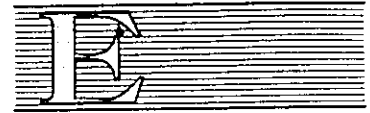




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**ECONOMIC COMMISSION FOR AFRICA**  
**Second Meeting of the Committee on**  
**Natural Resources and Science and Technology**

**Addis Ababa, Ethiopia**  
**30 October – 01 November 2001**

**Enhancing Africa's Competitiveness:**  
**Policy Issues in Natural Resources and Science and Technology**

## **EXECUTIVE SUMMARY**

1. Enhancing and sustaining competitiveness in Africa in the area of natural resources is of paramount importance for the development of the continent. Natural resources still play a significant role in the development of African countries, although this role may be diminishing, as the world economy is becoming more globalized, more information and knowledge-intensive and more technology-driven. The exploitation of natural resources alone cannot guarantee development anymore. Adding value to natural resources through more intensive use of technology has become necessary to development. In this context the ability of African countries to compete and prosper depend less and less on natural resources endowment and more and more on technological capacities and innovation.
2. African enterprises must face increasing competition as trade liberalization and globalization intensify, progressively transforming the world economy into a vast free-trading zone. They also are facing increasing competition at the subregional level as subregional free-trade agreements are being gradually implemented throughout Africa. Increased competition in national markets has thus become a reality, not only from industrialized countries but also from large industrializing countries, such as China, India and Brazil. In addition, technological innovation has increased the possibilities of material substitution, thus also increasing competition amongst producers of various raw materials. In this environment the capacity of nations and enterprises to compete is essential to economic growth and development.
3. Throughout history competition has been a very powerful force shaping the technological progress and the prosperity of nations. Competition is thus something to be nurtured and encouraged. It increases competitiveness, which can be enhanced by strengthening market mechanisms, by building comparative advantages, by fostering appropriate value systems and by boosting innovation.
4. Improved markets mechanisms foster competition and competitiveness. Enterprises that are competitive in national markets are positioned to become eventually competitive in world markets. Hence the need to promote market-friendly policies at the national level that stimulate competition. Comparative advantages are more and more built and depend less and less on natural resources endowment. Hence the need for governments to make strategic choices, to identify niches where enterprises can compete and to put in place a wide range of supportive policies to enhance their competitiveness. Value systems also enhance or inhibit competitiveness in many subtle ways. Much of the successes of industrialized and industrializing countries can be attributed to values that emphasize personal effort, responsibility, loyalty, hard work, discipline, restraint, saving and the quest for knowledge. Hence the need to promote values that are conducive to competitiveness and development. Lastly, technological application, upgrading and innovation, as well as access to information and knowledge, are crucial for enterprises to gain and sustain a competitive advantage.
5. A starting point for African countries to accelerate technological transformation is to conduct comprehensive national technology assessments and launch national dialogues involving all stakeholders. The objectives would be to raise awareness about the crucial role of science and technology in development and to facilitate the process of taking the necessary actions to increase that role. These exercises would contribute to the evaluation of weaknesses in the policy environments; the identification of key technological challenges and opportunities; the formulation of sound strategies and effective policies; the strengthening of political awareness and leadership,

institutions and infrastructure in the area of science and technology; and the creation of enabling cultural, economic, commercial, regulatory and fiscal environments.

6. The dialogues would seek to increase government support to science and technology, the promotion of research, demonstration and centers of excellence in key areas, the fostering of entrepreneurial and managerial capacities and the strengthening of partnerships and networking. They would also contribute to paying special attention to critical new and emerging technologies as well as environmentally-friendly technologies, such as in the area of mining, agriculture, renewable energy and water. Lastly the national dialogues would contribute to the enhancement of the national systems of innovation and the mobilization of the necessary resources for building the vital capacities that are needed for African countries to compete on the global scene and prosper.

