

## Adoption of Information & Communication Technologies in Developing Countries: An Impact Analysis

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### Abstract

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

*In developing countries Nigeria precisely, preliminary investigations show that only a few organizations in the economy have adopted the IT, but there has not been formal study to determine the level of diffusion and the factors affecting IT diffusion as well as impact on the efficiency of the organizations. This study, is therefore, designed to determine the level of diffusion in the Nigerian economy, and the impact on the operations of these organizations as well as investigating the factors responsible for the present level of diffusion of these technologies in the economy.*

**Keywords:** Network, Diffusion, Communication, Organization and Internet.

### Introduction

How to adopt Information Technology (IT) successfully in Developing Countries is one of the most pressing current developmental issues (Kim, 2000). Since IT became commercial in the early 1990s, it has diffused rapidly in developed countries but generally slowly in developing ones. This has led to a widening IT gap known as *digital divide* between the two groups. The IT gap among developing countries is also increasing. The more advanced, such as the Newly Industrialized Economies (NIEs), Brazil, Chile, Estonia and Malaysia, have made enormous progress toward a digital economy, but many of the rest of the developing nations remain much more backward.

The world has an estimated 350 million internet users. Over 90% of them are in industrial countries, although developing countries comprise about 85% of the world population (Berndt and Morrison, 1995). Furthermore, while Internet use is not limited to certain groups of

individuals (in terms of ages and sexes) in industrial countries, the internet users in developing countries are mostly young, male, urban individuals in the middle and upper income groups. In developing countries, IT has not been effectively adopted by many micro-enterprises, agro-industries, small traders, farming/livestock households, public offices, schools, health centres, etc., particularly in rural areas.

National economies are increasingly tightly tied together globally by ultra high-speed information networks. In these circumstances, problems created by the digital divide include a vicious cycle. Lack of IT leads to lower productivity growth, loss of business opportunities and lower incomes (Brynjolfsson and Hitt, 2000), which in turn impede use of the latest technologies, including IT. An individual (or a country) that lags behind finds it difficult to catch up with the state-of-art IT because of this vicious cycle and the rapid progress in IT. This paper however, identifies the impact of IT diffusion in developing countries, particularly Nigeria.

## **Technology Revolutions, Information and Growth**

### **Revolutions in Technology**

Although tremendous technological advances took place over the past 100 years in several sectors, such as transport, communications, electrification and medicine, recent ones are much more comprehensive and powerful. Their salient characteristics involve convergence and interaction of many strands of technological change, with social consequences far more profound and far more difficult to foresee. They fall into three basic categories or strings of technical changes: in materials, in biotechnology and in information (Hallberg and Bond, 2000). Research has discovered many new, innovative materials. Transport enjoys lighter materials for fuel efficiency; health care takes advantage of dynamic images and intelligent prosthetics; and the energy sector benefits from many new materials as well. Biotechnological advances dominate in health applications (therapeutics and diagnostics) and are spreading quickly to other areas. Marine biotechnology leads to better disease prevention and reproduction control of fish, while biotechnological applications in agriculture increase productivity, improve animal health and diversify products. Bioremediation technology in the environment field provides new methods for waste and water treatment, waste-site cleanup and forest restoration. The revolution in IT has itself been brought forth by a company of innovations in telecommunications and informatics, made possible by cheaper new lightweight materials (e.g. optical fibres) transmitting information faster. Information flows faster and less expensively throughout the globe, but it will take substantial time to reach full digitalization given the youth of IT.

### **Information and Economic Growth**

Among the three strings of technological advance, IT is much more powerful than the others in deciding the magnitude and quality of economic production. Information, together with capital and labour, is a critical, essential production factor. It is a major contributor to labour productivity and total factor productivity. An increase in information content has significantly changed the concept of production, signifying the importance of timely information flows. Firms failing to incorporate new information can be left behind in gaining productivity and competitiveness,

given that the scope of the impact of new information technology is much broader than that of other technologies. While they impact on limited sectors, IT does so across the board. IT also significantly changes corporate behaviour and organization structure, which should increase productivity (Brynjolfsson and Hitt, 2000). Many of the early studies on the role of information technology in productivity, which generally used economy or sector data, found little evidence of significance. See, for example, Roach (1987), Berndt and Morrison (1995), and Morrison (1996).

