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**Information Technology and the
Challenge of Economic Development in
Africa**

by

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African Development Bank

The views and interpretations in this paper are those of the author
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Introduction

The recent advances in information technology are becoming central to the process of socio-economic development. Information technology offers new ways of exchanging information, and transacting business, changes the nature of the financial and other service sectors and provides efficient means of using the human and institutional capabilities of countries in both the public and private sectors. The world is rapidly moving towards knowledge-based economic structures and information societies, which comprise networks of individuals, firms and countries that are linked electronically and in interdependent relationships.

In an increasingly globalized economy, information technology is one of the key determinants of competitiveness and growth of firms and countries. Firms are becoming more competitive on the basis of their knowledge, rather than on the basis of natural endowments or low labor costs. It is becoming increasingly apparent that the role of traditional sources of comparative advantage (a large labor force and abundant natural resources) in determining international competitiveness is diminishing. The competitive and comparative advantages of countries are gradually being determined by access to information technology and knowledge. The comparative advantage that now counts is man-made, engineered by knowledge through the application of information.

Since man-made comparative advantage can only be acquired by knowledge and brainpower, the newly emerging knowledge-based economic structures have far reaching implications with regard to labor markets and the roles of technical education, human capital formation and research and development in the process of economic growth. The evolution of the knowledge-based economy is expected to result in increasing the demand for skilled labor and reducing the employment prospects of unskilled labor. And within economies, enterprises would succeed only to the extent that their employees can access and use information and knowledge effectively.

Information technology does not only determine the market share and profitability of individual companies in tomorrow's global economy, but it also has a huge impact on future generations of workers and on a country's economic prospects. What are the implications of information technology for the relative fortunes of nations? Countries that invest in and adopt information technology quickly will move ahead and those that fail to rapidly adopt information technology will be left behind.

The views on the possible impact of the information revolution on African countries can be grouped in two opposing schools of thought. The first school predicts that as African countries incur an increasing 'technological deficit' the welfare gap between them and the industrialized world would increase. This school stresses that Africa risks further reduction in its ability to generate the resources necessary to accelerate its growth rate and reverse the trend of increasing poverty. On the other hand, the second school believe that information technology may actually help reduce the income gaps between rich and poor countries. In the words of Negroponte (1998): "the Third World five years from now may not be where you think it is. There have been many theories of leapfrog development, none of which has yet survived the test of time. That's about to change".

The basic issue separating the two schools with regard to the impact of information technology on African countries is the question of whether Africa and other developing regions could, in the first place have adequate access to the global information infrastructure, and hence to the information technology age. The prediction of the first school stems from the notion that, starting from an initial position of poverty,

African countries would not be able to finance the investments in information infrastructure and computer hardware and software required to access the information technology age. This would, in turn, mean that they would risk increased marginalization in the global economy with severe competitive disadvantage for their goods and services, and hence for their development prospects. The prediction of the second school is based on the argument that the information technology, itself, would provide the means for countries to turn their disadvantages into advantages; adjust to the new ways of doing business; and, put in place the required infrastructure of telecommunications and information systems.

This paper reviews Africa's development challenges in an increasingly information and knowledge-based global economy. It outlines the roles of knowledge and information technology in addressing these challenges and also discusses the strategies and policies that Africa and its development partners particularly the African Development Bank could adopt to accelerate the process of integrating the region into the emerging global information system. The paper is organized in five sections. Following this introduction, the next section examines the major developmental challenges facing Africa and what role information technology could play in overcoming them. Section III outlines the policies that would need to be adopted by African countries to improve their information accessibility and examines the initiatives taken by African countries in this domain. Section IV examines the role that could be played by the African Development Bank Group. The conclusion of the paper is provided in the last section.

Development Challenges and Information Technology

Africa's overarching objective remains fundamentally one of accelerating economic growth and reducing widespread poverty. To effectively reduce poverty, the pattern of economic growth would need to be broad-based so as to bring about social development and improvements in the welfare of African peoples. To this end, priority should be accorded to investing in physical as well as human capital, especially with respect to access to education, health and nutrition. It is also important to promote private-sector led growth and international trade. Furthermore, efforts would be needed to attend to cross-cutting issues such as environmental management. In a nutshell, Africa's quest for sustainable development should be based on the pursuit of the intertwined goals of accelerating the pace of economic growth, while also spreading the benefits widely among the population so as to make significant strides in poverty reduction. To achieve this fundamental objective, Africa faces a complex mix of development challenges that need to be tackled. Although vast and multifaceted, some of these include:

- Integrating Africa into the global trade and finance;
- Effective macroeconomic and public sector management;
- Promoting private enterprise development;
- Achieving agricultural development and food security;
- Ensuring Environmental Protection; and
- Promoting Human capital development.

Integrating Africa into the Global Trade and Finance

The world economy is becoming increasingly globalized and the centrality of international and regional trade to the process of economic growth and poverty reduction cannot be overemphasized. Trade performance sets the limit to which investments and growth can be expanded without encountering balance of payments and debt repayment problems. Therefore, in any open economy trade is one of the main driving forces of the process of economic growth. African countries, which are striving for sustainable economic growth and improved living standards, cannot afford to disregard the significant deterioration in its international market share. Africa's traditional exports have been increasingly displaced by new and relatively efficient producers from other regions. Over the last 25 years the region's world market shares in cocoa beans fell from 80 per cent to 67 per cent; in coffee from 26 per cent to 15 per cent; in cotton from 30 per cent to 16 per cent; in timber from 13 per cent to 7 per cent; and, in iron ore from 12 per cent to 2 per cent. The loss of Africa's markets in cocoa beans, coffee and timber was mainly to Asian countries; in iron ore to Latin American countries; and, in cotton to Eastern European countries (African Development Report 1995). Africa's overall trade share fell from about 6 per cent in 1980 to 2.1 per cent in 1995.

In addition to holding great potential for enhancing the productivity and supply of exports, the application of information technology to the demand side can help African countries improve their trade performance and recoup the losses in their international market share. This is particularly true because the poor export performance of African countries is largely attributed to non-price factors on the demand side. For instance, a study conducted for the African Development Report 1995 (see Hussain 1995), found that

price competitiveness (Africa's dollar export prices relative to the price of competitors) explain only about 25 per cent of the decline in Africa's market share. Non-price factors were found to be responsible for about 75 per cent of the decline in Africa's market share. These factors normally include the act of selling or marketing including information on markets and prices, speed of delivery, the extent and efficiency of distribution network, after sale services, quality, level of product sophistication and reliability. Inadequate exchange of trade information among developing countries, specifically among African countries, is one of the main reason for the low level of commercial exchange and this inhibits their economic growth. Trade and commercial activities record their best performance when producers, exporters and consumers are aware of each other's products, product-quality, and supply and demand capabilities. These functions are traditionally performed by trade exhibitions, trade promotion organizations and embassies.