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## I. INTRODUCTION

1. This paper is about the competitiveness of African's industries<sup>1</sup> based on natural resources with an emphasis on science and technology as one of the most important factor of competitiveness. Its objective is to provide an introduction to the main theme<sup>2</sup> to be discussed at the second meeting of the Committee on Natural Resources and Science and Technology, to be held at the end of October 2001 in Addis Ababa.
2. The paper discusses the concept of competitiveness and how the concept has evolved over time. This analysis is useful to understand and assess the current state of competitiveness in Africa and how competitiveness can be enhanced. Then the role of natural resources in long-term development is examined and some development or strategic issues facing natural resources-rich countries are discussed. Some practical implications on public policies are formulated and a framework for possible areas of policy intervention is suggested together with some specific policy instruments that can be used to enhance the competitiveness of African countries.
3. The paper also briefly analyses the role of competition in development and how it has proved to be a very powerful force shaping the technological and economic progress of nations throughout history. The impacts of liberalization, privatization, regional integration and globalization on the competitive environment in Africa are also discussed together with the related new challenges facing the African enterprises, particularly in the transformation of natural resources into manufactured products and wealth. The need to build important capacities in science and technology, including managerial, institutional and entrepreneurial, in order to enhance competitiveness is made clear and some policy directions are formulated in these respects.
4. The necessity of paying particular attention to new and emerging technologies, particularly information and communication technology, biotechnology, manufacturing technology and environmentally-sound technology is highlighted. The need to strengthen the technological innovation capacity of African countries is also stressed.
5. In conclusion the paper underlines the urgency of promoting political, institutional, regulatory, cultural, social and economic enabling and conducive environments, particularly in the area of science and technology, for enhancing the competitiveness of the continent and for increasing the well being of its peoples.

## II. COMPETITIVENESS: CONCEPTUAL ISSUES

6. The concept of competitiveness has evolved over time<sup>3</sup> with economic development and with the formulation of development theories. Classical economists viewed competitiveness as arising from "market mechanisms" (Smith), which force enterprises to measure up with each other in the production and distribution of goods and services at the best possible price and quality<sup>4</sup>. Market

<sup>1</sup> Africa is a very diverse continent and it is almost impossible to generalize. In this paper Africa refers particularly to the least developed countries of sub-Saharan Africa.

<sup>2</sup> The theme was identified at the first meeting of the Committee on Natural Resources and Science and Technology, which was held in November 1999.

<sup>3</sup> See for instance the works of Porter on competitiveness and the latest attempts to "measure" the degree of competitiveness of nations by the International Institute of Management Development, which produces the World Competitiveness Yearbook (WCY).

<sup>4</sup> During the last 15 to 20 years many African countries have embarked on structural adjustments and reforms that have focused on strengthening market mechanisms through privatization and liberalization.

mechanisms foster competition and efficiency in resources allocation, promote the survival of the fittest enterprises and eliminate less efficient ones.

7. Other economists saw competitiveness between countries as mainly arising from the endowment of production factors: "land, capital, natural resources and labour". The famous theory on comparative advantages (Ricardo), for example, is an effort to understand how and on what basis countries compete with each other. It was obvious that a country with a cold climate, for example, could not compete in the production of tropical fruits<sup>5</sup>. The theory was later refined by other economists to attach more importance to "socio-economic factors", since many countries with an abundance of land, capital, natural resources and labour were not performing as well as others less well-endowed countries. It was noted that countries with no "capitalist class" (Marx) or no "entrepreneurial class" (Schumpeter) were not competitive even if they had comparative advantages according to the classical views.

8. Competitiveness is also a function of a country's "culture and value system". A century ago a close relationship was found between certain values and development (Weber). Some values are deemed to favor competition and development more than others. The values underpinning the success of England, Germany and the United States in industrial development, for instance, are quite similar to those of some countries in Asia today, such as Japan, Korea and Taiwan<sup>6</sup>. It can be argued that if development is a cultural process then African cultures and values must evolve to become more conducive to development<sup>7</sup>. This thinking has gained currency in Africa recently after the realization that economic reforms alone do not necessarily produce the expected economic growth rates that have been observed in other regions of the world.

9. Lately, a number of economists have emphasized "technological innovation", "information", "knowledge", "ideas" and "brains" as the new bases for competitiveness (Solow, Lundvall, Mytelka, Garelli, Dosi, Freeman, Soete, etc.). A growing body of literature has emerged in the last fifteen years that lays emphasis on these growth and competitiveness factors.

10. According to these concepts African countries can enhance their competitiveness by (1) strengthening market mechanisms, (2) identifying the competitive advantages that they can build and sustain, (3) fostering cultures and values conducive to technological innovation and change, and (4) developing relevant information and knowledge networks and nurturing entrepreneurship.

