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NEEDS FOR ESTABLISHING SUPPORT SERVICES FOR INVENTORS, INNOVATORS, SMES AND R&D ORGANIZATIONS IN AFRICAN COUNTRIES

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TABLE OF CONTENTS

		Page
1	**INTRODUCTION**	3
2	**THE NATURE OF INNOVATORS, INVENTORS, SMES AND R&D ORGANIZATIONS**	3
2.1	**The Inventor**	3
2.2	**The Innovator**	4
2.3	**The SMEs**	4
2.4	**R&D in Africa**	6
3	**WHY THE SUPPORT SERVICES ?**	6
4.	**TYPES OF SUPPORT SERVICES**	6
4.1	**Technical Infrastructure**	7
4.2.	**Information Infrastructure**	7
4.3	**Intellectual Property Rights**	8
4.4	**Business Support Services**	8
4.5.	**Human Resources Development**	8
4.6.	**Financial Institutions/infrastructure**	9
4.7.	**International Cooperation**	9
4.8.	**Political Will and Stability**	9
5.	**SOURCES OF SUPPORT SERVICES**	10
5.1	**Government Funded Agencies**	10
5.2.	**Trade and Professional Associations**	11
5.3.	**African Regional Bodies**	11
5.4.	**International Organizations**	11
5.5.	**Direct Foreign Investments**	11
5.6	**Cooperatives and Town Unions**	11
6	**CONCLUSIONS**	12
TABLE 1		13
TABLE 2		14
TABLE 3		14
TABLE 4		15

1 INTRODUCTION

After nearly half a century of industrial development efforts, Africa remains the poorest region of the world. The hopes contained in nearly all of her economic and industrialization programmes appear to have been mere mirage. On the basis of current technology policies (or lack of policies) of most African countries, the prognosis of the world's industrial structure in the coming millennium is clearly unfavourable for Africa and appears to be getting increasingly desperate with each passing year. The gap in science between Europe and Africa has continued to widen. Poverty and,with it, social and political instabilities ravage the continent. The continent has been largely unable to add much value to either her abundant natural resources or any imported material; and this is not surprising since the productive base is significantly weak, indeed largely absent in many of the countries.

Technology is the means for adding value to goods, materials or resource in order to generate useful products or services. Thus industrial development is strongly related to the process of adding value to goods or materials and therefrom create a surplus (wealth creation). And technological capability is the key for doing this. A credible industrial development programme must be hinged on the availability of active indigenous technological capability.

Inventors, innovators, SMEs and R&D organizations constitute the pillars on which technological capability is constructed. And indeed it is through these bodies, often working in concert, that technology is nurtured, acquired, assimilated and fueled to power industrialization.

2 THE NATURE OF INNOVATORS, INVENTORS, SMES AND R&D ORGANIZATIONS

2.1 The Inventor

The inventor is a technical expert of extraordinary skills with novel idea that permits in practice the solution of a specific problem in a field of technology. When the idea is new, non-obvious and applicable in industry, in the sense that it can be industrially manufactured or used, it can be protected through patents. The work of the inventor only gets rewarded when it is exploited (made, used, sold, imported) by or with the authority of the patentee in a society with strong enforceable Industrial Property Rights.

The patent system is a very strong spur for industrial development. In particular:

i) it gives an incentive for the creation of new technology which will result in, inter alia, new products, inventions and commercial opportunities;

ii) it contributes to the creation of an environment which facilitates the successful industrial application of inventions and new technology and the legal framework which encourages investment;

iii) it acts as a catalyst for the commercialization of inventions and their transfer to productive use; and

iv) it encourages the disclosures of technological information because of the guaranteed protection accorded to the inventor under the patent laws, and therefore contributes to rapid flow of knowledge.

But the development of a patentable invention generally involves long painstaking work that needs an environment with adequate facilities and infrastructure, heavy financial outlay, network of information and databases, as well as other support services. Many inventors work under lonesome conditions, but more often today, they work in groups in research and industrial organizations.

2.2 The Innovator

The innovator is someone, generally an expert, who creates value, and ultimately wealth, by exploiting some changes in technology, materials, marketing techniques, services, etc, in order to generate new demands or new ways of exploiting an existing market. The creation may not necessarily be a patentable product. But induces a demand which generates wealth, often of extraordinary proportion. Therefore innovation has taken the centre stage in the industrial system and has become the key to business success.

