infrastructure (NII) backbone as the gateway to the Global Information Infrastructure (GII) interconnecting it with State Information Infrastructure (SII) and the Local Information Infrastructure (LII). The policy also plans to encourage the local production of ICT equipment and materials such as computer and telephones. NITDA is expected to work with the private sector in actualising these goals.

1.2 Statement of the Problem

Though ICT is known to be a major contributor to social and economy welfare, the Industry has not been thriving as expected in Nigeria. One reason for this is that the country has been participating in ICTs mainly as consumers. The country lacks

innovation, capacities and capabilities in ICT development. New forms of knowledge and higher level of skills that could lead to innovation is either low or where available are not being utilized. This is least expected considering the dynamism of ICT in developed economies and with the rate of technical obsolescence much faster with ICT compared with the natural technologies such as steel, textiles and petrochemicals. Africa, especially Nigeria considered to be the giant of Africa could face the difficulty of sourcing for parts, components and peripherals, unless they begin to accumulate the capacity for component manufacture.

Aside, the lack of innovation, capacities and capabilities, the level of interrelationships between the firms in the sector is not known and where known is not strong enough to lead to distinctive synergetic competitiveness in any area of expertise. In addition, level of contributions from government agencies and Industrial Development Centres (IDCs) towards learning and acquisition of skills in the Sector is uncertain and not measurable. Public institutions relevant to ICT are isolated from the needs of firms in the industry.

1.3 Research Questions

- (i) What are the capabilities (potentials, competence and facilities) available in the industry?
- (ii) What are the various technological innovations (product and process) that have emanated over time from the operations of the firms?
- (iii) What are the factors that determine and influence the available capabilities and technologies?
- (iv) How does the innovativeness of the industry impact on its performance?

- (v) What impact has government policies and other external factors had on technological capabilities and innovativeness in the firms?

1.4 Objectives of the Study

The general objective is to carry out a study of selected ICT firms in Nigeria in terms of their process, product and organizational innovations with a view to providing information that would enhance growth and competitiveness in the industry.

Specific Objectives:

The specific objectives of the study are to:

- (i) Identify the technological innovations in selected ICT firms in Nigeria within the last ten (10 years).
- (ii) Identify the capabilities available in the firms
- (iii) Examine factors affecting technological innovations in the industry.
- (iv) Determine the impact of innovations on the performance of the firms.
- (vii) To develop appropriate strategies to enhance technological capabilities and innovation in the sector.

1.5 Significance of the Study

ICTs are a systemic and pervasive set of technologies. They are associated with fundamental institutional, social and economic restructuring. In developed countries, the diffusion rate of ICTs is very rapid, facilitates human development and produces material benefits. In such countries, ICT contribute to an innovative climate and institutions, adequate supply of skills and finance, disposable income and investment capital, policy intervention among others. However, in many more countries, where the learning, skill and needs of ICT are not adequately explored and given attention, there exist a vicious

cycle of absence of innovation, participating in ICTs as consumers only, ICTs being poorly integrated with the rest of the economy and society, lack of skilled people and finance, low levels of income and insufficient policy capability.

The positive benefits of diffusion of ICTs which include productivity gains, job creation, improvements in wealth, enhancement of well-being, are for the most part, limited to wealthy countries. In those countries, the rapid diffusion of ICTs has been facilitated by technological innovation, economic restructuring in OECD countries, reorganization of firm-level production processes, changes in functioning of markets and social and political change, and through a series of feedback effects, has produced material and social gains.

The need to transform Nigeria into a knowledge-based economy should be motivated by the necessity to shift from an input-driven to a productivity-driven growth strategy. For a knowledge economy, national plans and strategies must relate to improving human resource and skill capability, others include institutional development, incentives, information structure, science and technology capacity, public and private sector reforms and bridging the digital divide. Malaysia in her quest to become a knowledge-based economy undertook the Eighth Malaysia Plan, 2001-2005 and introduced a host of measures, taken from the Knowledge Economy Master Plan. These included the areas of human resource development, research and development, science and technology, venture capital financing, ICT infrastructure, content development, promoting electronic based activities as well as creating a supportive regulatory framework.