### **III. COMPETITIVENESS AND NATURAL RESOURCES: DEVELOPMENT AND STRATEGIC ISSUES**

11. At a low level of development the importance of the resource sector in relation to the total economy is larger than it is at a higher level of development. In the most advanced countries today around 80% of the economy is based on services. Economists refer to this evolution as the "dematerialization" of the economy, which means that the amount of natural resources used by unit of GDP is decreasing with the increase in the level of development. Furthermore the importance of

<sup>5</sup> Africa has been historically perceived as competing in the world economy on the basis of its reservoir of vast and varied natural resources.

<sup>6</sup> The Confucian principles of "personal effort, responsibility, loyalty, hard work, discipline, restraint, saving and the quest for knowledge" are quite akin to the protestant ethic and values that dominated Europe and the United States in the 18<sup>th</sup> and 19<sup>th</sup> century, which fuelled the industrial revolution and the unprecedented development that followed.

<sup>7</sup> Attitudes toward work, toward women, toward scientific knowledge and scientific rationality, toward the elderly, toward ancestral customs and traditions, toward authority, toward the environment, toward the individual vs the group, etc., need to be supportive of social and technological change and development.

natural resources endowment for a given country is eroded by trade liberalization, which makes it easier to import raw material from other countries.

12. Many African countries are rich in natural resources and exports of raw material are very important for their economies. Most of these countries have adopted development strategies and have built their competitive capacities by relying more heavily on natural assets than on technological processes. These countries are not considered very competitive on the world markets. On the other hand other African countries, such as Tunisia and Mauritius, are poor in natural resources and are essentially relying on transformation processes, using mature, off-the-shelf technologies and adapting technologies for their development. In general, the process-oriented economies are more competitive than the assets-oriented economies.

13. From these observations some economists view natural resources as a "spell" or a "curse"<sup>8</sup> and see ample evidence of asset-rich nations that have not developed in spite of their enormous wealth and also see many resource-poor countries that have developed spectacularly, such as Japan, Taiwan, Singapore and Korea. Consequently, it is conjectured that the endowment of natural resources can be a "trap", for it leads countries to concentrate or focus too much on their natural resources for their development and to neglect other important sectors, particularly high value-added sectors in rapid expansion.

14. One should avoid jumping to the conclusion that natural resource assets constitute "negative assets" for the development of a country. Some countries, such as Canada, Norway, Sweden and others, have historically developed by relying heavily on the exploitation of their natural resources. In addition, the natural resource sector has evolved from a low-tech sector based on low-cost labour to a high tech sector. Competitiveness does not depend on the endowment of resources but on the technological capacity to process them. Adopting a strategic development orientation that emphasizes processes and accumulating knowledge and building technological capacities to become competitive in these processes are thus the keys development.

#### ***IV. INTERNATIONAL COMPETITION, TECHNOLOGICAL INNOVATION AND DEVELOPMENT***

15. Competition between States and nations is a powerful force in development. The competition between the United States and England during the last century, for instance, has been very much beneficial to the scientific progress and technological advancement of the world. The bitter rivalry between the US and Germany during World War II, between the US and the Soviet Union during the cold war, between Japan and the US during and after World War II and more recently between Korea and Japan<sup>9</sup> has greatly accelerated technological innovation and development. Foreign competition and rivalry are major driving forces underlying technological innovation.

#### ***V. COMPETITIVENESS IN AFRICA: AN EVOLVING CONTEXT***

16. As the world economy is being deregulated, liberalized and as it is becoming more and more globalized, many companies have to compete not only in foreign markets in order to prosper but they also have to compete in their own national markets. In fact in as little as 10 to 20 years much of the world will be a vast free-trading place and competition will further increase. The competition

<sup>8</sup> For a discussion of this concept, see Mikesell.

<sup>9</sup> See Kim (1999) for the role of competition between Korea and Japan in Korea's development.

from many developing countries, such as China, Indonesia, Brazil and India, is also rapidly increasing. These countries compete with African enterprises with very low labour costs and increasing technological capabilities.

17. Competition is also intensified within Africa among African enterprises, particularly at subregional level, due to the implementation of subregional free trade areas. The African Union project will further increase that competition across the continent. The 'competitive gap' between the industrialized countries and African countries is also widening, particularly with sub-Saharan African countries. By and large African countries are still exporter of raw material although many African enterprises are conquering new markets with non-traditional products.