Information technology offers effective methods to perform these trade promotion functions and address Africa's lack of international competitiveness. For instance, using the Internet, it is possible to access on-line information on markets, market regulations, prices, potential buyers and many import-export data. The use of computer technology for data processing would speed up delivery time by improving the internal and external networks, export-servicing facilities, customs operations, and reduce transaction costs. Mauritania, for instance, instituted computer-backed trade-management system with an initial investment of US\$1 million. The system reduced transaction costs associated with external trade as customs processing time was reduced from 48 hours to 30 minutes, and the time it takes to declare goods to between one and two days from 5 to 20 days (Talero and Gaudette 1996). The application of information technology will also make it possible for export producers to 'disintermediate' middlemen and conduct their transactions directly with exporters or export markets, increasing, thereby, their profitability and incentives to produce.

Equipping regional trading communities with efficient information technology systems that provide them with accurate and relevant information and exchange mechanism can be a major means of enhancing the growth of inter-African trade. There are already some efforts that have been made towards the attainment of these objectives. The African Ministers of Trade, in their Twelfth Session in Tunis, 1993, passed a resolution which requested the UN Economic Commission for Africa Secretariat in collaboration with the Secretariats of the Organization of African Unity (OAU) and African Development Bank (ADB) to study the prospects of establishing a data bank for dissemination of information on trade with the aim of promoting intra-African trade. Since then, a number of sub-regional economic cooperation groupings began to operate their own trade information networks. For instance, the secretariats of economic cooperation groupings-such as the Economic Community of West-African State (ECOWAS), the Economic Community of Central African States (ECCAS) and other regional groupings have already started to set up trade information systems and networks with the assistance of the International Trade Center. These have made some contributions towards building subregional trade information infrastructures. To date, however, the type of a regional trade information which links the countries of the continent with the rest of the world has not yet materialized.

The promotion of inter-African trade will also require efficient financial and payment systems to settle inter-regional transactions. For many African countries, this means harnessing information technology to improve the banking infrastructure; strengthen prudential regulations and the legal framework; build sound and efficient payment systems; and deepening capital markets. For instance, Mauritius is implementing a service sector modernization project which aims at improving banking and finance services. The project would develop an automated payments system within the banking and finance system; improve delivery of key public services with priority to those services which directly interface with the private sector, such as company and land registration; and modernize the legal framework, particularly in the areas of intellectual property, rules of evidence, data access and confidentiality. The development of national and regional capital markets will be facilitated by widespread adoption of information technology. In Cote d'Ivoire, the Abidjan stock market has now been transformed into the Bourse Regionale. The Bourse covers eight countries, with local representatives in each of the UEMOA countries linked by satellite information system to the main office in Abidjan. In 1997, the Nigerian Stock Exchange adopted computerized trading system to facilitate efficiency in the capital market.

Information technology will likely extend the scope of tradeables in the services. With internet as the main medium of electronic commerce, the globalization of services will be intensified permitting many professional services such as legal, accounting, medical and education to become tradeable across cities and countries. The widespread adoption of electronic commerce will likely transform other services aside from banking, brokerage, insurance and financial services, such as retailing, franchising, courier, tourism, hotel, entertainment, travel, advertising, consultancy and professional services, news and information services. For example, news and information services in several countries including Côte d'Ivoire, Kenya, Ghana, Zimbabwe and Tanzania can be obtained from local newspapers posted on the internet via Africa

Online, a private owned internet access company operating in these countries. Digital media is also increasingly available in other African countries.

Macroeconomic and Public Sector Management

Since the mid-1990s, African countries have made notable progress in the area of macroeconomic management. This progress was marked by restrictive fiscal policies which reduced overall budget deficits from 5.5 per cent of GDP in 1994 to a historic low of 1.9 per cent of GDP in 1997. In the last two years, 60 per cent of African countries had budget deficits below 5 per cent of GDP. Tighter financial policies further reduced inflation from 40 per cent in 1994 to 17.6 per cent with a median rate of inflation of 5.7 per cent in 1997. These improvements were associated with recovery in the growth of GDP which averaged 4.4 per cent during the period 1996-1997.

Although the recent improvements in macroeconomic management and economic growth are welcome, recovery remains fragile and the socio-economic setbacks of the previous two decades are yet to be overcome. While the decline in fiscal imbalances has contributed to non-inflationary economic growth, there is increased concern over the adverse impact of public expenditure reductions on the social sector. There is also some evidence that there are inefficiencies in resource mobilization and in the use of available resources. Progress in stabilizing the macroeconomic environment, strengthening the efficiency, accountability, and transparency of government can benefit a great deal from the introduction of information technology applications. Information systems which can help governments design, implement, and assess policy reforms are now powerful instruments of public policy. Such information systems could increase the speed, volume, quality, transparency, and accountability of government transactions, yielding large productivity increases in government services.

In fiscal monitoring, governments can use information systems to design and follow-up the process of tax collection and validate its revenue collections against its expenditure. In budgetary planning, information technology provides simulation techniques to simultaneously maximize revenue and minimize the tax burden on selected income groups and economic actors. In public procurement, the adoption of information technology can help simplify purchasing procedures through electronic advertising, qualification, tendering, selection and payment. In debt management, information systems can be used to co-ordinate the processes of borrowing and debt repayment transactions with the various bilateral and multilateral creditors in order to improve the efficiency and transparency in the use of foreign capital and avoid the problems of corruption and excessive debt burdens. Such applications are also labor-saving and can also help governments to keep a small, efficient and well-paid civil service. In Morocco, for instance, the Ministry of Finance is computerizing tax administration, auditing, and control. Information systems are also being used for public investment planning and public debt management. Computer-based modeling is being used in macroeconomic monitoring, external trade management, and industrial promotion. In Egypt, the Information Decision Support Center is established to provide advisory services to government ministries through effective information systems such as the debt management system and trade information system (Trade Net).

Private Enterprise and Industrial Development

Industrial performance has been poor in most of Africa and many African countries have suffered deindustrialisation. The real rate of growth of manufacturing value-added in the continent was only 3 percent per annum during the period 1980 to 1993, and the rate of growth declined over time, from 3.7 percent in the first half of the 1980s to under 2 percent in the early part of the 1990s (Lall 1996). One of the most important challenges to Africa's industrial development is the upgrading of the technological capabilities of local industries, particularly Small and Micro Enterprises (SMEs) which form the bulk of private sector industry and provide employment for a large number of people. SMEs make a potentially important contribution to economic and social development in Africa. Compared to larger firms, they tend to use less capital per worker and have the capacity to use capital productively. Small- and medium scale enterprises employ workers with limited formal training, and use local raw materials that would otherwise be neglected. They also mobilize the small savings of proprietors which tend to exist outside the formal banking system. Studies have shown that owners of SMEs have a surprisingly high propensity to save and invest, even at quite low income levels. In addition, SMEs have important linkages with large firms through subcontracting arrangements.