Since the mid-1990s, however, analyses at the firm level have begun to find positive effects of information technology on firms' productivity. Using data from over 300 large firms for 1988–1992, Brynjolfsson and Hitt (1995, 1996) and Lichtenberg (1995) found a clear, positive relationship between firm-level IT investment and multifactor productivity, despite a great deal of individual variation in firms' success with information technology. Many other studies also suggest that information technology contributed to substantial increases in output and productivity (Greenan and Mairesse, 1996; Kelley, 1994; Mukhopadhyay *et al.*, 1997).

### **Required measures for IT Diffusion and Financing options**

A major barrier in IT diffusion is the poor condition or limited availability of physical infrastructures in developing countries. Existing telecommunications networks are often limited to urban areas only, and even these offer poor services in contrast with the ultra high-speed systems present in IT-advanced countries. Modernizing existing infrastructures as well as building new ones in rural and remote areas is thus the key issues. The following considerations are important in augmenting IT infrastructures:

- a. They should be financially sustainable;
- b. Systems should meet satisfactory equity criteria; and
- c. Maximum use of the infrastructures must be ensured.

IT services generally are provided through communication lines, and it is essential to build or improve these facilities in underdeveloped areas. Telecommunication line construction in remote areas, however, although responding to the equity consideration, will not ensure maximum use and will not be financially sustainable, with costs much higher than collectable service charges, given the low demand in such areas. Cheaper, complementary methods should therefore be identified as basic infrastructures are developed step by step. One would be to use satellites, which should cover as many areas as possible to ensure economies of scale and financial sustainability. Many countries use satellites as a major telecommunications infrastructure; they are particularly popular in Eastern European countries. Cellular-phone services, which do not require wires, offer another method. Example is the thuraya mobile phone. Wireless telecommunication services are rapidly replacing wired ones and are leading in the telecommunication markets.

The next issue concerns how to distribute efficiently the information/data received from the infrastructures. Individual receiving is too costly in remote areas. An alternative uses a collective method called a telecentre. A telecentre provides the public with access to information and communication technologies for personal, educational, social and commercial/economic purposes. The first telecentre was established in the mid-1980s in a Swedish rural agricultural community (Brynjolfsson and Hitt, 1995)

It became a powerful concept to bring the latest technologies to remote communities traditionally neglected by the market. The telecentres contributed to an equitable expansion of the telecommunications network and offered rural communities the chance to adopt information and communications technologies to their benefit, strengthening social ties within the community and economic ties with the outside world. Since then, the concept has spread rapidly around the world. Governments, development institutions, non-profit organizations and entrepreneurs operate them, in different forms to accommodate local conditions and opportunities. Telecentres have brought a visible and identifiable change in the skills and capacities of people and institutions in communities Fuchs (2000).

Shakeel (2000) found out that, although their objectives, sizes and configurations can vary, the key characteristics of telecentres include:

Developing infrastructures is expensive and requires heavy funding, which cannot be borne by individuals in rural communities. The problem relates not only to the costs themselves but also to financial sustainability of the infrastructures. Except in special cases, therefore, the local or national government must be involved in the construction of the projects with a notion that IT should be a universal service to all inhabitants of the country, a public-goods concept. International donors may co-finance the projects to bridge the funding gap. If the circumstances allow the participation of private companies in developing the infrastructures, arranging co-financing with the provision of certain risk-hedging formulas should encourage their participation. Necessary legal/regulatory arrangements should facilitate efficient and effective private sector operation and provide some incentives; for example, companies diffusing IT in IT-underdeveloped areas might be given priority to receive licenses to run commercial telecommunications services in other, profitable areas. Other measures that can encourage private participation include privatization of state owned enterprises to increase market competition and economic efficiency; de-monopolization of niche sectors (*e.g.* cellular phones); foreign participation; government guarantees; supports for financing arrangements; and policy and institutional reforms.