18. This new competitive context brings new challenges for African enterprises, which need to upgrade their capacities to compete. It also brings new challenges for African economies, which need to transform themselves in order to be able to mobilize and organize the necessary resources to face up the new challenges of competitiveness.

## **VI. ROLE OF GOVERNMENTS IN ENHANCING COMPETITIVENESS**

19. International trade agreements limit, constrain or forbid certain types of state interventions in order to achieve fair competition but there is still plenty of room for the State to play a very active role in promoting competitiveness. Nations and countries compete on the basis of numerous factors<sup>10</sup>, such as those related to (1) Government Efficiency, (2) Support to Businesses and (3) Quality of infrastructure. Government efficiency can be promoted by a series of efficient policies affecting competitiveness, such as monetary, financial, budgetary, fiscal, labour, trade and by increasing political and policy stability, reducing corruption and tax evasion, improving administration of justice and bureaucracy, etc.. Support to businesses is increased by promoting entrepreneurship, skilled labour, investment in technology, sound management practices, etc. Infrastructure is enhanced by the provision of quality education, health, environment, water, energy, roads, etc., and science and technology institutions.

20. Sound government policies support competitiveness. A dynamic national system of technological innovation supports competitiveness. A globally integrated financial sector in a country supports its international competitiveness. A skilled labor force supports a country's competitiveness. A well-developed infrastructure supports competitiveness. Reducing factors inhibiting competitiveness is thus the way forward<sup>11</sup>.

<sup>10</sup> See Garelli for a methodological framework of government interventions to enhance competitiveness

<sup>11</sup> Some of the factors inhibiting competitiveness of African countries have been identified in an extensive study carried out by UNIDO (1998). The most important factors identified are: shortage of trained labour, engineers and technicians, weak infrastructure, financing difficulties, high taxes, cumbersome regulations, coups, corruption, policy instability, crime and work ethic: Botswana (Labour, inflation, financing, infrastructure), Burkina Faso (Financing, infrastructure, taxes, regulations), Cameroon (corruption, financing, taxes, infrastructure), Côte d'Ivoire (taxes, policy, finance, education, infrastructure, coups), Ethiopia (infrastructure, taxes, finance, corruption), Ghana (inflation, finance, taxes, infrastructure, corruption), Kenya (corruption, infrastructure, crime, finance, policy, instability), Malawi (infrastructure, finance, crime, corruption, education), Mauritius (labour, education, policy instability, inflation), Mozambique (infrastructure, taxes, crime, education, corruption), Namibia (education, work ethic, labour crime), Nigeria (infrastructure, corruption, policy instability, inflation, crime), South Africa (crime, taxes, labour, work ethic, education), Tanzania (taxes, finance, infrastructure, inflation, regulation), Uganda (finance, infrastructure, taxes, corruption, political instability), Zambia (finance, taxes, inflation, crime, education, infrastructure), Zimbabwe (taxes, inflation, infrastructure, corruption, policy instability). Source: UNIDO (1998), *Domestic Capacity-Building for Enhancing Productivity and Competitiveness in Africa*, Vienna.

<sup>11</sup> These include among others: the ARCT, ARCEDEM, OAPI-ARIPO, ARSO, etc. and the Committee on Natural Resources and Science and Technology (ECA-CNRST).

## **VII. THE NEED TO BUILD CAPACITIES IN SCIENCE AND TECHNOLOGY**

21. The persistent poor competitiveness of African countries is reflected in a number of indicators, including the low level of investments in scientific and technological capacity building. Africa's share of global export trade fell from 5.9 per cent in 1980 to less than 2% at the end of the 1990s. This trend reflects a low technological capacity to compete in world markets and it can be observed in a wide range of commodities. The regional share of stock of inward foreign direct investment (FDI) also dropped sharply, from 7.7 per cent in 1980 to around 2% now. Sub-Saharan Africa also suffered a decline in its market share of global manufacturing value added (MVA) from 0.6 per cent in 1970 to a low 0.3 per cent now.

22. In the last few years the gross domestic product (GDP) of a majority of African countries has been growing as fast or faster than population, contrasting markedly with the past two decades of declining per capita income<sup>12</sup>. This performance is not shared evenly across the continent and across economic sectors but it reflects some improvements in the economic policy environments and probably some improvements in the competitiveness of businesses.