It is estimated that in the last two decades, greatest dramatic industrial growth rates in companies and nations have come about through innovations, more so in areas of high technology: biotechnology, information, energy, materials, etc.

A study of world's industrial cycles, from the first wave which appeared in the late 18th century (with water power, textiles and iron) to the fifth wave (of micro electronics, digital network, software), that started about the late 1980's, shows that technological revolutions are usually heralded by innovations. Companies or nation's that get into the industrial cycle early (that is, who catch the wave early) exploit extraordinarily large profits that accrue from the innovative process/product and become leaders while others lose out.

Innovation is generally not a simple chance thing. It is a complicated business and it is costly. Consequently, innovation is systematically pursued in most organizations, more generally through research. And most Governments are now committing massive amount of public funds into R&D in order to sharpen and ensure national competitiveness.[1]

2.3 The SMEs

The Small and Medium Establishments (SMEs) are generally defined in terms of capital investment and size of the work force, the exact numbers of which vary from nation to nation and depends on the level of the nation's industrial development. In most African countries it is defined as companies employing between 10-100 workers and with capital investment not exceeding 500,000 US dollars.

The SMEs have been recognized as effective instruments for energizing a young/infant or backward economic system and constructing the bedrock for a nation's industrial take off.

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[1] See Innovation in Industry, Nicholas Valery, The Economist, February 20th 1999, Vol. 350, No. 8107, The Economist Newspapers Ltd London.

The development of SMEs is therefore an essential element in the growth strategy of most economies and hold particular significance for Africa. Together, SMEs not only contribute significantly to improved living standards, they also bring about substantial local capital formation and achieve high levels of productivity and capability. SMEs can be major contributors to increased industrial output and employment and serve as vital mechanism for entrepreneurial, technological and managerial growth. Through SMEs, whole sectors of industry can increase their competitiveness and export capability. From a planning standpoint, SMEs are increasingly recognized as the principal means for achieving equitable and sustainable industrial growth and ensuring industrial diversification and dispersal. On account of their small size, they are flexible and adaptable. They add flexibility to the industrial growth and structure by engaging in small batch production and made-to-order, or other types of "financing" operations complementary to the activities of large scale industries. Since innovative projects typically start small, they are also instruments of innovation and they generate green field investments. SMEs in general and in most countries account for over half of the total share of employment, sales and value added.

In a nutshell, the role of SMEs can be summarized as follows:

i) generation of employment, including self-employment, as they together sometimes account for more than 90% of all enterprises in the vast majority of countries;

ii) helping to fight and alleviate poverty;

iii) provision of a breeding ground for entrepreneurs and through the "demonstration effort." they spawn enterprises;

iv) provision of the main driving force behind the interrelated flow of trade, investment and technology;

v) mobilization of resources and allocation of them among productive sectors;

vi) engaging in a wide variety of activities ranging from provision of goods and services to the manufacture and export of goods in the modern sector;

vii) a means for converting inventions and R&D results to industrial products;

viii) helping to conserve foreign exchange since they generally source their raw materials locally as compared to large enterprises who often rely on imported raw materials;

ix) acting as active instruments for rural and social development;

x) helping to mitigate the impact of industrialism; and providing means of attaining self - actualization for the independent minded individuals.

2.4 R&D in Africa

The R&D organization in Africa is mainly lodged in Government sponsored network of institutions. The performance or status of the R&D activities in African can be expressed by:

(i) expenditure on R&D as a percentage of GDP;

(ii) manpower in science and technology (number of scientists per working population) or the number of scientists employed in R&D, and

(iii) the quality of information system and network.

Tables 1, 2, and 3 give comparative values of these indices for some African countries and some selected nations of the world. The data consistently point to the weak position of the continent's R&D and, in turn, to its industrial stagnation. Industrial establishments in the continent are yet to make any meaningful impact on R&D efforts.