Chinese information and communication technology (ICT) firms have developed in the past 20 years into internationally competitive players and major contributors to their country's industrial development. To reach this position they have innovated new products that are competitive on the world market. This achievement is particularly significant since China remains a poor country in terms of per-capita income, and other developing countries have failed to make similar breakthroughs. Hence, there is a need to research how this has been accomplished. One important aspect that has not been studied is how the specific make-up of labour market institutions for knowledge workers, including the mobility of knowledge between academic and business institutions influences the ability of companies to innovate.

Thus, it becomes imperative that a study of this nature would in no doubt contribute to building a knowledge-driven society and address need issues that would position Nigeria into emerging as one of the leaders in ICT development. The implementation of the policy recommendation made in this study would enable Nigerian ICT firms to compete globally.

Expected Outcome

The research would provide information that would enhance the technological capability of the firms in the sector.

CHAPTER TWO: LITERATURE REVIEW

- 2.1 Technological innovations and industrial development
- 2.2 The Nigeria industrial sector
- 2.3 The concept of micro and small-scale firms
- 2.4 Information Communication Technologies (ICTs) around the world
- 2.5 The ICT sector in Nigeria
- 2.6 The concept of Innovation
- 2.7 Innovation and the ICT industry
- 2.8 The OSLO manual
- 2.9 Measuring innovations in developing countries
- 2.10 Technological innovations and its promotion
- 2.11 Concept of technical change
- 2.12 Technology innovation activities and strategies
- 2.13 Roles of government in technology innovations

CHAPTER 3

METHODOLOGY

3.1 Introduction

The Oslo manual, which contains guidelines for collecting and interpreting technological innovation data, was employed for this study. However, due to the peculiar nature of innovation in developing economies where dissemination mechanisms and incremental innovations account for most of the innovations that occur, the proposal for an annex to the oslo manual as a guide for innovation surveys in less developed countries was also adopted. Thus, consideration are given to technological content of exports, absorption (in terms of technological transfer) capability of the system, strengths or weaknesses of the industry and of its innovation system in general, identification of networks, relationship between formal education level and evolution of employment as well as the effectiveness of different public instruments for supporting and promoting some activities performed by private actors in the sector.

3.2 Conceptual Framework

In order to derive the basis for which information can be collected for the study of technological innovations, concepts and activities that constitute technological product and process innovation were considered. Scholars of innovation manuals have made efforts to explain the complex nature of innovation as having diversified activity with many interacting components of which sources of data need reflect. A coherent understanding of the different types of technological innovations and activities gave insight into what constitute an innovative firm, the complexity of the innovation process and the variations in the way it occurs in different types of firms. Thus, this study

concentrates on innovation at the level of the firm and more particularly adopted the neo-Schumpeterian approach and the chain-link model of innovation which views innovation in terms of interaction between market opportunities and the firm's knowledge base and capabilities. Also, in consequence of the policy and analytical needs that the study intends to articulate, the six key areas for study proposed by the Oslo manual were captured. These include; corporate strategies, the role of diffusion, sources of information for innovation and obstacles to innovation, inputs to innovation, the role of public policy in industrial innovation, and innovation outputs.

3.3 Area of Study

The study would cover one state each from the former three regions of the country (northern, western and eastern regions) demarcated by the Niger and Benue rivers. These include Kano, Lagos and Rivers state. The states were selected based on their predominant commercial activities and their age-long existence coupled with the proximity of Lagos and Rivers to sea ports. Furthermore, Lagos house the popular otigba cluster which is believed to be representative of ICT developments rapidly taking place in other cities of Nigeria and even in Africa. The study would cover mainly ICT firms and institutions.

3.4 Research Instrument

The study would employ the use of structured questionnaires and personal interviews to obtain primary data from mainly ICT firms involved in production, engineering, maintenance and sales of radio, television, telephones, global system for mobile communications (GSM), computer (notebooks, laptops and desktops) hardware and software and its accessories such as power pack, unlimited power supply (UPS), printer,

storage devices, modems and servers. Secondary data from reports, journals, internet, government publications and newspapers would also be used.