### **Current trends in Internet usage in Nigeria**

The Internet has become an important tool for business growth, social activities and research in Nigeria. While the interest is well integrated into education, business and social activities in developed countries, Nigeria can be said to be attempting giant strides in embracing its usefulness and applications. Internet/cyber cafes have sprung up in major cities with majority of them in cities having educational institutions and in big commercial/business centres/activities. A large majority of Internet access is provided by these cyber cafes, universities and other research centres.

In developed countries, individuals are well connected to the Internet via various communication links but in developing countries, individuals might not get connected due to several reasons. These include:

- a. Absence of adequate communication network infrastructures.
- b. Relatively high cost of equipment that could not be afforded by the large low-income portion of the Nigerian population.
- c. Lack of government interest and support.
- d. Problems associated with technical and management support for Internet connection.

Several authors have discussed these problems and their potential solutions (Ahiakwo, 2002; Anao, 2002; Longe and Chiemeké, 2006). In Nigeria, the Executive Vice Chairman of Nigeria Communication Commission (NCC), Ernest Ndukwe describe the level of Internet diffusion as very low attributing the cause to high cost of bandwidth, computers and Internet infrastructure, as well as unreliable power supply. A casual investigation of the Nigerian ICT terrain reveals that wireless network will grow faster than wired network. This fact is supported by the rapid increase in mobile telephone subscribers in recent times (Chiemeké and Longe, 2007).

The major challenges facing ICT adoption can therefore be summarized under the following categories:

- a. The challenges of sustainable wired and wireless networks.
- b. Cost of connection.
- c. Security issues.
- d. Political instability/policy inconsistencies and
- e. Lack of effective coordination.

### **Correlating ICT with Socio -Economic Development**

One of the most potential benefits of the information technology revolution concerns the opportunities that become open to Nigerian businesses to access a wider global market through e-commerce. As e-commerce opens up the Nigerian market to foreign enterprises, the relatively affluent Nigerian consumer with access to the Internet is given much greater choice with regard to desired products and services. Nigeria has much to gain from the revolution in communication and information access. In contrast to the situation in developed world, where transport, communications and technological infrastructure for delivery of both physical and information services are well established. The alternatives available in developing countries are generally slow, expensive and inconsistent. The communications and information delivery capability of ICT products and related services serves all sectors of the society. The areas of education, health, social policy, commerce and trade, government, agriculture, communications and science and technology all benefit from access powered by ICT. These resources are interlinked and synergetic; individuals can visit and exploit relevant information sources, which often point to additional sources of information and to knowledgeable individuals.

The correlation between information, communication and economic growth are well known, making the significance of networks apparent. Electronic networking is a powerful, rapid and inexpensive way to communicate and exchange information. When networks are available, developmental changes can be sporadic.

In Nigeria, networking is now crucial to scientific research and development efforts, many of which yield tangible economic benefits. The country's commercial/economic growth is enhanced

by access to information and improved contact with support from purchasing personnel and customers as well. Access to GSM and satellite TV networks also improves the effectiveness of the development of communities, comprising representative of international agencies, staff of non-governmental organization and others working locally and abroad. Nigerian universities are focusing on curricula that might contribute more directly to economic growth and network connections.

### **Measuring ICT Diffusion**

Today, almost every country in the world has a direct connection to the Internet. Although this is an impressive achievement, ICT penetration levels vary among and within countries, thereby creating a digital divide between those with high and those with low access levels. The convergence of ICT industries and the new emphasis on addressing the digital divide, has led to the need for a set of policy-oriented information society statistics. Although, a number of ICT indicators already exist, they are often inappropriate for policy analysis; few countries collect pragmatic indicators for measuring access and even where they exist, international comparisons are often hampered by differences in definition and methodologies. They are also typically derived from administrative records rather than from purpose-built surveys. This statistical divide is as great as or even greater than the digital divide. A more precise way of measuring access is to examine the availability of ICTs in households. Universal Service, a fundamental regulatory concern is quantified in this way and is measured as a percentage.