3 WHY THE SUPPORT SERVICES ?

Support services must need to be provided for inventors, innovators, SMEs and R&D organizations because, as already noted, these bodies drive the national economy. Thus they are "the geese that lay the golden eggs": yet they are very vulnerable and fragile and require huge financial commitments, supported by network of services, linkages and infrastructural facilities.

4. TYPES OF SUPPORT SERVICES

The peculiar characteristics of inventors, innovators, SMEs and R&D organizations have made the provision of certain structures and services mandatory for their success. Consequently, these services must be constituted within the overall national industrial policy programme. Prominent among these services are:

i) technical infrastructure;

ii) information infrastructure;

iii) intellectual property rights;

iv) business support services;

v) human resources development;

vi) financial institutions and infrastructure;

vii) international cooperation;

viii) political will and stability.

4.1 Technical Infrastructure

National networks of well-equipped laboratories and workshops with facilities for standard tests/analysis and high level scientific and technical research work in various fields, including high technology, are important for the work of scientists and engineers and all persons engaged in innovative and inventive activities. These networks are also prerequisites for successful operation of SMEs.

This national technical infrastructure must reach a critical level or threshold to ensure absorption, assimilation, diffusion and adaptation of imported technologies, the development of indigenous innovations and inventions, the manufacture of quality products, the internalization of S&T in the social cultural milieu and, with it the demystification of technology and the assurance of national technological capability.

Yet another aspect of technical infrastructure is the creation of institutions or framework for nurturing or inculcating small businesses from laboratory results. Referred to as Technology Business Incubators (TBI), Technology Parks, Small Business Technology Transfer Programmes (SBTTR), etc, the TBIs are innovation-based initiatives with small management staff, physical work space and shared facilities located near a university or research laboratory which provides technical and business support services for facilitating the transformation (or incubation) of an innovation or invention into an industrial enterprise. World-wide, the TBIs have become proven instruments for translating innovation and research results into products, encouraging entrepreneurship and generating technological development. It is now commonplace to have TBIs spread across many zones in a country to provide opportunities for innovators and entrepreneurs and therefrom the growth of technological and industrial activities.

A national legal framework upon which legitimate business activities are carried out in accordance with international practice is an important component of a national technical/infrastructure. Such a framework specifies protection of ownership, profit, responsibilities, etc, of all parties to an agreement. It also stipulates enforceable trade laws, labour laws and the basis of all transactions. In a nutshell, it should guarantee order, which is paramount for any successful activity.

4.2. Information Infrastructure

Network of laboratories and workshops must be backed up by a sound and reliable information infrastructure with adequate and easy access to national as well as global technology databases. On the national level, it is able to provide a monitor showing who is doing what at which location, so as to reduce duplication of efforts and resources and encourage the concentration of skills. It should also provide data on national material resources, manpower, facilities, etc. On the global level, it provides information on what (technologies, expertise, etc) are available in other parts of the world, and therefore ensure better focussing of research efforts, building upon known technologies (avoiding reinvention of old inventions), with opportunities for leap-froging. Here, for example, WIPO, under its cooperative programmes with developing countries, offers training not only in the acquisition of foreign technology, but also provides access to scientific and technological information contained in millions of patent documents world-wide. The information networks also furnish operators with latest achievements and developments in knowledge, market for their products, as well as potential opportunities and threats in global trade.

To be useful, such information must be disseminated effectively and widely to all practitioners, for example, through publication of Newsletters and Directories, and through Workshops, Radio and Television, including Local Area Network (LAN) and, of course, the internet.

4.3 Intellectual Property Rights

Related to the legal framework and information infrastructure is the important issue of intellectual property rights (IPR) especially as it relates to inventions, industrial designs, the rights of the inventor, the protection offered him/her under the IPR system and the strict enforcement of IP laws. Nations most need to enter into membership and comply with the various Intellectual Property Conventions administered by WIPO.

4.4 Business Support Services

One other important plank of support services is that of entrepreneurial support through appropriate Government Agency or Professional Association that forges and maintains a linkage between the inventors/innovators, research organizations and the SMEs with respect to sourcing of technologies, know-how, equipment, workshops and test laboratories for quality assurance, formulation of demand-driven research projects, and ready commercialization of inventions.

Another form of linkage often promoted by a deliberate Government policy on industrial location and incentives is that of development of sub-sectorial clusters of SMEs. Such clusters would have shared facilities, with common pool of information network on markets, venture capital, databases, etc.

