Report of the Vision 2020
National Technical Working Group
On
Science, Technology and Innovation

July, 2009

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LIST OF ABBREVIATIONS

S/N	ABBREVIATION/ ACRONYM	DEFINITION
1	ACRM	Action Committee on Raw Material
2	EMDI	Engineering Materials Design Institute, Akure
3	AIDS	Acquired Immune Deficiency Syndrome
4	AMAFAN	Agricultural Machine fabrication Association of Nigerian
5	AMT	Advanced Material Technology
6	ARIPO	African Regional Intellectual Property Organization
7	CANI	Computer for All Nigerians Initiative
8	CBD	Convention for Biological Diversity
9	CBN	Central Bank pf Nigeria
10	CSTD	Commission on Science and Technology for Development
11	ETF	Education Trust Fund
12	ETRI	Electronics and Telecommunication Research Institute
13	FCT	Federal Capital Territory (Abuja)
14	FEC	Federal Executive Council
15	FGN	Federal Government of Nigeria
16	FMST	Federal Ministry of Science and Technology
18	GAP	Good Agricultural Practice
19	GDP	Gross Domestic Product
20	GMP	Good Manufacturing Practice
21	GNP	Gross National Product
22	GPP	Good Pharmacy Practice
23	HIV	Human Immuno-deficiency Virus
24	ICT	Information and Communication Technology
25	IDCs	Industrial Development Centers
26	IFC	
27	INSDOC	Indian National Scientific Documentation Centre
28	IP	Intellectual Property
29	KIST	Korean Institute of Science and Technology
30	KOSEF	Korea Science and Engineering Foundation
31	KPI	Key Performance Index
32	Kwh	Kilowatts/hour

S/N	ABBREVIATION/ ACRONYM	DEFINITION
33	LGA	Local Government Areas
34	LGs	Local Governments
35	LT	Long Term
36	M.Sc.	Master of Science
37	MAN	Manufacturers Association of Nigeria
38	MDGs	Millennium Development Goals
39	MOST	Ministry of Science and Technology (Korea)
38	MT	Medium Term
40	MTSS	Medium Term Sector Strategy
41	NABDA	National Biotechnology Development Agency
42	NAEC	National Atomic Energy Commission
43	NAFDAC	National Agency for Food and Drug Administration and Control
44	NASENI	National Agency for Science and Engineering Infrastructure
45	NASRDA	National Agency for Space Research and Development Agency
46	NBTE	National Board for Technical Education
47	NBTI	National Board for Technical Institutes
48	NCC	National Communication commission
49	NCSIR	National Council for Scientific and Industrial Research
50	NEEDS	National economic empowerment and development Strategy
51	NeGst	Nigerian e-Government Strategies
52	NEMA	National Emergency Management Agency
53	NFSIC	National Foundation for Science, Innovation and Competitiveness
54	NGOs	Non-Governmental Organizations
55	NIFSIC	National Institute for Science and Innovation and Competitiveness
56	NIGCOMSAT	National Communication Satellite
57	NITDA	National Information Technology Development Agency
58	NOTAP	National Office of Technology Acquisition and Promotion
59	NPC	National Planning Commission
60	NRDCC	National Research and Development Coordinating Council
61	NSTC	National Science and Technology council (Korea)
62	NSTF	National Science and Technology Trust Fund
63	NTWG	National Technical Working Committee

S/N	ABBREVIATION/ ACRONYM	DEFINITION
64	NUC	National Universities Commission
65	NV2020	Nigerian Vision 20:20
66	OAPI	African Intellectual Property Organization
67	PCST	Presidential council of Science and Technology (Korea)
68	Ph.D	Doctorate Degree (Doctor of Philosophy)
69	PRODA	Project Development Agency
70	PTDF	Petroleum Development Fund
71	R&D	Research and Development
72	RDI	Research and Development Institutes
73	RI	Research Institute
74	RMRDC	Raw Material Research and Development Council
75	S&T	Science and Technology
76	SHETSTCO	Sheda Science and Technology Complex, Abuja
77	SME	Small and medium enterprises
78	SMEDAN	Small Scale Enterprise Development Agency of Nigeria
79	SSTIF	Science, Technology and Innovation Trust Fund
80	ST	Short Term
81	STEPI	Science and Technology Policy Institute (Korea)
82	STI	Science, Technology and Innovation
83	TB	Tuberculosis
84	TIC	Technology Information Centers
85	TMPs	Traditional Medical Practitioners
86	TRIPS	Trade Related Intellectual Property Rights
87	TVE	Town and Village Enterprises
88	TVET	Technical and Vocational Training
89	UN	United Nations
90	UNDP	United Nations Development Project
91	UNESCO	United Nations Education and Cultural Organization
92	UNIDO	United Nations Industrial Development Organization
93	USA	United State of America
94	WTO	World Trade Organization

Acknowledgement

We, members of the Vision 20:2020 Technical Working Group on Science, Technology and Innovation wish to express our gratitude to the Honourable Minister/Deputy Chairman, National Planning Commission, Dr. Shamsuddeen Usman (OFR) for giving us the opportunity to serve our fatherland.

Several people, too numerous to mention, have proven invaluable during the execution of this assignment. We wish to single out Dr. Akinyosoye, Director-General, Federal Bureau of Statistics and Engr. Ernest Ndukwe, Vice Chairman, National Communication Commission who provided facilities in their respective Offices in support of this assignment.

The staff of Accenture, specifically Mr. Olu Ogunfowora and Miss Banke Awojoodu who put gentle but firm pressure on us deserve our commendations. The manuscripts of this report had to be typed several times over especially after a virus attack. Prince I. O. Adegoke of Raw Materials Research and Development Council did this without complaining. Thank you.

Needless to say, we identify with the Vision of President Umaru Musa Ya'adua, (GCFR) and Vice President Jonathan Goodluck (GCON) who believe that Nigeria deserves to be among the top twenty economies of the world.

Executive Summary

The Assignment

A mandate was given by Federal Government of Nigeria to the National Planning Commission (NPC) to develop a blue print that will lead Nigeria to be among the top 20 economies of the world by the year 2020. In pursuance of this mandate, NPC created 29 National Technical Working Groups (NTWG) to address various thematic areas. This includes the NTWG on Science Technology and Innovation (NTWG-STI).

The Team

Membership of the team, drawn from public and private sectors, is as follows:

NAME	
Ibidapo-Obe Oyewusi (Prof., *OFR*) – Chairman	Kumuyi A. J. (Prof.)
Onwualu P. A. (Prof.) – Coordinator	Lawal N. A.
Adeoti John Olatunji (Dr.)	Makoju Joseph (Engr.)
Ayo Daniel (Dr.)	Modibbo B. A. (Dr.) – Secretary
Az-Zubair M. Kabir (Dr.)	Mujtaba Suleiman Abubakar (Dr.)
Bello Muhammad Yahuza (Prof.)	Othman Danladi
Garba Magaji (Prof.)	Umaru Alka (Dr.)
Iliyasu Musa (Mr.)	Odejide Abisoye (Mrs.)
Andrew Igili (Mr.)	Bindir Umar (Dr.)
Itaketo Umana (Dr., *Fnse*)	Maduako Adanma
Kabo Aminu Usman (Dr.)	Megwa Patrick Eze Engr.. (Dr.)
Keshi Chuba	

Terms of Reference

The NTWG-STI was mandated to produce a Science, Technology and Innovation Plan to serve as input to the blue print that will lead Nigeria to be among the top 20 economies of the world by the year 2020.

Methodology

The group held a total of six meetings, spanning three days at intervals of two weeks. During the meetings, members brain-stormed on issues and consulted a Report from previous studies, Workshops and Seminar Reports, as well as studies from selected developed countries. Data were obtained from publications of various agencies such as National Bureau of Statistics and Nigerian Institute for Social and Economic Research. At the end of each meeting, members were given assignments in preparation for the next meeting. A comparative benchmarking analysis using selected STI indicators was carried out to arrive at specific goals and initiatives based on the Vision defined by the group.