3.5 Sample Population and Sampling Technique

From the Goldstar Directories of the major 5,000 companies in Nigeria (2007/08), 21% (1066) were found to be ICT firms having a range of 10 – 300 employees. A sample size calculator software by Raosoft, Inc © 2004, which is based on the normal distribution statistical method given by

$$\begin{aligned}
 x &= Z(c/100)^2 r(100-r) \\
 n &= \frac{N x}{((N-1)E^2 + x)} \\
 E &= \text{Sqrt}[\frac{(N-n)x}{n(N-1)}]
 \end{aligned}$$

where n is the sample size, E is the margin of error, N is the population size, r is the fraction of responses of interest, and $Z(c/100)$ is the critical value for the confidence level c ; was used to select 275 ICT companies in Nigeria situated in Lagos, Kano and Rivers state; with 5% margin of error, 95% confidence level, population size of 1066 firms and a response distribution of 60%. A purposive sampling technique would be used to select the firms in the states.

3.6 Study Variables and Measurement

The study variables aside firm profile, structure, manpower development, licensing and networks would include activities involved in technological product and process (TPP) as well as marketing and organization innovations. They include the four major innovations that shall be measured using the innovative index based on the work of Romijn and Albaladejo, 2004.

1. Major Type of Innovation

- (a) Product innovation (introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics)
- (b) . Process innovation: implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.
- (c) . Marketing innovation: implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.
- (d) . Organisational innovation: implementation of a new organisational method in the firm's business practices, workplace organisation or external relations.

Since the 2005 edition of the *Oslo Manual*, two new types of innovation that can be considered non-technological have been identified. They contrast with product and process innovations, which are considered more closely dependent on technology. They are included in innovation surveys in less details and are defined as follows:

- A *marketing* innovation is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.

- An *organisational* innovation is the implementation of a new organisational method in the firm's business practices, workplace organisation or external relations.
- The implementation of a significant change in the design of a furniture line to give it a new look and widen its appeal.
- First introduction of direct selling or exclusive retailing.
- First introduction of a method for varying the price of a good or service according to the demand for it.
- First introduction of management systems for general production or supply operations such as supply chain management, business re-engineering, lean production, quality management system.
- First establishment of formal or informal work teams to improve access to and sharing of knowledge from different departments, such as marketing, research and production.
- First use of outsourcing of research or production.

2. Degree of novelty

(a) Diffusion: the way in which innovations spread, through market or non-market channels, from their first worldwide implementation to different consumers, countries, regions, sectors, markets, and firms. The minimum entry for a change in a firm's products or functions to be considered as an innovation is that it must be new (or significantly improved) to the firm.

(b) New to the firm: A product, process, marketing method, or organisational method can already have been implemented by other firms, but if it is new to the firm (or in case of products and processes: significantly improved), then it is an innovation for that firm.

(c) New to the market: the firm is the first to introduce the innovation onto its market. The market is defined as the firm and its competitors. The geographical scope is subject to the firm's own view of its operating market and thus can include both domestic and international firms.

(d) New to the world: the firm is the first to introduce the innovation for all markets and industries, domestic and international. This implies a qualitatively greater degree of novelty than new to the market.

(e) Disruptive innovations: an innovation that has a significant impact on a market and on the economic activity of firms in that market. This focuses on the impact of innovations as opposed to their novelty. These impacts can, for example, change the structure of the market, create new markets, or render existing products obsolete. However, it might not be apparent whether an innovation is disruptive until long after the innovation has been introduced.

Table 3.1: Scale for Grading Enterprise's Innovations

Degree of Novelty		Low (Degree of Novelty) High	
		Clever Gimmick	Science-intensive
1. Major innovations (products, processes, marketing and organization)	a) Fundamentally new to the world	4	5
	b) Similar innovations adopted in other industries (new to the firm)	3	4
	c) Similar innovations adopted in enterprise's own industry, but its innovations differ in identifiable ways from other Enterprise' innovations	3	4
	d) Same or very similar innovations adopted by competitors	2	3
	e) No major innovations at all	0	0
2. Incremental innovations	Yes	1	3
	No	0	0

3. Measurement of Innovative Index

Two proxies will be used, based on the work of Romijn and Albaladejo (2004). The first proxy measure, called ‘innovation index 1 (II -1), will be based on the presence or absence of ‘major’ innovations during the three years preceding the study.

The second proxy, ‘innovation index 2 (II-2), which is more complex, will capture the incidence of major innovations, and also an assessment of their originality and technological complexity. It will also include a rating for the importance of ‘incremental’ innovations

By degree of innovativeness:

- The innovative firm is one that has introduced an innovation during the period under review. The innovations need not have been a commercial success – many innovations fail.
- An innovation active firm is one that has had innovation activities during the period under review, including those with ongoing and abandoned activities. In other words, firms that have had innovation activities during the period under review, regardless of whether the activity resulted in the implementation of an innovation, are innovation active.
- A potentially innovative firm is one type of “innovation active firm”, that has made innovation efforts but not achieved results. This is a key element in innovation policies: to help them overcome the obstacles that prevent them from being innovative (converting efforts into innovations) – Annex for developing countries.