4.5. Human Resources Development

Increasingly, research, innovation, inventive activities, operation and maintenance of equipment and facilities, and indeed the management of industrial production, especially in the high technology sectors are becoming more skill-demanding. Moreso for the appreciation and fruitful adaptation of imported technology. Similarly, the production of quality goods that can compete in international trade with imported goods in the local market demands very high skills and expertise for the product design, the maintenance of sophisticated equipment, as well as the marketing of products.

There is a dearth of skilled manpower in most parts of the African continent. Thus a wide range of training programmes need to be put in place to ensure availability of adequate pool of trained manpower in various areas and levels of technology-research, design, manufacture, management, data computation and analysis, information technology, legal, IPR and trade-related matters.

Well-funded and well-equipped universities and technical colleges and schools with sound curriculum (developed in close liaison with industry and research laboratories), coupled with vocational training, postemployment education and on-the-job training, must take a high point in them manpower development programme of each nation. Such manpower development programme would provide a bedrock on which SMEs and national R&D organizations can blossom and be able to compete in the global market of the next millennium.

4.6. Financial Institutions/infrastructure

Capital investment is vital for the development and operation of industrial enterprises and R&D organizations as well as for transforming an invention or innovation into a product for the market. It is well-recognized that an invention only become important when it is put into use i.e. enters the market and meets a need. In other words, an invention until it is commercialized, is nothing more than an idea on paper which may just remain dormant and be of no service to humankind. Only when it is commercialized does its importance become manifest.

Thus it is important to have a programme of investment and development banks as well as Government-supported credit systems which will provide:

i) venture capital for new industries (or older ones seeking expansion/modernization);

(ii) funds for collaborative research between industry and research laboratories;

(iii) funds for the commercialization of research results.

Equally important are financial support through fiscal incentives, such as, tax relief on R&D expenditures, excise duty waiver/exemption, import duty exemption for some machinery and equipment for research, tax holidays as well as other tariff measures aimed at assisting SMEs.

4.7. International Cooperation

International Relations could be a powerful means of providing invaluable support services to SMEs, R&D organizations and innovative activities generally, particularly through direct foreign investment (DFI), exchange of scientific personnel and joint research efforts, human resources development and bilateral trade relations and agreements.

4.8. Political Will and Stability

Nothing can really replace political will and stability when it comes to providing support services for inventors, innovators, SMEs and R&D organizations. No support service would be of any support unless it is backed up with resolute and determined political will in politically stable environment. This is so because at the end of the day it is really a political decision on the part of the national leadership of each country if it will take the necessary steps to ensure that the society can create, acquire, master and utilize technology.

Thus a purposeful and dedicated political leadership with deep interest in technology must oversee all other support services. Such a political leadership would have to ensure that the various support services are monitored and coordinated by appropriate national institutions and agencies to guarantee success.

5. SOURCES OF SUPPORT SERVICES

5.1 Government Funded Agencies

National Governments are expected to be the main promoters and motivators of the support services which have to be the components parts of a vibrant **"National Programme of Action on Technology".** Such promotion and execution of the support services has to be coordinated through various Government-funded Agencies with specific mandates. A good example of such Agency in Nigeria is the National Office for Technology Acquisition and Promotion (NOTAP), others are the Raw Materials Research and Development Council (RMRDC) and the National Risk Fund (NRF).

NOTAP was established by a Government Decree No.70 of 1979 then under the name of National Office of Industrial Property (NOIP) and later changed to the present name by Decree No.82 of 1992 to ensure that the name adequately reflects the entire functions of the Office as contained in Decree No. 70 of 1979 and also remove any ambiguity or misconception that may arise in relation to the Office for the Registration of Patents and Trade marks which is located in the Federal Ministry of Commerce.