Constraints

A major constraint was the dearth of critical statistical data needed for decision making. The situation was further compounded by the short period of time allotted to the exercise.

Vision Statement, Goals and Initiatives

After defining the Vision Statement, the NTWG-STI defined a total of 7 objectives and 16 goals. It also proposes 50 Initiatives. These initiatives, at first glance seem to be too many, but they are all related and necessary for the actualization of the vision

Vision Statement

To build a Science, Technology and Innovation System that will Drive a Competitive Knowledge Economy Towards 20:2020.

Objectives

i. To engender a Culture of ST&I in the Society

ii. To build competitive workforce that is science-based

iii. To forge a National Innovation system that encompasses all existing and new ST&I

iv. To enhance the level of investment and participation in R&D and innovation activities by the public and private sectors

v. To build Capacity in new Technologies such as Biotechnology, Nanotechnology, New and Advanced Materials.

vi. To attain Capabilities in Space Technology as an Essential Tool for Socio-Economic Development.

vii. To Develop a Science Based Traditional Medicine and Indigenous Knowledge

The following nine targets are considered to be of paramount importance:

i. Carry out a technology foresight programme by the end of the first year of inception of NV2020

ii. Invest a percentage of GDP on R&D comparable to the percentage invested by 20 leading developed economies of the World.

iii. Establish three Technology Information Centres (TICs) and three R&D laboratories for SMEs by the end of third year of NV2020 (MTSS)

iv. Double the production of scientists, engineers and technicians within the timeframe of NV2020 and ensure their retention

v. Progressively attain 30% local raw materials and process technology content within the first three years, 50% three years after and 75% at the end of the 10th year for Oil and Gas as well as manufacturing industries.

vi. Develop technological capability for producing 30% of Process Equipment used in Small and Medium Scale Industries by the year 2015 and 70% by the year

vii. Develop technology for converting at least 25% of crude oil and gas produced in Nigeria to knowledge-intensive New and Advanced materials

viii. Establish a National Foundation for Science, Innovation and Competitiveness (NFSIC) within the first two years of NV2020

ix. Establish framework to support programmes of the Professional S&T bodies (such as Nigerian Academy of Science, Nigerian Academy of Engineers, COREN, NSE, Science Teachers Association etc.) that have the objective of building STI capacity

The NTWG-STI recognized the importance of renewable energy and ICT but refrained from considering them further because there are two groups working on these thematic areas.

General Recommendations

- A multi-disciplinary implementation monitoring team, coordinated by National Planning Commission, should be set up to monitor the implementation of the Vision 2020 plan.

- All Ministries and government parastatals should be directed to align their programs and projects with the Vision 2020 programme proposals, immediately the Vision is presented

- The Honourable Minister of Science & Technology should be included as part of the Economic Council.

- Science, Technology and Innovation should take a prominent place in programs and activities of the National Planning Commission

- The Federal Government, through its various agencies should seek Strong International Cooperation for the acquisition of technological know-how in high-tech fields.

- An endowment fund should be put in place for building capacity for competitive R&D activities.

1. Introduction

1.1. Overview of Science, Technology and Innovation

Globally, Science, Technology and Innovation (STI) are recognized as key drivers of wealth creation and improved living standards. Recognizing this, successive Nigerian Governments put in place various measures aimed at expanding Nigeria's capability and capacity in Science, Technology and Innovation. The major focus has been in the areas of developing institutional capacity, infrastructure, human capital, as well as intensifying research activities.

The third and fourth Development plan periods (1975- 85) witnessed the establishment of various universities of Technology and Polytechnics in six geopolitical zones of the nation. These were complemented by the establishment of various research institutes across the nation. Though these tertiary institutions have improved labour-force in science, technology and innovation, the quality and critical mass of human capital required to make STI the driver of economic growth and development in Nigeria are yet to be built. This is largely attributed to poor funding of R & D which represents less than 0.1% of GDP. There is therefore the need to harness Science, Technology and Innovation as a stimulus and driver of economic growth and development.

The newly-industrialized countries took different paths in the development of their Science and Technology system. For instance, Brazil adopted the path of Western Europe and United States, by making Science and Technology a broader scientific culture linked to education, the development of modern professions and a prestigious scientific community. The Universities developed the scientific capabilities while investment in technology increased in state-owned corporations. South Korea, on the other hand, focused on technology with minimal basic science in its universities and other R & D institutions. Most of the investments in technology were made in industrial firms rather than in large, isolated government agencies. Whatever the pathway adopted, there is the realization, in each of these countries, that industrialization was key to the growth of the economy. It is further acknowledged that the foundation for such industrialization is Research and Development.

Among the key challenges to making STI drive the industrialization of the country is funding of R&D which is the most outstanding that requires Government intervention. Nigeria ranks amongst the lowest in ST&I funding (0.01%) as against such countries like India (2.5%) of GDP, Germany (2.8%) of GDP, USA (2.8%) of GDP, Russia (5%) of GDP.

The NEEDS 2 and the 7 Point Agenda of the current Government have adequately summarized the expected contents of a good vision for rapid economic development and poverty alleviation. However, there is the need to prioritize identified issues to take on areas where the nation has good chance of employing STI to achieve success. It is obvious that the nation needs to take giant strides to reach the desired goal of being among the top 20 economies in the world by the year 2020.

1.2. Scope of Science, Technology and Innovation

The character and content of today's science and technology demand massive investments in R&D and training with the ultimate objective of generating technological innovation which has become the key to global competitiveness. Since there are limited investible resources, to attain the vision of becoming one of the top 20 economies by 2020, the country must therefore identify and take advantage of new and emerging opportunities presented by STI, such that it can feed existing markets and create new ones.

The scope of STI in NV2020 would embrace elements of science, technology and innovations that will address challenges in critical areas of the Nigerian economy. NV2020 will aim at making STI the engine of economic growth and development. STI must contribute to improved welfare of Nigerians and Nigeria's capacity to advance the frontiers of knowledge. NV2020 will focus on building Nigeria's technological capability and creating a national system of innovation. The system would improve indigenous technologies through application of modern technologies and the building of a competitive knowledge economy. Value addition to materials, development and adaptation of efficient technologies for agricultural and industrial production, medicine, environment and energy would be major concerns in the research institutions. There will also be keen interest in new and emerging technologies.

Specifically, the scope of STI for NV2020 would span:

i. Biotechnology
ii. Nanotechnology
iii. Institutional Linkages
iv. Capacity Building
v. Renewable Energy
vi. Ventures Capital
vii. Space Research
viii. Small and Medium Scale Industry targeted Research
ix. Knowledge-Intensive New and Advanced Materials
x. STI Information Management
xi. Information and Communication Technology
xii. Intellectual Property Rights
xiii. Traditional Medicine and indigenous knowledge

1.3. Overall Targets for STI

NV2020 sets ten key targets for the STI capacity building. These are:

a. Carry out a technology foresight programme by the end of the first year of inception of NV2020

An immediate target of NV2020 would be the commissioning and implementation of a technology foresight programme to better understand the forces that shape the long-term future of technological development, and the strategic issues as it pertains to policy formulation, planning and decision-making with respect to the role of STI in economic development.

b. Investing a percentage of GDP on R and D comparable to the percentage invested by 20 leading developed economies of the World.