However, most firms in Africa operate in an information-poor environment. Collective support services to assist and facilitate technical learning are often poorly delivered, if they exist at all. Business associations are also weak and deliver very few, if any services. NGOs and international development agencies provide some useful services, but coverage is limited and the support services are aimed at only a few areas, such

as finance. In addition, with the exception of multinational companies and a few large exporters, most firms are technologically isolated from the rest of the world. Consequently, connections with international private learning sources, including foreign buyers and suppliers, are weak or non-existent. Information technology can be effectively used to increase the flow of information through providing information sources on technical and business matters; encourage vertical and horizontal linkages between firms; and increase the capacity of "learn-by-copying" and to "benchmark" the firm's operations against internationally competitive firms in the same business.

For small- and medium-scale enterprises to succeed in the current economic environment, forming networks and building alliances is important. As the global economy increasingly becomes more integrated and economic reforms take root in Africa, African businesses will have to network and build alliances to be able to survive and compete effectively. Where an alliance is formed by at least two firms coming together in some contractual arrangement, and a network refers to an elaborate system of connections and relations between various firms in the same or different line of business, by forming such networks and alliances, African businesses could place themselves in a position to innovate rapidly, improve their marketing skills, and compete effectively. Building alliances and networks has given rise to an idea of 'clusters' of SMEs which, through networking, reinforce each other and improve their international competitiveness. By harnessing information technology and pooling together their outputs, SMEs would be able to take advantage of economies of scale and compete effectively.

A number of factors make it imperative for African SMEs to harness information technology for the purpose of establishing networks and alliances. For one thing, existing and new markets are opening up as countries liberalize their trade in goods and services under the auspices of the World Trade Organization (WTO), and other forms of regional trading blocks and business becomes globalized. While offering better exporting opportunities, these developments have changed the requirements and rules of competition. In order to access these markets or compete effectively even in their own markets, it is imperative that African SMEs adopt a global outlook and form strategic partnerships, both domestically and in foreign markets. For instance, they could form strategic alliances with strong foreign distributors as a way of accessing new markets, while at the same time improving the quality of their products. These would not be possible without the extensive use of the modern tools provided by the advances in information technology.

Also, successful firms are going to be ones that respond to changing customer requirements. Consumers have become more health and environmentally conscious, and African SMEs that want to compete in international markets will have to take such concerns into account. African SMEs have traditionally tended to focus attention on production, sometimes at the expense of providing a quality good or service. Increased attention will need to be given to marketing and packaging as well. The tools of information technology provide enough flexibility to allow SMEs to deal with such requirements.

Furthermore, building alliances and networks can benefit SMEs is in the area of technical change. Rapid technological changes in the form of new products, along with new production processes and management systems threaten to engulf most African SMEs. Developments in transport, agriculture, manufacturing and finance are likely to erode further the competitiveness of African SMEs-even in areas where Africa traditionally held a comparative advantage. If African firms are to respond effectively to changing customer needs and take advantage of changing production incentives, it will be imperative that they improve their technological capabilities. To this end, African SMEs will have to source information technology which provides them with access to state-of-the art technology.

On the institutional front, upgrading technological capabilities requires the establishment of information-intensive institutions that can provide extensive extension services on a wide scale and deliver comprehensive packages of assistance comprising technical know-how, finance, management skills, training and sales information. In South East Asia which has been successful in this respect, institutions such as Productivity Councils (Hong Kong); Productivity Center (China) and; Medium and Small Business Administration (Taiwan) have different names but serve similar objectives. These productivity centers are usually entrusted with many tasks including (i) identification of problems facing enterprises and devising appropriate remedies and training packages; at subsidized rates; (ii) acting as major technology transfer and development agents; (iii) provision of specialized technical services for new industries such as computer aided industrial designs and inventory management systems; (iv) provision of credit, technology, management, accounting and marketing assistance; (v), transferring "production-ready technology" that the government has imported and adapted to local firms; and (vi) provision of information on international standards (Lall 1996). Information technology has the potential not only to establish and promote such productivity centers at the national level, but more importantly for resource pooling and information sharing at the regional level. The costs of establishing and running these highly specialized institutions are usually very high in terms of both material and human resources. Information

technology provides the opportunity for regional economic groupings in Africa to pool their economic resources and establish regional productivity centers which can be accessed by all the industries within the region.

Agriculture Development and Food Security

African economies continue to be heavily dependent on agricultural production and the export of natural resources. The widespread adoption of information technology holds considerable promise for African countries in their quest to improve their agricultural production and marketing practices. It provides opportunities for the development of information systems to monitor water and land resources, food transportation and storage and crop-diseases control. Video and radio-conferences between buyers and sellers, growers and extension officers, can also play important roles in stimulating internal and external trade and improving agricultural practices and productivity. Investing information technology opens up avenues to access and disseminate such information more quickly and extensively. It could also facilitate the use of more efficient distribution systems to reduce food storage costs. With information technology, access to world-wide knowledge about new techniques for improving agricultural production would be considerably enhanced. Such knowledge includes advances in genetic engineering which offer great opportunities for African countries to use seeds and plants that are adaptable to water availability and soil conditions.

In Nigeria and Indonesia, for instance, pilot applications of information technology have made it easier to conduct agricultural surveys, analyze survey data, and use such surveys for developing agricultural research databases and designing agricultural development projects (Hanna, 1991). Microcomputers introduced in Kenya are being used to improve crop forecasting, project monitoring and strengthening the country's Ministry of Agriculture. In Thailand, microcomputers are helping to regulate the operation of irrigation systems in accordance with changing environmental parameters (Hanna, 1991). Since 1996, the internet has been increasingly used to bring some Ugandan coffee growers into contact with their American customers. Through video conferencing, US coffee experts gave the Ugandan coffee growers information on the ratings of Ugandan coffee. The coffee producers had access to valuable information that would certainly help them compete better in the coffee market. These are only small steps in applying information technology to the agricultural sector. A wide range of many other applications could be adopted and propagated throughout the continent for the purpose of improving and accelerating the rate of agricultural development.

Environmental Management

African countries continue to experience serious drought, floods, and other natural disasters-with adverse effects on both humans and the environment. Africa's capacity to protect itself from such disasters, or to minimize the impact on both environment and human is limited by several factors, including the lack of resources, inadequate early warning systems, and the generally poor state of information on natural resources. The effects of the natural disasters on the environment are compounded by man-made factors. Low agricultural productivity has necessitated the greater and more extensive use of land for agriculture; large herds of cattle and other animals has led to overgrazing of lands and soil erosion, while pollution of water sources is rampant.