23. By and large the better economic performance that is observed falls far short of what is needed to pull Africa out of poverty. In order to achieve a significant reduction of poverty African countries need to strengthen their capacities in science and technology and at least double their level of investments for development<sup>13</sup>, including in scientific and technological infrastructure, in new and emerging technologies and in their system of technological innovation.

24. The technological innovation capacity of countries can be assessed by series of indicators, such as the resources invested on research and development, the number of science and technology personnel, scientific publications, registered patents, technology licensing fees, technology import, FDI related to technological transfer, computers, internet hosts and internet users per inhabitants, etc.. According to these indicators African countries rank among the least technologically-advanced countries in the world<sup>14</sup>. Africa's research and development expenditure amounted to \$4.2 billion in 1994 (0.9% of the world total). Africa's share in total world scientific publications was less than 1.5% in 1995, and Sub-Saharan Africa's was 0.8%. Africa's share was a mere 0.1% of U.S. patents. In 1996 only 0.06% of Ethiopians and only 0.08% of people in Burkina Faso were enrolled in universities compared with 6% in the Republic of Korea and 3% in Chile. In the same year the enrolment of students in engineering courses in Ethiopia was 3,393 compared with 454,033 in Korea<sup>15</sup>.

25. African countries need to produce a critical mass of skilled and a highly trained labour force, including scientists, engineers, technicians, programmers, policy-makers, managers and entrepreneurs, capable of fostering technological innovation and change and of raising the degree of competitiveness of their industries. They need to strengthen their capacities to generate and use knowledge and to participate in the new economy. In this context there is a need to upgrade their national systems of innovation<sup>16</sup>.

<sup>12</sup> ECA Annual Economic Reports on Africa

<sup>13</sup> For an evaluation of the level of investments necessary to achieve development goals in Africa, see ECA/ESPD Working Paper 2000/4

<sup>14</sup> For science and technology indicators see the World Science Yearbook produced by UNESCO. See also the report prepared by the Rand Corporation (2001) on science and technology collaboration with developing countries prepared for the World Bank.

<sup>15</sup> Source: Economic Commission for Africa, UNESCO 1970, 1998b

<sup>16</sup> For a discussion of the concept of National System of Innovation (NSI), see Lundvall, Carlsson and Stankeiwicz, Utterback, Christensen, Edquist, Nelson, Patel and Pavitt.

### ***VIII. ENHANCING MANAGERIAL CAPACITIES AND INFRASTRUCTURE***

26. Building capacities in science and technology includes enhancing technological infrastructure and institutions and putting in place enabling social, economic, financial and cultural environments. The infrastructure includes S&T policy-making institutions, S&T promotion, demonstration and monitoring institutions, research and development institutions, internet, mobile and other communications facilities, technological standards, intellectual property, technical training institutions, all of which affect the competitiveness of a country.

27. Effective managerial and policy making capacities in science and technology, for instance, are needed: (1) for charting out national strategies, directions and priorities in scientific and technological development and application; (2) for designing science and technology plans and programs of activities to implement the strategies; (3) for mobilizing the necessary national, regional and international science and technology resources; (4) for formulating and implementing supportive economic policies (investment, trade, taxation, procurement, etc.); (5) for identifying niches where African countries can compete in the global markets and where science and technology support from a variety of resources of the public sectors, including those of universities and the public research centers, can be directed; (6) for strengthening the national systems of innovation, (7) for promoting critical new and emerging technologies, and (8) for promoting value systems and cultures that are conducive to innovation and competitiveness. Enhancing managerial and policy-making capacities and infrastructure in science and technology will strengthen the support to the competitiveness of countries and firms.

### ***IX. STRENGTHENING INSTITUTIONAL CAPACITIES***

28. How technology develops and shapes the competitive advantage of nations is now better understood by science and technology policy-makers. There has been an evolution of the concept of science and technology over the years with a greater emphasis on processes, interactions, networks and clusters, information, knowledge, brains, entrepreneurship, rather than assets and stocks. But this conceptual evolution and this better understanding of the dynamics of technological change have not led to a similar evolution in science and technology organizations and institutions. The result is a discrepancy between new concepts and old organizational and institutional structures and a great deal of uncertainty on how governments should organize and institutionalize their efforts in science and technology to make them more effective.