Existing programmatic initiatives on new technologies (e.g. information and communication technologies, modern biotechnology especially in agriculture, nanotechnology, space technology, renewable energy technology, nuclear technology, etc.) based on on-going R&D at notable

research centres (e.g. SHESTCO) will be further developed while new ones would be to meet the challenges of economic empowerment and competitiveness under NEEDS2.

c. *Establish three Technology Information Centres (TICs) and three R&D laboratories for SMEs by the end of third year of NV2020 (MTSS)*

The TICs would provide IT to firms, including networks, software, internet capabilities and databases. The centres would also perform troubleshooting assistance and repair to firms; and provide training in IT applications. The R&D laboratories to be established for SMEs would design new processes and products with active participation of SME entrepreneurs; import and adapt new technologies to local needs; engage in reverse engineering on non-proprietary products; and emphasize learning and integration of technologies into the economy in collaboration with firms. The TICs and R&D laboratories would be established in selected locations that have relatively high concentration of SMEs.

d. *Doubling the production of scientists, engineers and technicians within the timeframe of NV2020* and ensure their retention

This target aims at strengthening Nigeria's human skills base by increasing the number of scientists, engineers and technicians. Rapid rates of industrialization are known to be highly correlated with both physical capital and human capital. NV2020 will strive to match improvement in physical capital with strengthening of the human capital. A major focus in this respect will be the strengthening of the capacity for the training of scientists, engineers and technicians. Previous attempts to mainstream entrepreneurship development in the education and training programmes under NEEDS would be accelerated. It would be necessary to rapidly increase investment in the educational training system (universities, polytechnics, technical colleges, etc.). NV2020 will also ensure the provision of adequate incentives and a reward system aimed at retaining STI professional in Nigeria.

e. *Support for programmes of the Professional S and T bodies (such as Nigerian Academy of Science, Nigerian Academy of Engineers, Science Teachers Association etc.) that have the objective of building STI capacity*

Building a strong political and civil society constituency for science and technology awareness and application will require improvement on existing advocacy programmes aimed at creating awareness on the role of STI in economic development and where necessary new advocacy programmes would be introduced to demystify taboos and superstitions traditionally associated with scientific thinking and advances.

f. STI Information Management (Acquisition, Storage and Dissemination)

Existing STI Information Systems will be strengthened to enable sharing of information amongst researchers, investors and the general public – local and international. Investments in R&D would be aimed not only at satisfying local needs, but also to ensure the contribution of local R&D initiatives to the global knowledge pool. Interactions with, and sharing of progress, outputs and impacts of similar R&D initiatives elsewhere, especially at the level of South-South cooperation would be a major target of NV2020.

g. Progressively attaining, 30% local raw materials and process technology content within the first three years, 50% three years after and 75% at the end of the 10th year for Oil and Gas as well as manufacturing industries

The implementation of the existing local content policy in the oil and gas sector would be strengthened and set targets achieved within the NV2020 period. Local content policy in other key industries such as the automobile, electronics and electrical equipments, and consumer goods manufacturing will be revived and applied. Bail outs for industries in decline (e.g. textiles) would be tied to the ability of such industries to improve local content of their manufacturing in accordance with these targets of NV2020.

h. Develop technological capability for producing 30% of Process Equipment used in Small and Medium Scale Industries by the year 2015 and 70% by the year

Existing research institutes mandated to develop process equipment in support of small and medium scale manufacturing industries will be strengthened with the ultimate aim of domesticating the technology for the production of major equipment utilized by the small and medium scale enterprises. A strong link between the academia, research institute, equipment fabricators and organized private sector such as the National Foundation for Process Equipment will be established.

i. Development of New and Advanced Materials (Alternate Use of Petroleum Products)

In response to the global efforts of Developing Nations to find alternate source of energy, NV2020 will aim at adding values to its petroleum products rather than focusing on export of crude oil and gas. NV2020 will support R&D necessary in this respect under a plan aimed at converting at least 25% of crude oil and gas produced in Nigeria to knowledge-intensive New and Advanced Materials obtainable from Petrochemicals, Minerals and Agro resources.

j. 2020 Establishment of a National Foundation for Science, Innovation and Competitiveness (NFSIC) within the first two years of NV2020

Reviewing the issues and challenges of STI capacity building, it has become apparent that there is need for a strong institution with the independence and capacity to promote scientific research, entrepreneurship, innovation, and competitiveness; coordinate the efforts of complementary institutions; and provide solid professional business support for entrepreneurs targeting both domestic and international markets. One of the primary functions of NFSIC will be the funding of basic and applied scientific research through a competitive bid process that involve active participation of the organized private sector as potential users of research outputs. It is envisaged that NFSIC will provide the critical missing factor that is required for ensuring that R&D is focused on addressing societal needs and results in technological innovation required for economic and social progress.

1.4. Process Involved in Developing the Plan

The National Technical Working Group (NTWG) on the Science, Technology and Innovation (STI) started with extensive brainstorming amongst its members. Members used the brainstorming sessions to share experiences, expertise, information, knowledge and many other relevant matters related to the thematic area. The sessions were also used to identify some important documents, data, information, etc that would be help the Group in addressing the STI thematic area.

The Group sourced and received some important documents related to the thematic area. The following documents, among others, were given to the Group by the Secretariat:

- Documents on the Millennium Development Goals (MDGs)
- Vision 2020: Challenges and Opportunities
- Nigeria's Vision 2010
- The Seven-Point Agenda
- Documents on NEEDS and NEEDS2
- Presentation by the Hon. Minister/Deputy Chairman, National Planning Commission to the Economic Management Team
- Presentation by the Hon. Minister/Deputy Chairman, National Planning Commission at Nasarawa State University titled *Vision 20:2020 – Challenges and Opportunities*
- National Policy on Science and Technology
- The vision documents for a number of countries (including India, Japan, Korea, Vietnam, Malaysia, Singapore and China)
- The 2008 annual report on China
- Documents dealing with vital development statistics on various countries.
- Documents from World Bank, UN, UNDP and other International Organization that set the various parameters and indicators of development in various areas.

In order to facilitate and streamline the work, the Group assigned roles. Members were generally asked to look into specific issues in details and then write position papers on the issues. Such

position papers were later subjected to extensive discussions and further input from all the members.

Members of the Group noted that the format and framework for the work and for writing the report presented by the Consultants were meant to ensure uniformity among the various NTWGs working in different thematic areas. The Group, however, decided that such formats and frameworks should not limit members' contributions and originality of ideas. Thus, even though the Group would try as much as possible to work according to the formats and frameworks, if necessary, the Group would make a case for such contributions that are not within the formats and frameworks.

2. CURRENT ASSESSMENT OF THE THEMATIC AREA

2.1. Global Trends

Over time it has been shown that economic development has both time and space dimensions. Essentially, the process of development in the 19th century was less complex than that of the 20th century; that of the latter less than that of the 21st century. For example, while Japan was able to industrialize rapidly in the mid 20th century when technology was relatively rudimentary, it will be more difficult for another Japan to emerge through the same process. In the same vein, the path to the rapid growth of the economies of China, India and Korea in late 20th century may be difficult to replicate in the present age. However, in Vietnam's Science, Technology and Industry strategy plan developed by UNIDO it was argued that rapid information from an essentially rural and traditional economy to one generally characterized as industrialized and mechanized will not be unprecedented.

The time frame for industrialization tends to collapse over time. **Figure 1.2 a**, adapted from World Bank Tables has been citied to support this view. The figure shows that it took Great Britain 58 years to double per capita output. The same doubling was achieved in 47 years in the United States between 1839 and 1886. Japan in 39 years between 1885 and 1919; Brazil in 18years between 1961 and 1979; Republic of Korea in 11years between 1966 and 1977; and China in 10years between 1977 and 1987. Technological advances were cited as the most critical factor in collapsing the time frame.

Table 1: Periods during which output per person doubled (Global Trends)

Years	10	20	30	40	50	60	Years Taken
United Kingdom 1780-1836							58
United State 1839-1886							47
Japan 1885-1919							39
Brazil 1961-1979							18
Republic of Korea 1960-1977							11
China 1977-1987							10

In countries that have achieved considerable technological and economic gains (e.g. Japan and South Korea), technology foresight has been an important instrument in providing and achieving economic reform objectives. This is neither an issue of identifying the so-called appropriate technologies nor a forecast of technologies; rather, technology foresight is about matching societal needs with technological capabilities. It would enable us to ascertain, in more concrete terms the short, medium and longer term goals and targets of STI capacity building.

Newly-industrialized countries took different paths in their science and technology (S & T) development. Brazil and South Korea typify radically different approaches. In Brazil, as in Western Europe and the United States, S & T developed as part of a broader scientific culture linked to education, the development of modern professions, and a prestigious scientific community. Most scientific capabilities were developed in the universities while investments in technology went to a few large scale government projects under the military and a handful of State-owned Corporations. It was assumed that S & T would spill over from the higher education and sophisticated technological projects to the larger society.