Environmental management in Africa requires timely and accurate data on socio-economic and demographic trends, weather patterns and natural disasters, and the availability and use of both renewable and non-renewable resources. It is also dependent on the analysis of this information and the ability to share the information among policy makers across the region (Hanna and Boyson, 1996). Developments in geographic information systems have led to the introduction of improved assessment and monitoring techniques of natural-resource endowments. Information on natural resources could be linked to data on socio-economic and demographic dynamics to achieve better management and overall resource planning. Satellite images about vegetation patterns, moisture levels and weather could now be combined with ground-based information to provide early warnings on insect infestations, droughts and other natural disasters (Talero and Gaudette 1996). Information technology holds great potential for developing access to areas threatened by disasters and environmental degradation. It can be used to monitor disaster prone areas and for coordinating efforts in the case of disasters. In this regard, the Image Display And Analysis (IDA) funded by the US Agency for International Development (USAID), the UN Food and Agriculture Organization (FAO) and the US Geologic Survey EROS Data Center (USGS/EDC) is designed to provide continent-wide environmental and food security services. The system uses model and data from satellites to forecast food crop output, hence providing early warnings with regard to food shortages and famine. In Guinea, the government is establishing systems for managing forestry and fisheries resources to manage forests, register land rights and research offshore fisheries management. Using satellite data, microcomputers and through training local scientists to collect and analyze

information, Chad is undertaking research into the techniques for rangeland conservation and crop-livestock integration. In Tunisia, information systems for research and planning, and communications equipment are important parts of the forest development project. Since poverty in Africa is the prime cause of environmental degradation, all applications of information technology alluded to in this paper, which would be instrumental in improving education, health, agricultural productivity, and farmers income, would also be conducive to the process of environmental preservation.

Human Capital Development

As detailed in the 1998 African Development Report, human capital development is seen both as an essential means for sustained economic growth and poverty reduction and as an important end in itself. Human capital matters because the poor's most significant asset is their labor, and the most effective way to improve their welfare is to increase their employment opportunities and the productivity of their labor through investment in education, and health.

Health and Disease Control

Africa achieved marked improvements in health development in the post-independence period (according to the latest available indicators). Life expectancy at birth increased from about 40 years in 1960 to over 53 years in 1995. Between 1960 and 1995, infant mortality rate was halved, from 168 to 89 per 1000 live births. Despite, these improvements, African countries are presently encountering serious health hazards. The probability of an African child dying before age 5 was estimated at 143 per 1000 live births in 1995, while the maternal mortality rate was about 630 per 100,000 live births, reflecting a combination of poor nutrition, environmental conditions and inadequate health services. The main causes of illness are, malaria, diarrhoeal diseases, respiratory infections, childhood diseases, parasitic diseases, sexually transmitted diseases, leprosy and injuries. The Human Immunodeficiency Virus (HIV) and its associated disease, AIDS, has emerged as one of the greatest threats to the health of African populations. Since the beginning of the epidemics in the late 1970s, about 10 million people in Africa have died of AIDS. By mid-1995, AIDS was the major causes of adult deaths in some countries. The WHO estimated that 21 million people in Africa were infected with HIV, two-thirds of the global estimates. Of the 5.8 million people newly infected with HIV in 1997, 4 million were in Africa. About 10 per cent of all new infections were in children under 15, and more than half of the remainder are in people aged 15 to 24 years. The emergence of AIDS has drawn attention to other sexually transmitted diseases which were already responsible for an estimated 70 million cases per year.

Information technology can help control and sometimes eradicate some of the health problems plaguing the continent. It could facilitate the establishment of a decentralized decision support system and provide information on health profiles. It could also enhance health administration and management through the provision of medical information systems, and could link health centers, delivery systems and medical transport to patients (ECA 1995). Other applications of information technology include statistical analysis of health and family planning indicators, epidemiology, demographics, medical research, health manpower planning and management and training (Hanna, 1991)

Access to the Internet and packages like WebPro, for instance, offer African physicians and hospitals opportunities to provide world-class services. With moderate investments in hardware and software, hospitals can create on-call teleradiology systems or consulting on remote cases over the Internet. The WebPro package to view ultrasound images can be transmitted quickly over ordinary phone lines, on commercially available PCs. When compared with previous solutions, which required custom hardware and software, and cost between \$8,000 to \$10,000 per station to set up, the WebPro solution is much more viable and easy to use.

With the WebPro package, a physician in any African country working on a computer with a Web browser can pull an entire ultrasound examination-images and patient data-from an Acuson AEGIS(R) digital image and information network or from an Acuson ultrasound system. With the WebPro package, hospitals and clinics can use Internet technology for linking radiologists with their patients-speeding turnaround, controlling costs, improving hospital productivity, and increasing patient access to first-class care. The reported case of the African doctor who tried unsuccessfully to treat a case of tuberculosis illustrates vividly the benefits of information technology to the health sector. He turned to the ProMed electronic net work for assistance and within 24 hours he received a response from a doctor in Texas who was able to give him precise information on medication-resistant strains in the African doctor's home region.

There are also several other applications of information technology in the field of health which proved to be very useful. In West Africa, for instance, health information systems have been developed which are

strengthening health delivery and disease surveillance. Computers are being used to project future health. In China, an expert system is being developed for computer aided diagnosis for the rural areas. In the Philippines, rural workers are using low cost radio networks to provide information on cases and drug requirements. These systems should be of great relevance to African countries. Information technology could also be useful in assisting AIDS researchers in Africa in several ways. Computers can be used to centralize the storage of HIV test information; to model group screening procedures that would enable cost-effective procedures for mass AIDS testing; and to preserve individual anonymity and thereby encourage more people to go for testing (Getao and Odhiambo 1995).

Education

As in the case of health, education improved during the two decades after independence, then faced serious problems in the 1980s and after. Annual primary school enrollments increased at a rate of 6.5 per cent between 1960 and 1970 and at 8.9 per cent between 1970 and 1980. In the 1980s, the rate of enrollment slowed markedly to 4.2 per cent. This slow down is very serious when viewed against the fact that from 1980 to 1990, Africa's primary school age population grew at an average annual rate of 3.3 per cent. By 1995, Africa experienced low net enrolment ratios for the relevant primary, secondary and tertiary level education age groups. Africa is also the only continent where average gross enrollment ratios for primary education have remained lower than 100 per cent. In addition, the educational system in many African countries suffers from various shortcomings including regional, intra-country and gender disparities; inability to meet the educational needs of disadvantaged groups such as nomads, street children and the disabled; losses and leakages with more than a fifth of African children who enrol in primary school either repeating several classes or dropping out of school all together; low teacher-student ratios; limited availability of instructional material; and, poor quality of education. Higher education also faces serious problems with regard to quality, relevance and finance. There are few libraries, most of them lacking access to international journals and generally deprived of educational materials, while research facilities remain limited.

Most of these educational problems are related to inadequate funding and inefficient use of available resources. Information technology offers a wide range of low-cost solutions. One of the most important applications of information technology in this area is distance education in Africa (defined to include print, broadcasting, and limited face-to-face education) which could be extensively used to pursue entirely conventional educational ends. The main advantages of distance education are economy, flexibility, and suitability for widely scattered student bodies (Talero and Gaudette, 1996). In addition, information technology has the potential to connect African educational institutions continent-wide, and link them with international universities, hence, facilitating research and the exchange of ideas. Access to data and educational materials would also be simplified.