29. This is illustrated by the fact that African governments (and to a large extent, non-African governments as well), have responded to the technological challenge by building a variety of institutional setup<sup>17</sup>. All these organizational arrangements reflect particular situations and also particular concepts of science and technology. They are not necessarily equal and the performance of these organizational arrangements also varies. It can be argued, for instance that when science and technology are attached to a social ministry – such as the Ministries of Higher Education and

<sup>17</sup> . Some governments have included science and technology in the constitution of the country to make it a permanent priority and concern, irrespective of the vagaries of governments. Some countries have set up a full Ministry dealing exclusively with science and technology issues. Small countries have usually set up a small Department or a Unit within a Department to deal with science and technology policies and management. Some countries have preferred to address science and technology issues with a non-departmental or non-ministerial structure called Commission, Council, Center, etc. Some have created an Advisory Body in addition to the main executive body. Some countries have put science and technology with a major sectoral (line) ministry while others have preferred to put science and technology with a horizontal ministry. Some other countries have split science and technology in two and placed it in two different ministries, such as science with the ministry of education and technology with the ministry of industry. In addition to these structures, many countries have designed ways to link up science and technology efforts to the highest political level in order to impulse political leadership into decision making.

Research – which can be found predominantly in francophone African countries, the organizational structures may not be efficient to promote ‘technological innovation’ because these ministries have virtually no contact with the private firms – the basic unit of technological innovation. Since technological innovation is an important factor of international competitiveness in this era of globalization, it can be argued that the science and technology effort must be brought closer to an economic ministry, such as the ministry of industry and commerce.

30. Science and technology should be the concern of each and every Department and institutions of the public sector. No Department should monopolize science and technology issues. This view is necessary to ensure that science and technology issues are on the agenda of all public stakeholders and are better addressed. Interdepartmental coordination can be tackled through an interdepartmental coordinating committee on science and technology. This kind of committee can be considered, perhaps, a “best practice”.

31. The practice of nominating high-level science and technology advisors reporting directly to the President or the Prime Minister has also proven its effectiveness in promoting technological awareness, leadership and commitment at the highest political level.

32. Science and technology policy-making institutions should be the main advocate of the Governments for all scientific and technological matters that impinge upon socioeconomic development. They should encourage both the public and private sectors to participate more in technological change and in technological innovation activities. They should also collect and disseminate (through appropriate information systems) all relevant technical information on science and technology and research and development issues. They should promote the commercial exploitation of the results of scientific and technological research to farmers, industrialists and other entrepreneurs. They should encourage the development and use of local consultancies in the design of development policies and projects with technological inputs. They should also promote critical technologies, including the application of “green” technologies and biotechnologies for food security in the context of sustainable development.

33. Besides science and technology policy-making capacities, many other institutional capacities can be built or strengthened to foster technological innovation<sup>18</sup>.

## **X. *PROMOTING ENTREPRENEURSHIP FOR ENHANCED COMPETITIVENESS***

34. One of the weaknesses of African countries is the relative small size of the industrial sector. This sector is crucial for development and science and technology policies must support its growth and strengthening. The sector may be the weakest link in the development of many African countries. Hence the priority must be accorded to the development of this sector through building entrepreneurial capacities to acquire and apply appropriate manufacturing technology for enhanced competitiveness. Priority must also be accorded to the creation of micro-enterprises and to the development of small and medium sized enterprises (SMEs). Science and technology policies must support this orientation.

<sup>18</sup> These include some of the following: technological innovation (such as technology incubators and technological parks already in development in a growing number of African countries), technology transfer, extension, diffusion and popularization, information, networking (including scientific and professional associations), international cooperation, R & D, technological standards and intellectual property. Infrastructures for information and communication technologies are also particularly important for any African country since these technologies can substantially improve productivity and efficiency in all sectors of the economy and support technology transfer and networking.

35. Building entrepreneurial capacities can be done through a variety of measures, such as the development of technology incubators, technology centers, technology parks and the organization of specialized conferences, courses and seminars, involving the business sector, the public sector and the universities.

## ***XI. KEEPING UP WITH CRITICAL NEW AND EMERGING TECHNOLOGIES***

36. The unprecedented technological wave that is sweeping much of the world – based on computers, telecommunications and the Internet – is having a tremendous impact on the competitiveness of nations and enterprises. Technology, particularly new information and communication technology (ICT), is now one of the most important assets of enterprises to compete on the world markets. Massive investments in these technologies – around 5% of GDP or more than \$1,000 per capita per year – are being made by the most technologically advanced countries. That means that public infrastructure cannot be viewed only in the traditional terms of roads, railways, power, ports and airports. It also means that modern technological infrastructures have become key assets for the competitiveness of countries.