South Korea, on the other hand, introduced modern technology but with little modern science in its universities and other similar institutions, while most of the investments in technology were made in industrial firms rather than in large, isolated government agencies including the military sector. Thus, rather than focus on “frontier” science, emphasis was on building labour skills, creating incentives and public institutions for discovering and adapting needed foreign technologies.

Policies and Plans

In South Korea and India, economic programmes are based on a series of 5-Year Plan (e.g. 1962–66). South Korea adopted an outward-looking industrialization because of its poor natural resource base, low savings rate and tiny domestic market. The approach promoted growth through labour-intensive manufactured exports. By the time of the 7th Plan (1992 – 96), there had been a shift from heavy industries to high-technology fields such as micro electronics, new materials, fine chemicals, optics and bio-engineering.

In Brazil, emphasis has been on three key industries; computer industries, missile programme and nuclear programme. A policy of protectionism was always in place, although efforts are often made to adjust in response to world development

In India, S & T planning is integrated into the national socio-economic planning by the Planning Commission. Scientific Advisory Committees in individual socio-economic ministries formulate long term plans and identify applicable technologies for their particular area of responsibility.

S & T policies in India were aimed at achieving the goals of the Industrial Policy Resolutions. The Industrial Policy Resolution of 1948 gave government a monopoly in armaments, atomic energy, and railroads as well as exclusive rights to develop minerals, iron and steel industries, aircraft manufacturing, ship building and manufacturing of telephone and telephone equipment. The Industrial Policy Resolution of 1956 greatly extended the preserve of government by restricting seventeen industries to the public sector. Economic reforms, starting in 1985, introduced liberalization, the slashing of the number of sectors reserved for public ownership and the encouragement of public-private partnership. These policies and reforms were religiously implemented.

Education

In South Korea, literacy rate increased from 22% in 1945 to 87.6% in 1970 and 93% in 1980s. Primary school completion rate increased from 98% in 1991 to 101% in 2006. Government spending on education increased from 2.2% of Gross National Product (GNP) or 13.9% of total government expenditure in 1975 to 4.5% of GDP or 27.3% of total government expenditure had declined to 16.5%.

In Brazil, primary school completion rate increased from 93% in 1991 to 105% in 2006. Public expenditure on education constituted 4.0% of the total Gross Domestic Product (GDP).

In India, primary school completion rate increased from 64% in 1991 to 85% in 2006, while public expenditure on education was 3.8% of GDP.

These high levels of expenditure on education, particularly scientific education are reflected in the high figures of researchers and technicians in R & D, notably in South Korea (Table 1).

In India, the government encourages the study of indigenous languages with a view toward the gradual shift from English to regional languages and the teaching of Hindi in non-Hindi speaking States. As a result, there are schools in various languages at all levels.

Fund Mobilization

South Korea in its 6th Five-Year Plan (1987 – 91) decided to accelerate the development of S & T by raising the ratio of R & D investment from 2.4 per cent of GDP to over 3 per cent by 1991. The figure currently hovers around 3% (2.99 per cent in 2006), one of the highest in the world.

While Brazil spends about 0.91 per cent of its GDP on R & D, it is noted for the creation of R & D funding institutions. For instance, the National Bank for Economic and Social Development, its main investment bank, created a special fund for S & T, organized as a private corporation under ministerial supervision.

Brazilian R & D financial institutions are characterized by abundant funding resources, quick decision-making mechanisms and some flexibility in the use of grants. Even large projects resources are provided whenever possible to the group leader in a deliberate by-pass of the constraints of bureaucracy.

India's R & D funding as a percentage of GDP while still relatively low compared to South Korea (0.8 per cent) has been on the increase – from 0.5 per cent in 1975 to 0.6% in 1980 and 0.8 per cent from 1985 to date.

The shares of the public and private sectors in R & D funding vary widely across countries. In India, the central government contributes 75.7% of total financial support, while the States account for another 9.3 per cent. Private sector contribution (15%) is therefore relatively low compared to 80 per cent in Japan and about 50 per cent in USA.

Because of the allocation of financial resources, India and Brazil, have been more successful in the promotion of special, large scale scientific endeavors (in India, space and nuclear science, and Brazil, nuclear and missile programmes), than in promoting industry technology, which is the focus in South Korea.

Technological Institutions and Infrastructure

Beginning with the establishment of Korea Institute of Science and Technology (KIST) in 1966 to meet industrial needs and find solutions to simple and practical problems arising from the application of imported technology. Korea at the close of 20th century, had about 100 S & T science and engineering research centres based in the universities, 30 government supported research institutes and about a dozen research institutes in the private sector.

Many of the Research Institutes are specialized like the Electronics and Telecommunications Research Institute (ETRI) which is the second most important RI in the industrial sector after KIST and is the backbone of the strongest performing electronics and telecommunications sub-sector. Another is the Korea Atomic Energy Research Institute.

Other key institutions in Korea include the Science and Technology Policy Institute (STEPI) established in 1984, the Korea Advanced Institute of Science, Graduate school in basic research; and, the Korea Science and Engineering Foundation (KOSEF).

In 1967, the Ministry of Science and Technology (MOST) was established as an executive arm of the Korean government. In 1999, two new ST institutions were established; namely National Science and Technology Council (NSTC) and Presidential Council on Science and Technology (PCST). NSTC is chaired by the President and composed of ST-related ministries and representatives from the ST community, while PCST is an advisory body comprising leaders of diverse areas of S & T. By this arrangement, the President is actively involved in ST policy and R & D programmes.

Brazil has also developed significant institutions for STI. The institutions are tied together by availability of research support, different types of incentives, market potentials and identification of

local opportunities. The major instruments in Brazil for promotion of STI are tax incentives, tariff protection, patent legislation, government procurement and long-term investments in technological projects through public-private partnership arrangements.

In India, there is a network of nearly 200 national laboratories, with links with other 200 public sector R & D institutions and 1,000 R & D units in the industrial sector, all supported by both public and private funds.

A major institution in India is the Indian National Scientific Documentation Centre (INSDOC), a government S & T information agency. It provides the following services among others; document delivery, on-line data services, directed research and bibliographic services, translation services, and training and testing. It also publishes S & T related bibliographies, abstracts, library science documentation conference proceedings and directorates. It serves public and private sectors, organizations and individuals both in India and South Asia on a partial cost-recovery basis.

In India, there are strong linkages between the research centres and the productive sector. Usually, the research centres are much better endowed in terms of facilities, staff and resources than research groups in the universities and academic institutes.

In all the countries great attention has been given to the development of the power and energy sector. The achievement of these countries in this respect can be seen in Table 2 and 3. (In 2003, per capita consumption of electricity was 7018Kwh for South Korea, 4513Kwh in South Africa compared to 107kwh in Nigeria).

Roles of Citizens in Diaspora and Retired Professionals

Starting in the early 1970s, thousands of overseas-trained Koreans were recruited and beginning in the mid-1970s, dozens of new research institutes, all government-supported were established for them. The most prominent of such institutions was Pohang institute of Science and Technology, POSTECH, later renamed Pohang University of Science and Technology. The process was helped by the fact that around that time, the job market for scientists and engineers in the US had started to tighten up. They were involved in projects dealing with high-risk research

and also industry-initiated projects dealing with core industrial technologies that private firms could not develop alone.

Brazilian and Indian citizens in Diaspora have also contributed much to their STI development, although not on the scale witnessed in South Korea.

Reforms and Incentives

South Korea's reforms of early 1980s, involving strict monetary and fiscal policies, liberalization, expansion of public investment in infrastructure, were aimed at reducing the structural imbalance in the economy, particularly the dependence on external markets, and the imbalance between rural and urban sectors.

Brazil's policy of protectionism faced tremendous opposition from the outside world, which became louder with increasing globalization. This policy is being reversed. In addition, new and systematic means of incorporating technology into the industrial process are being put in place. Attempts are also being made to promote easy access of scientists and engineers to libraries and data bases.