For instance, Zambia, the second country in Southern Africa to achieve full Internet connectivity, has made valuable educational use of the Internet. In 1991 the University of Zambia (UNZA) medical library obtained e-mail connectivity with the University of Florida medical library. This has made it possible for UNZA medical library, the University Teaching Hospital (UTH) as well as several other university departments to upgrade research capability; obtain relatively cheap access to information; and, improve the quality of teaching and graduate students' research projects and assignments (Mwiria, 1997). Research has been improved by accessing, at a relatively low cost, research information and publications available in the richly endowed data banks of developed countries. For UNZA, this represented a significant step for an institution that had hitherto been unable to subscribe to relevant periodicals. Connectivity to the Internet has also induced research collaboration between Zambian and other researchers. It also provided an efficient means for graduate students to consult with their academic supervisors in Zambia and abroad. In addition, Internet connectivity became a major source of income for the institution with the system becoming self-financing within a year. The network has several thousand dial-up users in all sectors, including government.

Continent-wide, a step forward in the application of information technology to education will be the establishment of the African Virtual University (AVU). The AVU is a satellite-based distance education project initiated by the World Bank in 1995. The AVU offers an example of the power of modern information technologies to increase access to desperately needed educational resources in Africa. The objectives of AVU are to educate and train world-class scientists, technicians, engineers, business managers, health care providers, and other professionals needed to support economic development in Sub-Saharan Africa (SSA). In addition to offering university degree programs in these fields, the AVU will also provide noncredit training and seminars; remedial instruction for motivated students without the necessary qualifications to meet university entrance requirements; and, electronic library services.

Four guiding principles underpin the project design: (i) offer simple, efficient, and cost-effective solutions to urgent educational and economic development problems facing the SSA countries; (ii) develop an international network for resource sharing digital satellite- and computer- based academic resources; (iii) serve more students than ever before possible by leveraging the existing facilities and institutional infrastructure of universities and other academic institutions in SSA, and by promoting the emergence of new organizations to provide educational resources through cooperative partnerships with the AVU; and, (iv) add value to existing academic resources available from institutions worldwide through their use in the virtually untapped tertiary education market of SSA. The AVU has the potential to help overcome the existing barriers of declining budgets, too few faculty, outdated equipment, and limited space and facilities that prevent increased access to higher education for a significant majority of students in SSA.

Towards Improving Africa's Accessibility to Global Information

The regional and national infrastructure required to provide adequate access to the information age consists of strategic information systems necessary for sustainable economic development such as education, health, public financial management, and transportation, as well as the telecommunications networks and computer hardware and software. For the purpose of this paper the issues pertaining to accessibility are discussed with reference to telecommunications and computer hardware and software which represent the backbone of information systems.

The Status of Africa's Telecommunications¹

The prerequisite for the creation of an information-based economic structure, is the existence of an efficient telecommunication infrastructure and services, the poor state of which has been one of the main constraints to the accessibility of many African countries to the global information infrastructure. Africa has one of the lowest teledensities (the number of main telephone lines per 100 inhabitants) in the world. According to the 1996 Report of the International Telecommunication Union, ITU, Africa's teledensity was estimated as 1.66 in 1994. Overall telephone lines have been increasing, though at a rate slower than those of other regions. From 1986 to 1990, the growth in telephone lines was 8 percent for Africa, 6.6 percent for Latin America and 12.3 percent for Asia. In the following four-year period (1991-1994), the growth in telephone lines in Africa stagnated at 8 percent while those of Latin America and Asia accelerated to 10.4 percent and 26.7 percent respectively.

This overall picture masks the great disparities that exist between South Africa, North African countries and those of sub-Saharan Africa. The majority of telephone lines are in South Africa, while sub-Saharan Africa has very few telephone lines. The teledensity in South Africa increased from 8.7 to 9.5 between 1990 and 1994. For North Africa, teledensity increased from 2.9 to 4.2 while in Sub-Saharan Africa it remained below 0.5 over the period.

The African telecommunications sector is highly dependent on international telephone communications, which account for more than 50 per cent of the region's receipts. Although the telephony traffic-volume increased, the growth rate in sub-Saharan Africa has slowed since the early 1990s. Most regional traffic is between South Africa and its neighbors. Within the region, North Africa, South Africa and sub-Saharan countries represent 36 per cent, 26 per cent and 38 per cent of the traffic, respectively. In the past decade, North Africa's share dropped, South Africa's increased, and sub-Saharan Africa's remained unchanged. Since 1991, the volume of arriving-traffic has been more than departing traffic. This is illustrated by traffic between Africa and the United States of America with the arriving telephone calls from the United States increasing from 75 million minutes in 1990 to 173 million in 1994.

Several factors have been identified as contributory to the limited progress in the development of telecommunication in the continent. These include:

- Constraints on the supply side. Supply-side constraints have affected the development of services to meet the growing demand. These constraints include the state monopoly of telecommunications and the existence of regulations that prevent the private sector from participating in the sector. Also contributory is the lack of resources to augment investment in telecommunications sector sometimes due to the high level of indebtedness of the local operator. Even where funds are available, limited project implementation capacity may constrain network development. In other cases, investors are deterred by the lack of political stability and civil strife.
- High population growth rates. Population growth rate in Africa is the highest in the developing world, and is estimated at around 3 percent since the 1990s. Although the number of telephone

lines has been increasing in absolute terms, the growth rate has to be much higher in order to impact positively on the level and growth rate of teledensity.

- Low private sector participation. The private sector has played minimal, though increasing, role in the investment in the telecommunication sector in Africa. The bulk of investments have come from self-financing and from bilateral and multilateral sources. Compared to other developing countries, the level of self-financing by local operators is high, indicative of the lack of capital from other sources. At the same time, lending from bilateral sources is declining. Whereas bilateral lending for the sector was US\$431 million in 1989, it was only US\$97 million in 1994.
- Low investment efficiency and high installation costs. Installation costs per line in Africa are extremely high relative to the industry average, reflecting the state of investment inefficiency in the sector. It is estimated that the average cost per line in the region is over US\$4,500, more than three times the industry average of US\$1,500. Thus, if the industrial average prevailed in the region, the investment made could have financed three times more lines with the same amount of funds. The huge installation costs are partly due to the large rural areas that have to be covered. These large costs are reflected in high subscription charges. For instance, in Mozambique subscription reaches up to 69.8 per cent of GDP per capita (Figure 1).
- Lack of income diversification and price discrimination. The region's operators depend heavily on international telephone communications which tend to yield higher income. The region's operators have preferred to target the well-to-do, top international hotels and export-oriented enterprises. The common denominator of this target group is the amount of international telephone calls they make. In contrast, the tariffs remain too high for the rest of the population as demonstrated by problems related to the non-payment of bills and the increasing number of disconnections. Price discrimination which charge lower prices for households and relatively higher prices for business might widen the market and reduce overhead costs.
- Foreign exchange imbalances of public operators. International telecommunications tariffs in developed countries have fallen, as a result of which payments for traffic from outside have increased in Africa. These payments are often made in hard currency, although the public telecommunications authorities have noted that funds so received are absorbed by other public agencies. On the other hand owing to the high international tariffs charged by local public telecommunications networks, they are increasingly being pushed aside by "parallel" networks. This tended to reduce the import capacity of local public operators to renew and service equipment, resulting in quality deterioration and poor service.
- Civil Disturbances and Political Instability: A factor accounting for the lack of development in telecommunication in the region has been the absence of political stability. This is partly responsible for the low densities in such countries as Somalia, Angola, Liberia, Sudan and Rwanda, to mention a few. It is expected that the attainment of political stability in these countries should contribute favorably to the improvement of their telecommunication infrastructure.