4. Innovation activities

Innovation activities are all the scientific, technological, organisational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations. Some innovation activities are themselves innovative, others are not novel activities but are necessary for the implementation of innovations. Innovation activities also include R&D that is not directly related to the development of a specific innovation.

(a) Innovation activities for product and process innovations

- *Intramural (in-house) R&D*: This comprises all R&D conducted by the enterprise, including basic research
- *Acquisition of R&D (extramural R&D)*: R&D purchased from public or private research organisations or from other enterprises (including other enterprises within the group)
- *Acquisition of other external knowledge*: Acquisition of rights to use patents and non-patented inventions, trademarks, know-how and other types of knowledge from other enterprises and institutions such as universities and government research institutions, other than R&D.
- *Acquisition of machinery, equipment and other capital goods*: Acquisitions of advanced machinery, equipment, computer hardware or software, and land and buildings (including major improvements, modifications and repairs), that are required to implement product or process innovations.
- *Other preparations for product and process innovations*: Other activities related to the development and implementation of product and process

innovations, such as design, planning and testing for new products (goods and services), production processes, and delivery methods that are not already included in R&D.

- *Market preparations for product innovations:* Activities aimed at the market introduction of new or significantly improved goods or services.
- *Training:* Training (including external training) linked to the development of product or process innovations and their implementation.

(b) Innovation activities for marketing and organisational innovations

- *Preparations for marketing innovations:* Activities related to the development and implementation of new marketing methods. Includes acquisitions of other external knowledge and other capital goods that are specifically related to marketing innovations.
- *Preparations for organisational innovations:* Activities undertaken for the planning and implementation of new organisation methods. Includes acquisitions of other external knowledge and other capital goods that are specifically related to organisational innovations.

5. Kinds of innovation activities

- *Successful* in having resulted in the implementation of a new innovation (though they need not have been commercially successful).
- *Ongoing*, work in progress, which has not yet resulted in the implementation of an innovation.

- *Abandoned* before the implementation of an innovation.

6. Factors influencing innovation

- Objectives: Identifying enterprises' motives for innovating and measuring their importance
- Hampering factors: reasons for not starting innovation activities at all, or factors that slow innovation activity or have a negative effect on expected results. These include economic factors, such as high costs or lack of demand, enterprise factors such as lack of skilled personnel or knowledge, and legal factors such as regulations or tax rules. The ability of enterprises to appropriate the gains from their innovation activities is also a factor affecting innovation.

7. Objectives and effects of innovation

- Competition, demand and markets
- Replace products being phased out
- Increase range of goods and services
- Develop environment-friendly products
- Increase or maintain market share
- Enter new markets
- Increase visibility or exposure for products
- Reduced time to respond to customer needs
- Production and delivery
- Improve quality of goods and service
- Improve flexibility of production or service provision
- Increase capacity of production or service provision

- Reduce unit labour costs
- Reduce consumption of materials and energy
- Reduce product design costs
- Achieve industry technical standards
- Reduce production lead times
- Reduce operating costs for service provision
- Increase efficiency or speed of supplying and/or delivering goods or services
- Improve IT capabilities
- Workplace organisation
- Improve communication and interaction among different business activities
- Increase sharing or transferring of knowledge with other organisations
- Increase the ability to adapt to different client demands
- Develop stronger relationships with customers
- Improve working conditions
- Reduce environmental impacts or improve health and safety
- Meet regulatory requirements

8. Factors impeding innovation activities

- Knowledge factors:
 - Innovation potential (R&D, design, etc.) insufficient
 - Lack of qualified personnel: Within the enterprise / In the labour market
 - Lack of information on technology / markets