In India, concerted efforts have been made to liberalize the economy, particularly since the early 1990s. Many restrictions on private companies were lifted and new avenues for private participation in the economy were opened. However, a lot still needs to be done, in view of opposition to liberalization by vested interests, particularly labour unions and the bureaucracy.

2.1.1. Comparative Benchmarking Analysis

In view of the main objective of vision 20:2020 which is that Nigeria should become one of the world's 20 leading economies by the year 2020, the analysis in this section focuses on the development of the STI system in the current 20 world leading economies. This development is gauged using some STI indicators. The main features are as follows:

- The population varies widely – from 20 million in Australia to 1.3 billion in China.

- While GDP in the countries is high, it also varies widely – from US$12 trillion to US$336 billion in Australia. Similarly, there are noticeable differences in per capita GDP - from US$3600 in Indonesia to US$41,600 in the US.

- R&D expenditures as percentage of GDP are generally high. It is lowest in India and Iran (0.6 per cent) and highest in Japan (3.2 per cent). The average for the 20 countries is 1.8 per cent.

- There is a high proportion of tertiary students enrolled in science, engineering, manufacturing and construction. The percentage of such students to total enrolment ranges from 40% in Iran and South Korea, 31% in Mexico, 30% in Spain and 16% in Brazil. The average for the 20 countries is 25%.

- Patents granted to residents per million population varies sharply from 0.1 in Turkey and Brazil, 857 in Japan, to 113 in south Korea. The average for the 20 countries is 173 patents granted to residents per million populations.

- Receipts of royalties and licence fees range from zero in Turkey,US$0.1 per person in China, US$0.5 in Brazil, US$191.5 in USA and US$220.8 in the UK the average is US$52.4 per person.

- There is a large number of researchers in R&D system. The figures ranges from 341 in Turkey, 119 in India, 4605 in USA and 3187 in South Korea. The average for the 20 countries is 2200.
- All countries have high proportions of technology exports. The percentage of technology experts as proportion of total manufactured exports is lowest in Turkey (1.5%). It is 2.6 per cent in Iran, 31.8 per cent in USA and 32.3 per cent in South Korea. The average for the 20 countries is 16.1 per cent.

- The high level of infrastructural support for STI is reflected in the high consumptions of electricity per capita. The average figure is 6322kwh, and varies from 476 kwh in Indonesia to 14240kwh in USA.

Table 2: Comparative Benchmarking Analysis using some STI Indicators

STI INDICATORS	USA	CHINA	JAPAN	INDIA	GERMANY	UK	FRANCE	ITALY	RUSSIA	BRAZIL	CANADA	SOUTH KOREA	MEXICO	SPAIN	INDONESIA	AUSTRALIA	TAIWAN	TURKEY	IRAN	AVERAGE	NIGERIA
Population (millions)	300m	1.3b	127m	1.1b	82m	61m	61m	58m	143m	188m	33m	49m	108m	40m	245m	20m	23m	70m	69m	-	140 m
GDP (2009) ($) trillion	12	8.9	4.0	3.7	2.5	1.8	1.8	1.7	1.6	1.5	1.1	1.1tri	1.0tri	1.0tri	8.70b	336b	630b	585b	579b	12tri to $570	
GDP (2009) per capita ($)	41,600	6,800	31,600	3,700	30,100	30,100	29,600	28,700	11,000	8,300	33,100	22,600	10,000	24,600	3,600	31,600	27,500	8,400	8,400	20,984	
R&D Expenditure as % of GDP (2004)	2.7	1.2	3.2	0.6	2.5	1.7	2.1	1.1	1.2	0.9	2	2.8	0.4	1.1	-	1.8	-	0.7	0.6	0.6-3.2 (1.8)	
Science, Engineering, Manufacturing and Construction as % of Tertiary Students 1995 - 2005	16	-	19	22	-	22	-	24	-	16	20	40	31	30	-	22	-	21	40		
Patents granted to residents per million 2000-2005	244	16	857	1	158	62	155	71	135	1	35		1	53	-	31	-	1	8	173	
Receipts of Royalties and license fees in dollars per person 2005	191.5	0.1	138	-	82.6	220.8	97.1	19.5	1.8	0.5	107.6	38.2	0.7	12.9	1.2	25	-	0	-	52.4	
Researchers in R&D per million people	4,605	708	5,287	119	3,261	2,706	3,213	1,213	3,319	334	3,597	3,187	268	2,195	207	3,759	-	341	1,279	2,200	
High Technology expertise (as % of manufactured experts) 2005	31.8	30.6	22.5	4.9	16.9	28	20	7.8	8.1	12.8	14.4	32.3	19.6	7.1	16.3	12.7	-	1.5	2.6	16.1	1.7
Electricity consumption per capita (kilowatt HRS-2004)	14,240	1,684	8,459	618	7,442	6,756	8,231	6,029	6,425	2,340	18,408	7,710	2,130	6,412	476	11,849	-	2,122	2,460	6,322	157

2.1.2. Key Learning Points for Nigeria

The newly developed countries recognized that, the foundation for industrialization is Science, Technology and Innovations. Other issues also taken serious are those of comparative advantage, competitiveness, networking, and information management.

It has been observed that technologies when available to developing countries, was under restricted conditions, the know-how remaining essentially with the original owner. Efforts by many developing countries to assert control over transfer of technology by establishing units to oversee the legal and contractual aspects of technology transfer, achieved limited result.

Discussing the dramatic success of the tiger economies of East Asia, Vietnam's Science, Technology and Industry strategy plan developed by UNIDO observed that imitation was the entry point to innovation rather than the linear model of carrying out R&D, developing the products and then marketing. The imitation process, contrary to widely popular idea was not a 'leapfrogging' process by which vintage technology is by passed to enter directly into high tech areas of electronics, information technology and biotechnology. Rather, the Asian tigers engaged in a pain taking and cumulative process of technological learning from imitation to innovation. The lesson is the need for critical mass of scientists with practical orientation.

The leading role of privately owned SME's in the economic growth, technological diffusion and employment creation was also acknowledged, especially in the case of Taiwan, Hong Kong and China. In China for example, by 1996 the Town and Village Enterprises (TVE's) employed about 135 million people and accounted, together with the urban non- state sector far twice as many jobs as the state sector. It is believed that the technology diffusion program (SPARK) set up by the Chinese government was a major catalyst to this achievement.

Key learning points derivable from experiences of developed countries include:

A clear vision and focused STI policy backed by honest and committed leadership

The series of 5-Year development Plans of South Korea and India were implemented religiously. Similarly in Brazil, emphasis on three key industries; computer industries, missile programme and

nuclear programme remained consistent. The policy of protectionism with periodic adjustment has also enabled the country chart its path of development.

Strong Emphasis on Education

The countries that have made giant strides in STI development are also those that have placed strong emphasis on education at all levels. This is based on the belief that human resources are crucial to socio-economic development and the achievement of STI objectives.

Mobilization of Resources

Whatever the pat taken, a common denominator of countries that have advanced in terms of STI is the large-scale mobilization of resources for R & D. This mobilization involves the government (at all levels), the private sector, and, in some cases, external sources.

Creation of Solid Technological Institutions and Infrastructure

Another major characteristic of countries that have progress in STI is the establishment of solid and well-supported technological institutions and infrastructure.

Involvement of Citizens in Diaspora and retired science and engineering professionals

The involvement of citizens in Diaspora has contributed immensely to STI development in South Korea, Brazil and India. Competencies of retired science and engineering professionals should also be utilized. Japan realized the potentials of such competencies hence included it as one of its major action points in its Science and Technological Work Plan

Willingness to Undertake Reforms and Put in Place Appropriate Incentives

The experiences of South Korea, India and Brazil posts advantages for countries like Nigeria in search of rapid STI development. The first is the opportunity to leverage with these experiences and shorten their learning curve for STI development. Another is the ability to take a wide range of options, including those of Europe and USA. However, some constraints exist, particularly as a result of globalization. A major constraint is that because of the free trade which globalization entails, it is not easy to evolve a protected market as the USA did in early 19th century. Similarly, as a result of the Intellectual Property (IP) protections in WTO Agreement on Trade-Related

Aspects of Intellectual Property Rights (TRIPS), it may not be easy for firms to imitate and adapt technologies as Japanese firms did in mid-20th century.