Notwithstanding the poor state of telephony in Africa, various ambitious public telephone installation projects are ongoing. The telecommunication market is being liberalized in several African countries. This consists of authorizing private companies to install and operate public telephones, allowing entrepreneurs to offer telecommunication services in telephone booths. This new development is illustrated by the following examples. South Africa sold a 30 per cent stake in the state-owned Telkom for \$1.3 billion to Thintana Communications-a joint venture between SBC Communications of the United States, and Telekom Malaysia BHD of Malaysia. In Nigeria, a number of private telecommunication companies being given inter-connectivity with the government-owned NITEL, thereby increasing competition in the sector. In Côte d'Ivoire, France Telecom acquired 51 per cent share of CI-Telcom. The new joint-venture company plans to spend \$450 million in upgrading telecommunication in the country. In Ghana, the major privatization activity was also in the telecommunication sector where the government sold 30 per cent of its stake in Ghana telephone Company to Malaysia Telkom for US\$38 million.

Africa countries have also shown increased interest in accessing the Internet. The first sub-Saharan countries were linked to the network in 1994; as of December 1995, 16 African countries could connect directly to the Internet. Nearly 50 000 servers are linked to the world wide web, but most of them are found in South Africa. However, most current initiatives to set up a network are taking place at the local level with the support of the international community. These target the university and scientific communities, especially as the private sector is increasingly more active in the field. Generally, these initiatives consist in putting electronic mail systems at the disposal of researchers, the target objective being connection to the Internet. However, the high cost of infrastructure and hired lines are among the factors impeding large scale and continent-wide connection to the Internet. Restrictive regulations and high duties on imported hardware have also contributed to delaying access to the network. These impediments are central to the debate on the possible impact of the information technology on African countries.

In summary, despite the recent efforts to liberalize and improve telecommunication services, access to the global information infrastructure by African countries is still far from adequate. Major and urgent improvements would need to be made in teledensity if the continent is not to risk increasing marginalization. Africa needs to invest in telecommunications, as a priority sector, if it is to stand a chance in the emerging global competitive environment. This is particularly the case as Africa is classified, on the basis of telecommunication revenues and investment, to be among the least possible regions to achieve convergence (to the standard of services in development countries) in the foreseeable future. Table 1 arranges the different regions of the world in a 'convergence scale' such that the leading regions where convergence is reachable are placed at the top, while the regions where convergence is out of sight are placed at the bottom. It can be observed from the Table that South Africa falls in the middle of this scale, followed by the Mahgreb countries in the beginning of the bottom quarter and other North African and Sub-Saharan African countries at the bottom end. Fortunately, the information revolution offers opportunities for African countries to build the required telecommunications and information systems and accelerate their convergence rate towards the standards set by the developed world. However, opportunities would need to be exploited through concerted efforts and visionary planning. This is all the more important because the information revolution creates extraordinary opportunities to leapfrog development which could empower the continent out of the vicious circle of poverty, low growth and the degradation of natural and human resources.

Africa's awareness of the opportunities of the knowledge-based economy was reflected in the African Regional Symposium on Telematics for Development which was organized by the Economic Commission for Africa (ECA) in collaboration with other organization including the International Telecommunication Union. Following this, a high-level working group consisting of experts on information technology in Africa was set up to draft an action framework to take advantage of the information and communications technology for African development. The working group produced a document: "Africa's Information Society Initiative (AISI): An Action Framework to build Africa's Information and Communication Infrastructural". The African Initiative envisaged that by the year 2010, a sustainable information society would have been established, such that:

- Information and decision support systems are used to support decision making in all sectors of every country;
- All Africans would have access to information and knowledge resources through computers
- Access is made available to international "information highways"
- Information and knowledge are disseminated and used by the public at large.

To attain these objectives African countries would need to overcome numerous obstacles including the inadequate state of telecommunication services and the high cost of computers and software.

Towards Improving Telecommunication Services

Measures to improve telecommunication in Africa need to address those issues constraining supply. Particularly, the regulatory frameworks in some countries would have to be reviewed, in order to break the monopoly of local operators and attract private investment. Many countries have already engaged the private sector to participate in the provision of telecommunication services. However, the involvement of the private sector has been more in the provision of cellular services, leading to notable increases in cellular subscribers (Figure 2). The private sector is playing a strong role in internet development especially in countries with relatively liberal telecommunication sector. Recently, private participation has been introduced into the operations of the state-owned telecommunication company in Ghana. With privatization and reform would come need to address the attendant issues of licensing terms, procedures and fees, interconnection agreements and tariff policies. In addition there is a need to resolve the problem of overstaffing which tend to reduce efficiency. In Madagascar there are 10 lines per employee in the public telecommunication operator, in Tanzania there are 18 lines per employee, while in Morocco there are 80 telephone lines per employee (Figure 3). It is also important to reduce the installation cost per line in the region. In Tanzania, the cost per line is estimated at \$1400, below the industry average and well below the average for Africa. This low cost has been attributed, in part, to the fact that the country received multilateral assistance which typically requires international competitive bidding and transparency in equipment procurement. An alternative being explored by many African countries is to allow private operators to enter the sector under a build-operate-transfer (BOT) arrangement. Under BOT, the private operator bears the cost of providing the lines and in return is permitted to operate these lines for a limited time.

It is also necessary to adopt innovative solutions for exploiting the opportunities presented by the advances in information technology. For instance, the problem of inadequate and expensive telephone

services in many African countries and the severe limitation it imposes on access to the Internet can be surpassed by a combination of geo-stationary and low-Earth orbiting satellites. In the short-run, geo-stationary satellites have potential because many of the orbital slots over Africa are underused or unused (Negroponte 1998). A remote school in an African country having access to the world's libraries using a one-meter dish, is a change of very large magnitude. Convenient turnkey satellite link is sold for only US\$2,700 (a price that is expected to drop to \$1,500 by the end of 1999). This means that such applications are now within the reach of many African countries. In the long run, low-Earth orbiting satellites have more potential. The first of these satellites will start service before the end of 1998. Although they were originally designed for affluent cell-phone users, there is a great potential to make their services accessible to the very poor.

In addition, there is the possibility of tapping global information infrastructure, which has a variety of low-cost options for local connections, competing global operators for long-distance services, digital transmission, and low-cost, reliable, simple network access with increasingly sophisticated terminals (World Bank 1991). This version of telecommunications infrastructure presents an opportunity for African countries to leapfrog and exploit the industrial world's enormous investment in wired local loops, which are the most expensive part in telecommunications installation. African countries can, therefore, provide better service at a much lower cost compared with prevailing rates. With radio and satellite options for the local loop, widespread deployment of telecommunications becomes affordable, and African countries can have access to and reap the benefits of the information age (Forge 1995).