- Deficiencies in the availability of external services
- Difficulty in finding co-operation partners for: Product or process development / Marketing partnerships
- Organisational rigidities within the enterprise: Attitude of personnel/ managers towards change, Managerial structure of enterprise
- Inability to devote staff to innovation activity due to production requirements
- Institutional factors:
 - Lack of infrastructure
 - Weakness of property rights
 - Legislation, regulations, standards, taxation
- Cost factors:
 - Excessive perceived risks
 - Cost too high
 - Lack of funds within the enterprise
 - Lack of finance from sources outside the enterprise: Venture capital / Public sources of funding
- Market factors:
 - Uncertain demand for innovative goods or services
 - Potential market dominated by established enterprises
- Other reasons for not innovating:
 - No need to innovate due to earlier innovations

- No need because of lack of demand for innovations

9. Impacts and outcomes

- Impacts of innovations on firm performance range from effects on sales and market share to changes in productivity and efficiency. Important impacts at industry and national levels are changes in international competitiveness and in total factor productivity, knowledge spillovers of firm-level innovations, and an increase in the amount of knowledge flowing through networks.
- The outcomes of product innovations can be measured by the percentage of sales derived from new or improved products.

To evaluate the impact of innovations on business performance based on annual profit, the following model will be considered as relevant:

Performance of ICT firms will be measured in terms of profitability in the last accounting year. Mathematically, this will be expressed as:

$$Q_0 = f(X_i)$$

Where:

$i = 1, 2, 3, \dots, 10$ for ICT firms

Q_0 = Performance (Measured in terms of profitability)

X_1 = age of the enterprise (based on year of establishment)

X_2 = staff strength (total number of employees)

X_3 = educational qualifications

X_4 = working experience measured in years

X_5 = investment in research and development (measured in Naira investment)

X_6 = investment in training (measured in Naira investment)

X_7 = product innovation (Dummy: Yes = 1, No = 0)

X_8 = process innovation (Dummy: Yes = 1, No = 0)

X_9 = Organisational innovation (Dummy: Yes = 1, No = 0)

X_{10} = Marketing innovation (Dummy: Yes = 1, No = 0)

10 Linkages

- The innovative activities of a firm partly depend on the variety and structure of its links to sources of information, knowledge, technologies, practices, and human and financial resources. Each linkage connects the innovating firm to other actors in the innovation system: government laboratories, universities, policy departments, regulators, competitors, suppliers, and customers.

Innovation surveys can obtain information on the prevalence and importance of different types of linkages, plus the factors that influence the use of specific linkages.

- Types of external linkages:
 - (a) *Open information sources* provide openly available information that does not require the purchase of technology or intellectual property rights, or interaction with the source.
 - (b) *Acquisition of knowledge and technology* are purchases of external knowledge and capital goods (machinery, equipment, software) and services embodied with new knowledge or technology that do not involve interaction with the source.

(c) *Innovation co-operation* is active co-operation with other firms or public research institutions for innovation activities (which may include purchases of knowledge and technology).

- Sources for transfers of knowledge and technology
 - Internal sources within the enterprise:
 - *R&D
 - *Production
 - *Marketing
 - *Distribution
 - Other enterprises within the enterprise group
 - External market and commercial sources:
 - *Competitors
 - *Other enterprises in the industry
 - *Clients or customers
 - *Consultants/consultancy firms
 - *Suppliers
 - *Commercial laboratories
 - Public sector sources:
 - *Universities and other higher education institutions
 - *Government/public research institutes
 - *Private non profit research institutes
 - *Specialised public innovation support svcs

- General information sources:

Patent disclosures / Professional conferences, meetings, literature and journals / Fairs and exhibitions / Professional associations, trade unions / Other local associations / Informal contacts or networks / Standards or standardisation agencies / Public regulations (*i.e.* environment, security)

3.7 Design and Administration of Questionnaires

A structured questionnaire would be designed having six sections.

- Questions in section A would identify firm's nature of business and profile.
- Section B would assess the skill(s) training and development of respondents;
- Questions in Section C would verify the licensing and linkages that exist in the firms;
- Section D would collate the types of innovation and innovation activities within the study period.
- Section E would post questions on reasons for innovating
- Questions in Section F would elicit from respondents sources of information for innovation.
- Section G would measure the impact of innovation on firm's performance
- Section H would elicit information on obstacles to innovation in the firms
- Section I would post questions on R&D and Patents
- Section J would post questions on the use of ICT

- Section K post questions on government support and policy for the ICT industry in Nigeria.

3.8 Pre-testing of the Questionnaire

The pilot test would be conducted in Ibadan, Oyo state with about 10 firms.