37. Fast, affordable and reliable connections to the Internet and development of mobile telephony are some of the new technological infrastructure that nations need to put in place in order to become or remain innovative and competitive. Some countries, such as the Republic of South Africa, are leapfrogging some technological infrastructure, for example, by developing mobile rather than fixed phones and by using the Internet to deliver services to isolated areas – such as banking, financial, information, distance-learning and health services. The Internet enables companies to have a global reach and conduct efficient business transactions.

38. Other new technologies, such as biotechnology, material technology, solar technology, manufacturing technology, are also changing the technological landscape and affecting competitiveness. Thus a critical issue for African countries is to keep up with the development of new and emerging technologies in order to maintain or increase their competitiveness.

## ***XII. REGIONALIZATION, GLOBALIZATION, INNOVATION AND COMPETITIVENESS***

39. Much of the pressure to compete and innovate come from the forces of liberalization, regionalization and globalization. Policies should therefore aim at addressing the challenges arising from these forces and at exploiting the opportunities arising from the new regional and global environment. They should also aim at strengthening cooperation with both industrialized and industrializing countries and designed to capitalize on certain comparative advantages, forces, assets and resources and to reduce or mitigate a number of shortcomings, disadvantages, liabilities and weaknesses, particularly in the area of science and technology. The regional and global dimensions of science and technology must indeed be addressed adequately by science and technology policies.

40. In this regard, specific policy orientations include: (1) coordinating regional and subregional efforts and activities in science and technology; (2) contributing to the elaboration of regional common positions on international policies and agreements relating to science and technology; (3) implementing protocols, resolutions and conventions in the area of science and technology in the framework of the African Union; (4) designing ways to benefit from the expertise of African expatriates and minimizing brain drain; (5) forming partnerships, alliances and associations and the twinning of scientific and technological institutions; (6) carrying out cooperation and collaboration

activities at the regional or subregional levels related to technological innovation such as joint exhibitions, units for demonstration, research, fine tuning, adaptation etc.; (7) networking through various regional or subregional networks related to science and technology; (8) concluding bilateral agreements in science and technology to secure needed scientific and technological expertise; (9) conducting regional or subregional studies such as scientific and technological indicators of development or the identification of the region or subregion's technological needs and potential; (10) sharing science and technology resources and assets with other countries of the subregion in the areas of higher education; research and development; scientific and technical information, including patents and standards; infrastructure (laboratories, metrology, centers etc.); (11) strengthening regional and subregional scientific and technological organizations, institutions and associations (or strengthen their roles in science and technology)<sup>19</sup>.

### ***XIII. CONCLUSION***

41. Africa is the birthplace of science and technology and a major contributor to civilization. However, the continent has not been able to replicate the recent successes of other parts of the world in socioeconomic development and it must now try to catch up in an increasingly borderless, competitive and unequal world. Hence the need to formulate and implement sound policies to succeed in this endeavor.

42. In the years ahead, as the world will move closer to a vast free trading zone, development will be more and more dependent on capacities of enterprises and countries to compete. This capacity to compete will be less and less based on natural resources and more and more based on information, knowledge, technology and innovation. These factors have become amongst the most important ones for development and as countries move up the economic scale, the more they thrive on these factors to ensure their prosperity and to compete in world markets. African countries are not prospering because of their weak scientific and technological capacities, including their capacities to access and generate knowledge, and because they are not enough innovative and competitive. The reasons for this lack of scientific and technological capacities, this lack of innovativeness and this lack of competitiveness are complex, historical and inextricably intertwined with politics, institutions, culture and economics. This suggests that progress will have to be made simultaneously on many fronts.

43. Perhaps as a first step African countries could conduct comprehensive national technology assessments and launch effective national dialogues involving all stakeholders. The objective of these exercises would be to formulate strategies, policies and plans of action for enhancing competitiveness and accelerate economic growth and development, particularly through a greater and better utilization of science and technology.

<sup>19</sup> These include among others: the ARCT, ARCEDEM, OAPI-ARIPO, ARSO, AAU, AAS, MAGTECH, AFRISTECH, etc. and the Committee on Natural Resources and Science and Technology (ECA-CNRST).

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