In line with the globalization and liberalization of the world economy, NOTAP has shifted its emphasis from regulatory and control functions to promotional and developmental roles. The new areas of focus are aimed at attracting foreign technologies and investment, as well as emphasizing local manpower development with a view to strengthening local technological capabilities, that is to say:

i) encouragement of a more efficient process for the identification and selection of foreign technology;

ii) development of the negotiating skills of Nigerian with a view to ensuring the acquisition of the best contractual terms and conditions by Nigerian parties entering into any contract or agreement for transfer of foreign technology;

iii) provision of a more efficient process for the adaptation of imported technology;

iv) registration of all contract or agreement having effect in Nigeria for transfer of technology to Nigerian parties;

v) commercialization of R&D results and inventions;

vi) adaptation of imported technologies;

vii) development of guidelines for the documentation of all valuable inventions and R&D results nation-wide;

viii) assisting inventors and researchers in patenting all viable inventions and R&D results.

Over the years, NOTAP has provided invaluable support services to inventors, SMEs, and R&D organizations and plans are afoot to expand and enhance the scope of its operations.

Apart from Government established Agencies, support services can also be provided through some of the prominent sources summarized below.

5.2. Trade and Professional Associations

In Nigeria for example, the National Association of Small and Medium Scale Establishments (NASME), is an association of micro, small and medium enterprises (MSMESs), financial institutions, non-financial sector organizations, public sector agencies with responsibility for developing MSMEs, foreign MSMEs Associations and Donor Agencies. Its objectives among other things are to:

(i) to facilitate delivery of suitable credit to MSMEs;

(ii) create greater public awareness of the role of MSMEs in national development;

(iii) cooperate with Government Agencies and Parastatals in respect of the promotion of MSMEs;

(iv) design and execute an effective communications support programme for MSMEs in Nigeria;

(v) provide export promotion services, and (vi) identify and source appropriate and relevant technologies that can enhance the efficiency of MSMEs, among others.

5.3. African Regional Bodies

There are already exists such bodies as the OAU, ECOWAS, etc.

5.4. International Organizations

There are many international organizations for development programmes world wide. Prominent among these are WIPO, UNIDO, ECA as well as supranational organizations e.g. the EU, and many of the development support agencies.

5.5. Direct Foreign Investments

From private and multi-nationals.

5.6 Cooperatives and Town Unions

This is a source from which useful support can be drawn, but which has been neglected and not much exploited. From them can be extracted immense support in the form of land, social infrastructure and finance through equity participation and investment in research on e.g. local raw materials, etc.

6 CONCLUSIONS

Globalization has brought in its train a new imperative for Africa. Africa must put its acts together and quickly and deftly jump into the train. Africa must urgently construct and sustain support services for the creators and sustainers of technological knowledge and wealth, the inventors, innovators, SMEs and R&D organizations, in order to:

(i) snatch the opportunities offered by the latest wave of global technological revolution, and

(ii) attempt to move from the periphery to the centre of global industrial power structure; and lift the populace out of poverty, disease and political convulsions.

There is therefore a need for African countries to:

- establish well-funded and motivated Agencies to oversee various support services for inventors, innovators, SMEs and R&D organizations;
- formulate clear guidelines on fiscal and monetary policies which provide assistance to research and SMEs;
- introduce strict IPR law and ensure enforcement;
- construct legal framework for business enterprises;
- engage in massive human resources development in science and technology through formal education, vocational training, on-the-job training, and post-employment training;
- utilize support from international agencies and other organizations for assistance in training and research activities (human resources development), investments in infrastructural development and in information technology.

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TABLE 1

Expenditure in Africa on science ans technology as per cent of G.D.P. by country

COUNTRIES	1987	1990
AFRICA		
OAU Guidelines	1.0	?
Cameroon	0.8	1.0
Egypt	0.2	0.8
Ghana (1975)	0.9	0.4
Kenya (1975)	0.8	1.0
Nigeria	0.1	0.08
Zambia (1975)	0.5	0.4
OTHER DEVELOPING COUNTRIES		
Bangladesh	0.2	1.1
Brazil	0.6	2.0.
Cuba	0.7	0.9
India	0.9	2.0
Iran	0.5	1.0
Philippians	0.2	1.5
South Korea	1.7	3.0
Trinidad	0.6	N/A
INDUSTRIALIZED AND OTHER NEWLY INDUSTRIALIZING COUNTRIES		
Taiwan	1.35-2.35	
India	2.0	
South Korea	2.0	
United Kingdom	2.3	
German	2.8	
USA	2.8	
Japan	2.8	
USSR	5.0	

SOURCE: UNESCO Statistical Year Book, 1998, 1994.