2.2. LOCAL CONTEXT

2.2.1 Local Trends and Recent Developments

The creation of an institutional framework for development of Science, Technology and Innovation (STI) System in post-independent Nigeria began effectively in 1966 with the establishment of the Nigerian Council for Scientific and Industrial Research (NCSIR) by Decree No. 83 of that year. From then on the institutional framework went through a chequered history that witnessed no less than eleven major changes in twenty two years from 1970 to 1992 including National Science and Technology Act, CAP 276 of 1977 and the Federal Ministry of Science and Technology (FMST) Act No 1, 1980.

Since the reconstitution of the Ministry in 1993, the Federal Ministry of Science and Technology (FMST) has been operating as a full fledge Ministry. Today, FMST supervises nineteen parastatals including one spin-out company. These agencies were established to undertake Research and Development in crosscutting issues of S&T as well as to provide specialist skills and services to critical developmental sectors including health, transportation, education, security, environment, etc.

Arising from the recent Medium Term Sector Strategy (MTSS) meeting of the Ministry the Vision and Mission Statements of the Ministry was re-appraised for appropriateness and adequacy. Consequently, the FMST adopted the following vision and mission statements.

- **Vision Statement:** To make Nigeria one of the acknowledged leaders of the scientifically and technologically developed nations of the world.

- **Mission Statement:** To facilitate the development and deployment of science and technology apparatus to enhance the pace of socio-economic development of the country through appropriate technological inputs into productive activities.

The mandates of the Ministry as set out in the instruments establishing it – Science and Technology Act CAP 276 of 1977 and Act No 1 of 1980 – have been converted into eight (8) measurable and achievable goals to keep the Ministry focused and guided in its activities as follows:

Goal 1: Formulation, monitoring and review of the National Policy on Science, technology and Innovation and other sub-sectoral policies.

Goal 2: Acquisition and application of science and technology contribution to increase agricultural and livestock productivity for sustainable growth of agricultural sector.

Goal 3: Increasing energy reliance through sustainable R&D in Nuclear, renewable and alternative energy resources for peaceful and developmental purposes.

Goal 4: Promotion of wealth creation through support to key industrial and manufacturing sectors, including timely access to international standards, material science and other developments in material tools machinery.

Goal 5: Creation of ICT infrastructure and knowledge base to facilitate its wide application for development.

Goal 6: Popularization and application of natural medicine resources and technologies for health sector development.

Goal 7: Acquisition and application of space science and technology as a key driver of economic development.

Goal 8: Ensuring the impact of R&D results on the Nigerian economy through the promotion of indigenous research capacity (public and private sector) to facilitate country-relevant technology transfer.

The Ministry's Vision, Mission and Mandates which are distilled into the above stated goals are presently implemented through various specialized Research and Development (R&D) projects in parastatals and agencies and particularly through the FMST flagship programmes. The FMST flagships are as listed below:

- Biotechnology
- Information and Communications Technology
- Space Technology
- Power/Nuclear Energy
- Value addition to Agricultural and Mineral Resources
- Engineering Infrastructure, Health, Traditional Medicine, Education, Housing, Environment, etc.

The flagship programmes and other specialized activities of the Ministry are bearing some fruits that are expected to set the nation on the path of rapid technological and economic growth. The progress made in ICT and space technology, food preservation technology, and science and engineering infrastructure are good examples. Inadequate funding has however limited the achievements. The programmes basically cover the following activities:

Biotechnology:

The Biotechnology programme was initiated through the National Biotechnology Policy, leading to the establishment of the National Biotechnology Development Agency (NABDA) in November 2001. The establishment of the Agency facilitated the implementation of the policy, with remarkable achievements. The Biotechnology programme has expanded the nation's response to food security, sustainable environment, affordable healthcare delivery, wealth creation etc. Specifically, the following achievements have been recorded;

- Bio-resources Development, involving establishment of Tissue culture laboratories, aqua-culture, snailery, mushroom and grass-cutter units and the development of improved varieties of crops and animals.

- Foods and Industrial Biotechnology Development, involving the domesticated development of bio-reactors and development of Bio-processes for the commercial production of various

agro-based products.

- Medical Biotechnology Development, where in conjunction with relevant stakeholders, the Agency is embarking on the local production of diagnostic kits for HIV/AIDS, Malaria, Hepatitis B & C, syphilis, TB and Pregnancy. Further efforts are geared towards the local production of Vaccines and development of Stem Cell therapy for diseases such as Sickle Cell, Parkinson's and Alzheimer's.

- Environmental Biotechnology Development, involving the Bio-remediation of the polluted environment, combating desert encroachment, genetic research conservation and utilization.

- Molecular Biology and Bio-informatics Development, involving the molecular genetic characterization of Avian Influenza virus and development of genetic barcode for database of various plants and animals in Nigeria.

- Development of Human & Infrastructural Capacity in biotechnology. This is being achieved in partnership with some selected Universities in each geo-political zone of the country.

Information Communications Technology:

The Ministry established the National Information Technology Development Agency (NITDA) in 2001 to implement the National Information Technology Policy. The Agency was designed to transform the country into a knowledge-based and IT-driven economy, thus establishing global competitiveness. Some of the remarkable achievements recorded under this Flagship include:

- The development of the Mobile Internet Unit, to popularize and propagate the use of the internet among Nigerians in various locations.

- The introduction of the Computer for All Nigerians Initiative (CANI), aimed at stimulating and increasing computer literacy and usage by all Nigerians.

- Creation of the Special Purpose Vehicle, known as the Nigeria Internet Registration Association, to manage the country's code top level domain (.ng)

- Creation of the Nigerian e-Government Strategies (NeGst).

Space Science Technology Development:

The introduction of Space Science Technology in Nigeria opened the country to the league of global hi-tech players with the attendant benefits. The Flagship programme evolved out of the policy on space Science Technology, leading to the establishment of the National Communication Satellite (NIGCOMSAT) in 2007. Some of the remarkable achievements recorded under this flagship programme include the following:

- Launching of the NigeriaSat-1 (earth observation satellite) in 2003 and the NIGCOMSAT-! (Communication satellite) in 2007
- Development of remote sensing and Geographic Information System model for desertification
- Mapping and monitoring of impact of gully erosion
- Deforestation in Nigeria with implication of Bio-diversity
- Sale of bandwidth, Satellite control & Management and Network operation
- Domestication of Space Science Technologies
- Wide range of application in Agriculture, Urban Planning, Infrastructural development, Mineral Resources mapping, exploration and exploitation, Biodiversity monitoring and protection, education, health, good governance etc

Energy:

The Flagship programme on Energy is anchored on the National Atomic Energy Commission (NAEC),which was originally established in 1976 but re-activated in 2006 to explore, exploit and harness atomic energy for the socio-economic development of Nigeria. Some milestones recorded so far include:

- Surveying, evaluating and selecting appropriate nuclear reactor technology for Nigeria

- Developing the curriculum for the introduction of degree programmes in Nuclear Science & Engineering in the relevant knowledge Centres in Nigeria
- Developing the structures for growing the needed critical mass of professional manpower for nuclear technology in Nigeria
- Projected generation of at least 1,000 mega watts of electricity in ten to twelve years gradually increase the capacity to 4,000 mega watts within twenty years, through effective implementation of the approved national nuclear power roadmap

Value addition to Raw Materials:

With the global effort to find alternatives to crude oil as source of energy, the Ministry recognizes the need to find alternative uses for the nation's petroleum resources. Nigeria is also blessed with a vast array of mineral resources. The Ministry through Raw Materials Research and Development Council is promoting the development of knowledge-intensive New and Advanced Materials from Petrochemicals, Minerals and Agro resources

Engineering Materials Development:

Recognizing the importance of Engineering Materials development, this Flagship programme was initiated by the Ministry through the National Agency for Science & Engineering Infrastructure (NASENI), to mainstream Nigeria into the global system of designs and manufacturing. Some specific achievements in this regards include the following:

Advanced Manufacturing Technology (AMT):

The programmes activated under this include establishment of the Computer Aided Design/Computer Aided Manufacturing and Virtual Manufacturing facilities; setting up of the Reverse Engineering mini-workshop and full integration of the Reverse Engineering process. The AMT technique has been successfully used to replicate Oil Seed Expeller and the Integrated Cassava Flour Processing Plant.