Along these lines, various initiatives have been made to increase Africa's international telecommunications connectivity. With regard to satellite telecommunications, there is the Regional African Satellite Communications System (RASCOCOM), which was formed in 1992 by 42 African countries and headquartered in Abidjan, Côte d'Ivoire. The US \$ 1.2 billion satellite project which is developed on a build-operate-transfer (BOT) basis, aims at establishing a Pan-African satellite system. At the same time, it intends to coordinate Africa's needs with Intelsat, the world satellite system used by most countries in the continent. The satellite of the project which will be launched in 2001, and is expected to reduce the distance to the nearest phone in Africa by ten-fold from 50 kilometers to 5 kilometers. By combining their satellite needs under the RASCOCOM umbrella, African countries have been able to negotiate lower tariffs. Also the Gibraltar based African Continental Telecommunications (AFTEL) and Telesat Canada have plans to install a pan-African satellite (PAN-AFTEL) in two phases. The first phase will involve leasing and repositioning a satellite which serve southern Africa, while the second will see the launching of a new satellite covering the whole continent, with a target date of 2001. This will allow users to make and receive international telephone calls with a lightweight handset, and will be the first service of its kind to cover the entire continent. Aside from these initiatives, several international consortia currently propose low orbiting systems (LEOS) which are meant for mobile subscribers. Since they provide world-wide coverage, the LEO systems will also service Africa and should come on stream by the turn of the century.

Furthermore, there are a number of ongoing initiatives to integrate Africa into the global information network through fibre optic underwater cables. Optical fibre links to the outside world are already in South Africa and several North African countries. A French supplier of telecommunication equipments, is currently at work with several countries to lay underwater optical fibre cables to link West African countries to Europe. Also, AT & T (USA) plans to run optical fibres around the continent in the framework of the Africa One Project. More than one hundred countries will be linked to the network by the end of the decade. Apart from providing a regional and world connection, the African network optical fibre structure will strengthen the national networks. Connection to the African optical fibre network will enable national telecommunications authorities to develop their traffic and increase income, resulting in access to new markets and increased ability to support new comprehensive services that meet present and future demand. Moreover, the establishment of an optical fibre structure in Africa will supplement and strengthen such existing regional networks such as PAN-AFTEL and RASCOCOM. Integration of such a network into the microwave and satellite systems will enable Africa to penetrate the world network and increase the value of its existing resources.

Reducing the Cost of Computers and Software

The high cost of computers and software represents a serious impediment to Africa's accessibility to the world of information technology. The cost of personal computers (US\$1,500- 2000) per piece is higher than the per capita income of many African nations. However, software and hardware companies are able to get away with the \$1,500-2000 price tag when their primary customers are other businesses (Negroponte 1995). But now that the home is the fastest-growing market for such products, computer and software producers are targeting the household-market with affordable prices.

Experience has shown that the designed capacity of computers and software is not fully utilized by the majority of their users. This implies that buyers of such products are paying for certain features and qualities that they are not going to consume. According to Negroponte (1995), a 386 laptop - perfectly serviceable for Internet connections, wordprocessing, and graphics - can be built today for under \$250. This can be achieved, he argued, without subsidies by reducing the fat from today's PCs, making some bare-bones engines that word process, telecommunicate, and provide access to online services. A modest color display with a 13-inch window into the Internet is better than no window at all. It will also be possible to produce simple software at very low prices. Simple software will reduce, among other technical gear, computer memory requirements, making it possible to produce low-priced computers. Network computers and net PCs with simple stripped-down versions of hardware and software will be instrumental in facilitating the entry of a large body of Africa's businesses and individuals into the world of information technology.

One way to reduce the high cost of computers and software is 'bulk-purchasing' when placing orders to purchase computers or software. A computer supplier would be more inclined to sharply reduce prices if there is a commitment to purchase large quantities. This option, which could be practiced nationally or regionally, requires rigorous visionary planning. For instance, a national government that envisions the computerization of its various sectors, say in five years, would need to draw plans detailing the quantities and the qualities of computers required and their technical specifications including compatibility and expendability. Using such a planning framework, the national government can bargain to purchase wholesale the quantities of computers and software over the time horizon of the plan. A similar approach within regional economic groupings will be even more effective because of the larger purchases that could be made.

African countries can also draw on the stock of 'out-of-trend' computers. World-wide, companies, organizations and individuals regularly update their computer sets. As a result, there is a large stock of unused systems which creates, in most cases, problems of storage and discarding. Local NGOs could be encouraged to design and implement a scheme of collecting such systems and organizing their distribution at minimal costs. Following the notion that an old computer is better than no computer at all, the scheme might contribute to reducing the cost of importing computers and increasing the numbers of computer users. It might also provide technical schools with the computer gear, which could be used for training purposes and spare parts.

An idea pioneered by Negroponte (1995), is the advertiser-supported computing. The basic notion is to use the advertising industry to drastically reduce the cost of computer hardware. That is, computers are to be equipped with built-in devices to generate and display personalized advertising message as screen savers. Advertisers would pay to gain access to a large advertising space, which is changeable per square inch, per day, or per hour. The money could subsidize the cost of the computer. The applicability of this idea is positively related to the size of the advertising industry. The larger the industry the lower will be the price of advertiser-supported computers. In sufficiently large markets, the price of an advertiser-supported computer might even be negative in the sense that consumers would be paid to use them. In Africa, small national markets might limit the applicability of this idea, particularly with regard to the advertising of locally produced and consumed products. However, considering that the same brands of imported consumer and durable goods purchased and consumed throughout Africa, the advertising industry would be considerably larger if the producers of those goods are included. The application of this idea calls again for concerted actions from the part of African countries, particularly within regional groupings.

The Role of the African Development Bank Group

The present areas of focus of Bank Group operations include strengthening production capacity and socio-economic infrastructures; promoting policy reforms; supporting private sector development; and, promoting economic integration. As has been outlined above, information technology provides a wide range of applications, which are capable of spurring large developments in all domains of Bank Group operations. To foster such applications through greater integration of African countries into the global information infrastructure, the Bank Group could assist African countries in three main ways: increasing financial resources for projects in the telecommunication sector; the provision of advisory services, and technical assistance and dissemination of knowledge.

Provision of Finance

In the lending programs of multilateral institutions, the telecommunication sector is yet to receive the priority it deserves in the age of technological information. During the period 1986-94, lending from these

institutions for telecommunication projects in sub-Saharan Africa was estimated at US\$750 million. This constituted less than one percent of their total lending for infrastructure projects in the world. However, multilateral lending has had a significant impact on teledensity in some countries of the region. Benin and Togo, for instance, increased teledensity by 46 and 88 percent respectively through multilateral loans. The Bank Group may need to increase its financial support for investments in telecommunication and information technology as a high priority area. The Bank could also seek investment opportunities in this sector where enabling environments exist, as well as promote interaction between foreign and domestic investors so as to create enduring and profitable investments. The Bank operations could act as catalyst to encourage private participation in telecommunication through instruments that guarantee the private sector against risks inherent in participation in the sector. The Bank could also be instrumental by playing a catalytic role in mobilizing resources from the private sector, bilateral and multilateral development institutions for investments in telecommunications and for the acquisition of information technology systems.