3.9 Data Analysis

The data gathered would be sorted, coded and analyzed using the Statistical Package for Social Science (SPSS) and Microsoft Excel. These tools are found to be adequate for the kind of data that would be gathered. Quantitative methods of analyses both descriptive and inferential statistics would be used.

REFERENCES

- Aderemi, H.O (2006) Deployment of ICT for the Empowerment of Rural Women in Nigeria; Journal of Sciences, Engineering and Environmental Technology, vol.1, 2006 ISSN 0794-9650
- European Commission Information Society and Media DG; BU31 01/18 B-1049 Brussels; May 2006 Information sheet 7.2a (Fact sheets 6, 35) Downloaded on March 10, 2008 from http://ec.europa.eu/information_society/eeurope/i2010/docs/info_sheets/7-2a-i2010-innovation-en.pdf
- FMCI (2007) A One-Day Private Sector Consultative Dialogue with the theme “Achieving Vision 20-2020” organised by the Federal Ministry of Commerce and Industry On Tuesday, 16th October 2007 at the Muson Centre, Onikan – Lagos Assessed at <http://www.nigeria.gov.ng/NR/rdonlyres/A5F7621C-C07B-42AF-8FA9-D185A87F7B2D/955/AchievingVision2020.pdf> on March 8, 2008
- Gustavo Lugones and Fernando Peirano, 2004 Proposal For An Annex To The Oslo Manual As A Guide For Innovation Surveys In Less Developed Countries Non-Member of The Oecd. Researchers of Centro REDES (Centro de estudios sobre Ciencia, desarrollo y Educación Superior) and members of Red Iberoamericana de Indicadores de Ciencia y Tecnología (RICYT; Ibero-American Network of Science and Technology Indicators).
- Information and Communication Technologies (ICTS) in Africa – A Status Report Sept 7 2002 downloaded from www.itu.int/osg/spu/wsis-themes/UNMDG/jensen-icts-africa.doc March 2008

Mohammed M.Y.B. (2005) Knowledge Content in Key Economic Sectors in Malaysia; A Speech by the Minister in the Prime Minister's Department at the Launch of the 2004 Report on Knowledge Content in Key Economic Sectors in Malaysia. Downloaded from [http://www.epu.jpm.my/New%20Folder/speech/dato%20pa/EPU%20-%20Knowledge%20Content%20Report%202004%20\(6%20Sep%202005\).pdf](http://www.epu.jpm.my/New%20Folder/speech/dato%20pa/EPU%20-%20Knowledge%20Content%20Report%202004%20(6%20Sep%202005).pdf) on May 31st 2007.

OECD (2005) Organisation For Economic Co-Operation And Development, The Measurement Of Scientific And Technological Activities Proposed Guidelines For Collecting And Interpreting Technological Innovation Data Oslo Manual European Commission

OECD (2007) Science, Technology and Industry Scoreboard 2007, Innovation within companies pp 34

OECD (2007) Science, Technology and Industry Scoreboard 2007, Innovation and economic performance pp 35

OECD (2007) Science, Technology and Industry Scoreboard 2007, Innovation and economic performance pp 35

OECD (2007) Science, Technology and Industry Scoreboard 2007, R&D in Selected ICT industries pp 53

OECD 2002 Frascati Manual, Proposed Standard Practice for Surveys on Research and Experimental Development

- Ogbimi, F.E.(2000) Establishing the relevant framework for research activities in Nigeria. Lecture material, Technology Planning and Development Unit, Obafemi Awolowo Un iversity, Ile-Ife, Nigeria
- Oyelaran-Oyeyinka et al (2007) Small and Medium Enterprise Clusters in Nigeria: Institution Policies and support Systems
- Ramirez M. et al (2006) Labour Markets and Knowledge flows in the Chinese National System of Innovation. Downloaded from <http://www.sci-soc.net/SciSoc/Projects/Economics/Labour+markets+and+knowledge+flows+in+the+Chinese+national+system+of+innovation.htm> on May 31st 2007
- Raosoft, Inc © 2004; Sample Size Calculator Software downloaded from www.raosoft.com/samplesize.html on May 31st 2007
- The Basel Action Network 2005, The Digital Dump: Exporting Re-use and Abuse to Africa. Media Release Version, A Project of Earth Economics
- UNESCO, 2007 Measuring Research and Experimental Development Statistical Capacity Building Workshops, UNESCO Institute for Statistics