***Solar Panel Production*:**

In collaboration with a Chinese partner, NASENI, under a PPP arrangement, is establishing a Solar Panel manufacturing facility in Abuja for the production of Solar Panels.

***Nanotechnology*:**

Recognized as one of the technologies that will drive the future, Nanotechnology has been identified by the Ministry as a critical tool for our national development. NASENI was recently charged with the additional responsibility to establish the National Centre for Nanotechnology and Advanced Materials to underscore the importance attachment to the programme by Government.

Additional Flagship programmes

In addition to the above five core flagship programmes, the Ministry is focusing on developing the following additional flagship programmes:

- Chemical Technology Acquisition and Applications
- Innovations for the Education Industry
- Indigenous Technologies and Natural Products
- High-end research facilities and capabilities
- Health Technology Acquisition and Applications

The Federal Ministry of Science & Technology has effectively demonstrated that remarkable success could be achieved through these Flagship programmes, anchored on the functional deployment of the results of the various research efforts from the Ministry's Research Institutes.

2.3 Issues and Challenges

The following are key issues and challenges for development of a formidable STI for the country:

- **Political Will and Support:**

The political class, and to some extent, the government seem to lack the necessary political will to support and encourage STI. This is largely supported by insufficient financial allocation of resources to STI by governments in Nigeria since independence.

- **Policy Consistency and Continuity:**

Inconsistent STI government policies (from one administration to the other) as it affects STI, are also a big issue and challenge to STI development in Nigeria. An offshoot of this is often discontinuity of programmes aimed at advancing STI in the country.

- **Non-availability of STI Supporting Infrastructure:**

The Infrastructure that should played supporting roles to STI in Nigeria, are simply not there. These include foundries, versatile iron and steel companies, rolling mills, extracting mills, etc.

- **Under-Funding of Research Activities in Nigerian Universities/Allied Institutions:**

The under-funding of research activities in Nigerian Universities, Polytechnics and Allied Institutions, is a major issue and challenge to STI progress in the country. Many research products are often left on the shelve due to non-availability of funds to develop them to viable commercial products.

- **Unfavourable Legal Framework in the Country:**

There is, at the moment, unfavourable legal framework governing venture capital in Nigeria. This discourages investment in new R and D products.

- **Inadequate manpower:**

There is a dearth of manpower in some critical areas of STI. This is not being helped by the fact that the Federal Government's policy of 60:40 (science: non-science) admission ratio of students into the nations tertiary institutions is largely being ignored. The non-implementation may be directly linked to inadequate facilities in the Science and Engineering departments. This can be directly linked to inadequate funding.

- **Absence of Motivation to study Science and Technology:**

It is generally believed that Science and technology is more rigorous than other subject areas. The reward system and employment opportunity after graduating, however, does not reflect this. Many young Nigerians are thus not attracted to study science and technology. A large percentage

of the few young Nigerian scientists and engineers prefer administrative jobs to science and engineering jobs after graduating because of the reward system.

- **Non identification of Areas of Comparative Advantages:**

We need to identify our scientific and technological areas of comparative advantages and exploit such advantages. For example, Japan does not have substantial natural resources while Nigeria is blessed with both Agro and Mineral Resources. It will thus be advantageous for Nigeria to focus on technologies that will add values to its natural resources

- **Non Timely Identification of Competition and 'Role models':**

Inability to identify competition and potential competition is an issue and challenge. Countries considered as 'role models' should be identified.

- **Lack of Linkages between R&D and Manufacturing Firms:**

There is a persistent lack of linkages and cooperation between R&D efforts and manufacturing firms in the country.

- **Non Appreciation and Application of Modern Technology by General Citizenry:**

The general populace has not taken advantage of modern technology in their daily activities hence the demand for technological products are relatively minimal. This in turn has affected the development of technological products and services in the country. For instance, the vast opportunities created by the Internet and allied products and services have not been fully exploited in the country. This may in part be attributable to Poverty.

- **Cultural Beliefs and Superstition:**

Our culture and traditions are saddled with the burden of superstitions that retard scientific and technological adventures. This is a major issue and challenge to the advancement of STI. We need to re-orientate and re-shape our mind-set for scientific and technological adventures.

2.4 Strategic Imperatives

The Federal Government's Vision 2020 Statement, its National Policy on Science and Technology and the National Economic Empowerment and Development Strategy (NEEDS 1 and 2) are all based on the fact that, through embarking on a concerted effort to build science, technology capacity, Nigeria will greatly enhance her prospects of achieving growth, create employment, poverty alleviation, wealth creation and reorienting the value of citizens towards sustainable development.

To achieve this Vision, Nigeria will focus on the following Strategic Priorities regarding STI:

Strategic Priority 1: Establish and maintain a strong STI workforce and offer scientific literacy to all citizens. This can be done by paying special emphasis on the following

- Improved support and encouragement of the study of science in primary and secondary schools

- Organize annual seminars and workshops to educate the citizens on the role of innovation in economic development, focusing on concrete case studies. These workshop/seminars will demonstrate the value of adopting innovation policies that are different from traditional S&T policies

- Establishment of two advanced laboratories for R&D in key areas of new technologies within existing universities or research Institutes and upgrading existing human and physical infrastructures to manage such laboratories. Priority areas that must be included are biotechnology, laser, nanotechnology, material science, renewable energy and nuclear technology

Strategic Priority 2: Support high level training of manpower for STI by

- Supporting Ph.D. level training in areas related to basic and applied sciences at centres of excellence both locally and abroad especially in key areas of STI

- Involve the Industries in training and educational programmes in tertiary Institutions
- Involve state governments and private sectors in the process of establishing TIC and R&D laboratories
- Doubling Investments in the scientific and technological departments in tertiary institutions that produce scientists, engineers and technicians

Strategic Priority 3: Build the Nation's basic research capacity through critical investments in infrastructure. These includes

- Investments in advanced instrumentation
- Increased spending in R&D by both public and private sectors
- Provision of subsidies for industry's investment in R&D, especially those that collaborate with educational tertiary educational institutions and pubic research institutes
- Increase and accelerate the pace of development of ICT infrastructures in all educational institutions
- Maintenance and strengthening advanced laboratories at Sheda Science Technology Complex (SHESTCO), Abuja

Strategic Priority 4: Nigeria must maintain a position of eminence in basic and applied research, emphasizing areas of scientific challenge, greatest opportunity and potential benefit.

- Increase R&D spending as a percentage of GDP to 1% by 2008, 1.5% by 2009, 2% by 2010, and 3% by 2011

- Support for cutting-edge experimental capabilities. This support should be in at least one demonstrative project of the application of post harvest technology in each state of the federation and FCT within the time frame of NEEDS2.

- Establish a technology foresight steering committee that will manage the development and implementation of technology foresight for the country.

- Support for key National technological and applied sciences R&D projects that have impact on industrial growth particularly in those areas known to invigorate and sustain growth
- Establish a national foundation for science, innovation and competitiveness (NFSIC). Reviewing the issues and challenges of STI

2.5 Opportunities for Nigeria

The following are the key opportunities for STI to thrive in Nigeria.