Furthermore, given the Bank's operations in other sectors including education, health, agriculture, transportation and policy based lending, the Bank could document and monitor developments in telecommunications and the use of information technology in these fields. A specific section in the Country Strategy Paper could focus on telecommunication and information technology. Also, project design and implementation could focus on the information-technology components of projects and their link to other information technology systems operating in the country.

Provision of Advisory Service

Provision of advice on privatization of public telecommunications, private sector participation and information strategies are also important areas where Bank intervention and technical assistance could be important. The Bank could provide technical advice to governments on approaches to privatization and the preparation of the legal and regulatory framework necessary to privatize public utilities. Private sector participation in the sector is especially important in view of the declining resources from bilateral and multilateral sources and the apparent inability of local operators in most countries to inject the massive amount of capital required for the sector. The Bank needs to play a more significant role in the private financing of infrastructure, including, Build, Operate and Transfer schemes.

As earlier noted effective planning could help to minimize the cost of linking regional countries to the global information technology infrastructure. Unfortunately, most African countries do not have any explicit plans or policies on information technology. In most African countries, the use of information technology is a result of isolated initiatives without preconceived strategies and policies. Equipments being acquired by different private and public sector organizations with little coordination and planning. The Bank is mandated and well equipped to play a leading role in encouraging individual countries, as well as regional groupings, to develop long-term plans. Such plans would identify the investment requirements of the countries and define the required changes in institutional, training, legal and regulatory frameworks to create the environment that would foster the development of the information societies in Africa. Such plans would also serve as an explicit recognition of the challenges of the information technology and as instruments for attracting and coordinate donor assistance. The Bank could also intensify its collaboration with the ECA and OAU to realize the objectives of Africa's Information Society Initiative (AISI). The Bank could improve its policy dialogue with the private and public sectors by making available, via the internet, appropriate project and policy documents such as project brief, project appraisal reports, country strategy papers, operations policy papers, private sector investment briefs, environmental impact assessment. Greater access to these documents through the internet should help facilitate consultation with peoples, business and government who could be affected by Bank Group operations at various stages of programmes and projects. It will complement recent establishment of Public Information Centre (PIC) and facilitate greater access to information on the activities of the Bank Group. In essence, electronic networks present the Bank Group with an opportunity to reach its clients.

Research and Knowledge

In an era of dwindling resources, development through knowledge assumes more importance. In this context, the African Development Bank must reinforce its role as a knowledge and research center for information and analysis on Africa's socio-economic issues. The emergence of knowledge as one of the most important resources in the global economy has lent more support to this role. In this regard, the Bank's flagship publication, the African Development Report which is now published on behalf of the Bank by Oxford University Press, provides an authoritative annual survey of economic and social progress in Africa and is becoming a major source of analysis and information for policy-makers, businessmen, and economists interested in the continent. The Bank also publishes the African Development Review, a bi-annual professional journal devoted to the study and analysis of development issues in Africa. To enhance

its role as a knowledge centre, the Bank's human institutional capacity for research will need to be enhanced while at the same time pursuing greater networking with African development research centres.

To further its role as a knowledge center the Bank is making available-through the Internet-its publications as well as the large body of information and data that it has compiled over the years to African research institutions, policy practitioners and individual researchers. The Bank Group could also disseminate knowledge on the use of information technology and its applications to the various fields of development and share its knowledge on best practices from all over the continent and across production, services and social sectors. This could be facilitated through the development of networks with stakeholders and other relevant regional and international institutions around the world.

An information resource centre drawing on expertise in research, library and technology could be created within the Bank to monitor, compile, study and disseminate knowledge on the developmental applications of information technology. The library will need to be upgraded as a major information resource centre that can develop and maintain databases and document collection via electronic networking. As the premier African development finance institution, the Bank is investing in state-of-the-art information technologies such as high performing workstations and computers; file servers; fibre optic cabling; modern office automation hardware and software; electronic mail capability, and reliable and cost-effective telecommunications. The recent overhauling of the Bank's computers and information systems which provide regional and worldwide links with member countries and other stakeholders, the private sector and academic and research institutions is a welcome development. It is also important to note the creation of the Bank's Web site and installation of the Bank's own telecommunication satellite which improved the quality and capacity of external telephone communications as well as connectivity to the Internet and e-mail services. These investments coupled with efforts to increase the Bank's role as a Research and Knowledge centre on African development issues should enable the institution to harness information and knowledge to meet the development challenges facing African countries in the 21st century.

Conclusions

Information technology is rapidly changing economic and social activities. It provides opportunities and challenges for making progress with accelerated growth and poverty reduction in Africa. The emerging global infrastructure could make it increasingly possible for students to study and carry out research using the electronic networks to reach remote universities and libraries. Physicians could remote-view entire images and patient data, diagnose diseases and perform consultations with outside sites. Decision makers would be able to promote effective economic management and good governance; and for businesses to complete more effectively with timely and accurate market information, to name a few. For Africa, information and telecommunication innovations present opportunities for "leapfrog" strategies that could accelerate the development of the continent. To exploit these opportunities, African countries need, as a matter of priority, to upgrade their capabilities through the improvement of their telecommunication infrastructures and the acquisition of computer and computer related equipment. National institutions responsible for data collection and processing need to be strengthened and their traditional information collection and dissemination structures need to be modernized if they are to fully participate in the international information evolution. Sub-regional trade information systems would need to be improved to provide meaningful backing to national efforts in this area.

Governments have to facilitate information transmission and connectivity to the global infrastructure by passing the necessary laws and regulations. Governments need to create the supportive external environment for promoting the use of information technology. It will be essential to reduce or abolish import taxes on information technology hardware such as computers, printers, satellites, televisions and radios. In some African countries such equipment are treated as luxury items and, hence, heavily taxed. The numerous long term benefits from encouraging the use of information technology through the reduction of taxes on hardware would more than offset the loss of government revenue. These desired improvements need to be pursued within the framework of comprehensive national or sub-regional plans to link African countries to each other and to the global information technology infrastructure. Within the framework of such plans, there is a strong case for earmarking the proceeds that arise from the privatization of public telecommunications to support the computerization of the economy and improve its accessibility to global information. In these and other related objectives, the African Development Bank Group could play a leading role through project financing, mobilizing foreign resources, advisory services and technical assistance. The Bank Group needs to develop the capacity to respond quickly and flexibly respond to the changing needs of its member countries. In this regard, information and knowledge must be viewed as strategic resources. To perform its role as strategic advisor and knowledge centre on African development policy issues, the Bank must develop and maintain appropriate human, information and telecommunication infrastructure assets.

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