### **Universal Access Indicators for Measuring ICT Diffusion**

Universal access indicators reflect the level of the population that is covered by ICTs. These indicators are typically expressed as the percentage of a country's inhabitants or households for which an ICT service is practically available. Universal access indicators are pertinent because they help identify barriers to ICT use. A high level of ICT coverage but low level of use suggests that other barriers besides infrastructure are the bottleneck. As in the case of Nigeria today, inhabitant may not use an ICT service for different reasons ranging from lack of interest, illiteracy, lack of awareness, exorbitant rate of services, poor quality of service and low per capita income.

### **ICT Diffusion Indicators**

Comparable statistics on access to and use of Information and Communication Technologies (ICTs), are critical to formulating policies and strategies concerning ICT-enabled growth, for social inclusion and cohesion and for monitoring and evaluating the impact of ICTs on economic and social developments. However, comparable information society statistics are very limited particularly in the developing world (UN, 2005).

The United Nations have identified four major sets of indicators for complete information technology diffusion in a country (Chiemeke and Longe, 2007):

- a. ICT infrastructure and access.
- b. Access to and use of ICT by households and individuals.
- c. Use of ICT by businesses and
- d. ICT sector and trade in ICT goods.

The answer to the question of level of access to ICT in Nigeria will depend largely on how ICT accesses are measured. The conventional way is to divide the number of access devices or services by the total population. While such per capita measures are convenient and useful for comparing general differences between and within countries, they can be misleading. This is because; a per capita indicator does not reflect the socio-demographic composition of the nation. For example, if there are 1, 000 mobile lines in Nigeria, all owned by the same person, is the country better off than a country with 500 telephone lines owned by 500 different people? Or is a country with fewer mobile lines but larger households worse off than a country with more lines and smaller household? Per capita measures also fail to take into cognizance the principles of sharing of communication infrastructures in households or of computers in Internet cafes, for example. They also fail to take into account access to ICTs through the workplace, school or through government initiatives. The lack of detailed breakdown of data provided by per capita measures also makes it impossible to set specific targets. The fact that most ICT access analysis rely on such conventional indicators can often result in mistaken assumptions.

In summary, we recommend the indices below as indicators for measuring ICT diffusion in Nigeria.

#### **Indicators on ICT Infrastructure and Access**

- a. Fixed telephone lines per 100 inhabitants.
- b. Mobile cellular subscribers per 100 inhabitants.
- c. Computers per 100 inhabitants.
- d. Percentage of population covered by mobile cellular telephony.
- e. Percentage of localities with Public Internet Access Centres by number of inhabitant (rural/urban).

#### **Indicators on Access to and use of ICT by Household and Individuals**

- a. Proportion of households with satellites/cable television connections.
- b. Proportion of households with a fixed line telephone.
- c. Proportion of households with mobile cellular telephone.
- d. Proportion of households with a computer.
- e. Proportion of households with Internet usage at home.

#### **Indicators of ICT Usage by Businesses**

- a. Proportion of businesses using computers.
- b. Proportion of employees using computers.
- c. Proportion of businesses using the Internet.
- d. Proportion of employees using the Internet.

### Indicators on the ICT Sector and Trade in ICT Goods

- a. Proportion of total business sector workforce involved in the ICT sector.
- b. Value added in the ICT sector (as a percentage of total business sector value added).
- c. ICT goods imports as a percentage of total imports.
- d. ICT goods exports as a percentage of total exports.

### Conclusion

While some developed nations are racing ahead in measurement, tracking a multitude of factors such as ICT infrastructure, access, usage, volume and value, many developing nations are struggling to produce even ICT indicators. A globally relevant approach needs to concentrate on trends that can be measured to a comparable extent in all countries. In this study however, we have outlined the current trend in ICT usage in Nigeria while also shedding light on the areas of challenges. We discussed that access to ICTs is doubtless the most fundamental prerequisite for an inclusive information society. Measuring access is therefore a key priority for a set of indicators that are relevant in order to judge the effect of ICT on the socio-economic growth of developing nations.

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