TABLE 2

Scientists and engineers in R&D by region (1980-1990)

Region	No. of scientists and in engineers in R&D per Million inhabitants		Expenditure on R&D as % of GDP
	1980	1990	1990
Africa	82	117	0.25
sub-Saharan	82	74	0.29
America	1,057	1,492	2.89
USA	2,414	3,265	2.05
Latin America	94	364	0.40
Europe	1,807	72,206	2.21
Asia	287	401	12.05

SOURCE: UNESCO STATISTICAL BOOK, 1994.

TABLE 3

Nigerians graduating in science and technology (1988-1992)

S/N	CATEGORY	1988	1989	1990	1992
1.	No. Graduating in science	3,918.0	3,381.0	2,885.0	2,299.0
2.	As % of all Graduating Students	15.4	11.9	10.3	11.97
3.	No. Graduating in S&T	2,112.0	1,954.0	1,543.0	1,397.0
4.	As % of all Graduating Students	8.8	6.9	5.5	7.3
5.	No. Post-graduates in Science	420.0	474.0	620.0	276.0
6.	As % of total Graduating in Engineering	8.2	9.2	12.4	7.2
7.	No. of Postgraduates graduating in Engineering	278.0	219.0	305.0	112.0
8.	As % of total Graduating Postgraduates	5.3	4.4	6.1	2.9
9.	Government Expenditure on Science & Technology (NM)	134.6	69.6	201.8	292.1
10.	As % of gross Domestic Product	0.09	0.08	0.08	0.05

SOURCE: NUC Statistical Digest on Nigeria Universities (1988-1992)
FOS, Abstract of statistics 1995 edition

TABLE 4

Average annual growth of MUV in selected African countries (in%)

S/N	COUNTRY	1985-90	1990-95
1.	Algeria	1.1	3.5
2.	Angola	-11.1	-11.1
3.	Benin	6.2	2.9
4.	Botswana	15.2	2.2
5.	Burkina-Faso	0.4	2.8
6.	Burundi	6.5	-7.4
7.	Cameroon	3.0	-2.3
8.	Cape Verde	2.3	8.7
9.	C.A.R.	3.9	-0.2
10.	Chad	-2.2	-0.9
11.	Comoros	0.1	3.9
12.	Congo	3.3	-5.2
13.	Congo Dem. Rep.	-2.5	-10.7
14.	Cote d'lvoire	-4.9	3.5
15.	Djibouti	4.0	2.0
16.	Egypt	5.0	0.1
17.	Equi. Guinea	-8.5	7.4.
18.	Ethiopia and Eritrea	3.0	2.7
19.	Gabon	-7.2	-0.2
20.	Gambia	5.8	1.2
21.	Ghana	6.3	1.4
22.	Guinea	10.7	5.3
23.	Guinea-Bissau	-7.4	0.5
24.	Kenya	5.8	2.3
25.	Lesotho	13.9	7.0
26.	Liberia	2.5	3.2
27.	Libya Arab J.	3.5	8.7
28.	Madagascar	1.5	0.7
29.	Malawi	5.0	-0.5
30.	Mali	4.7	4.5
31.	Mauritania	1.2	1.6
32.	Mauritius	10.4	5.2
33.	Morocco	3.9	1.6
34.	Namibia	5.8	8.2
35.	Niger	2.4	0.7
36.	Nigeria	5.2	-0.3
37.	Reunion	3.6	2.3
38.	Rwanda	0.2	-16.4
39.	Sao Tome & Principe	-4.3	5.0
40.	Senegal	4.6	2.0
41.	Seychelles	11.2	0.2
42.	Sierra Leone	-6.4	4.4
43.	Somalia	5.2	-0.5
44.	Sudan	0.1	3.8
45.	Swaziland	8.4	3.7
46.	Tunisia	4.9	5.7
47.	Uganda	6.7	12.9
48.	U.R. Tanzania	3.6	3.6
49.	Zambia	3.6	-1.0
50.	Zimbabwe	5.2	-3.4

SOURCE: UNESCO STATISTICAL YEAR BOOK, 1994.

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