Abundance of Human Resources: Nigeria has highly qualified human resources possessing skills in various scientific disciplines. Many of those in Diaspora have demonstrated the willingness to invest their skills and material resources for national development if encouraged

Abundance of Mineral Resources: Nigeria is endowed with abundance of mineral resources that can be exploited to Nigeria's advantage. The natural resources of solid minerals, oil and gas particularly provide the advantage of access to relatively cheap raw materials for materials for industrial production. Many intermediate products that are critical in the global value-chain can be produced from these natural resources

Advantage of Geographical Location (and Availability of a Potentially Large Market): Nigeria's population of over 140 million (2006 census) is the largest in Africa, and one of the largest in the world, and growing at about 2.8%. Though per capita income is still very low, this portends a potentially large market which is of immense importance as the economy grows. Nigeria is relatively close to Europe, North America, and to emerging economies in Asia (e.g. India and China). The location of Nigeria thus presents an opportunity to access important external market for both exports and imports

Abundant Arable Land and Good Climate: There is abundance of arable land and the climate is very suitable for the cultivation of diverse agricultural commodities. Both stable food stuffs and

cash crops can be grown with relative ease across all the ecological zones in Nigeria.

2.6 Key Success Factors

Building STI capacity at the national level is important for Nigeria to effectively interact and compete in the international arena. Stable investment human and institutional resources are necessary to adopt, adapt, develop and apply new ideas and technologies.

Many countries took different paths in their science & tech (S&T) development. There is the recognition in each country of the fact that in order to modernize & develop, there is a need for industrialization. The foundation for industrialization is research and development (R&D), technological innovations and engineering.

It is important to remember that there is no single formula for STI based economic growth, henceforth Nigeria should continue to invest in and monitor progress in building STI capacity in order to rise up from the bottom of the technology ladder. Nigeria's STI policy must focus on niches, locations, markets and priorities for prompt execution and a success development.

In a nutshell, key success factors in STI development in Nigeria include;

i. **A Clear Vision and Honest Commitment by Leaders and Focused STI Policy:** This requires planning on trimly basis i.e. 2yrs, 5yrs, 10yrs, etc as deemed possible with a clear developmental focus on some particular industries. STI policy in Nigeria can best be productive by integrating into the National socio economic planning of the NPC. This can also be achieved by drawing a formula and identifying applicable technologies for a particular area of responsibility. Ministry of science and technology is to serve as the main scientific advisory committee in individual socio economic ministries for successful implementation of STI policy in Nigeria

ii. **Strong Emphasis on Education, particularly Scientific Education:**

Nigeria should place strong emphasis on education at all levels. This is based on the belief that human resources are crucial to socio-economic development & achievement of STI objectives.

iii. **Mobilization of Requisite Resources:**

Whatever the pathway taken to implement the STI policy, a common denominator of countries that have advanced in terms of STI is the large-scale mobilization of resources for R & D. This mobilization involves the Government (at all levels), the private sector, and in some cases, external sources.

iv. **Creation of Solid Technological Institutions:**

Another major characteristic of countries that have rapid progress in STI is the establishment of solid and well supported technological institutions and infrastructure.

v. **Involvement of Citizens in Diaspora:**

The involvement of citizens in Diaspora has helped and contributed immensely to the development of STI in the countries which have progressed technologically. Example Brazil and Indian citizens as well as South Koreans have contributed a lot to their STI development.

vi. **Appropriate Fiscal and Financial Incentives:**

This will help check the imbalance between the rural and urban sectors and will also help reduce structural imbalance in the economy, particularly the dependence on external markets.

vii. **Focused Choice and Pursuit of Pathways:**

To embark on STI programmes the nation needs to focus on a particular programme selected based on availability and accessibility of resources required. A formidable pathway is also chosen for effective development.

3. Strategies for Science, Technology and Innovation in Nigeria

3.1. Vision

Vision Statement:

A professionalised industry in a pluralistic environment, with deep commitment to promoting democracy, accountability and guided by solid sense of ethics and social responsibility, while enhancing national development

3.2. Objectives, Goals, Strategies and Initiatives

Objective 1: Engender a Culture of ST&I in the Society

S/N	Goals/Targets	Strategies	Initiatives
1	Improvement of Status and Remuneration of professionals working in STI sector to be at par with those in the oil & gas and finance sectors.	Mass mobilization for S&T consciousness	Establish programme for popularization of S&T in all MDAs
			Establish media programme devoted to S&T issues to be aired during a prime time on NTA
			Establishment of national scientific information centre with branches in every state to provide STI information services, document delivery, online data and bibliographic services
			Strengthen existing programmes for the promotion of STI such as Junior Engineers and Technicians (JETs) Club, Science Clubs, 'Catch them young' etc. through better financial and logistic support
			Provide S&T infrastructure for sports development
		Strong direct government advocacy on STI	Establish a National Foundation for Science, Innovation and

Objective 1: Engender a Culture of ST&I in the Society			
S/N	**Goals/Targets**	**Strategies**	**Initiatives**
			Competitiveness (NSIC) with the President as the Chairman of the Governing Council.
			Strengthen STI-related departments/division/units in all MDAs.
			Strengthen the Secretariat of National Research and Development Coordinating Council (NRDCC).
			Inclusion of the Minister of Science & Technology in the National Economic Council.
			Establish permanent sites for S&T Fairs at State and LGs.
			Create the department of Technology Policy and Planning in the National Planning Commission (NPC).
		Revise existing laws, policies and regulations concerning emoluments of S&T professionals	Establish a new remuneration package for S&T professionals
2	By 2015, Government and Organized private sector should provide special scholarships to S&T students in tertiary institutions (full scholarship)	Increase present amount allotted to Government agencies such as ETF, PTDF, Federal Scholarship Boards, etc and private sector.	Full reconstitution and invigoration of Federal Scholarship Board to award full scholarships to all Nigerians who study Science & Technology discipline
			Establishment of National Foundation for Science, Innovation and Competitiveness (NFSIC).

Objective 2: Build competitive workforce that is science-based			
S/N	**Goals/Targets**	**Strategies**	**Initiatives**
1	Increase Science based competitive workforce by 20% by 2015 and to 50% by 2020	Accelerate training in science and Technology disciplines.	Enforce the 60:40 Science/Art admission ratio by 2015 and Increase Science/Art admission ratio to 70:30 by 2020.
			Improve Teacher/Student ratio to 1:15 by 2015 in science based disciplines.
			Enforce compliance with the original mandates of technology institutions.
2	Increase in share of manufacturing sector in GDP from 4% to 20% by 2015	Revive and enhance training in technical and vocational skills. Improve training quality	Promote Technical and Vocational Education and Training.
		Strengthen institutions involved with the development and utilization of local raw materials, and process equipment	Upgrade identified institute to serve as Centre of Excellence for the development of SME process equipment
3	Progressively develop technological capability for sourcing 30% industrial Raw Materials locally within the first 3 years, 50% in next 3 years and 75% by 2020	Encourage research and development of local raw materials and process technology by research institutes and industries	Establish Electronic System for Acquisition, Processing, Storage and Dissemination of information on raw materials and Process technology to researchers, entrepreneurs and policy makers
			Establish legal frame work to monitor the progressive attainment of the local technology and raw materials content of manufacturing industries.
			The Local Contents Award (for industries utilizing local raw materials and researchers engaged in raw materials value addition) should be accorded a higher status equivalent to the National Productivity Award.

Objective 2: Build competitive workforce that is science-based			
S/N	**Goals/Targets**	**Strategies**	**Initiatives**
4	Develop technology for converting at least 25% of crude oil and gas produced in Nigeria to knowledge-intensive New and Advanced materials	Encourage research and development on New and Advanced Materials by research institutes and industries	Establish Electronic System for Acquisition, Processing, Storage and Dissemination of information on new and Advanced materials to researchers, entrepreneurs and policy makers
5	Develop technological capability for producing 30% of Process Equipment used in Small and Medium Scale Industries by the year 2015 and 70% by the year 2020	Promote application of appropriate Engineering design and calculation in the production of process equipment.	Prototypes of designs emanating from Annual National Process Equipment Design Competition to be produced and publicized
6	Improve productivity of workforce by 25% by 2015 and to 50% by 2020	Promote vibrant real and services sectors to absorb skilled labor.	Provide fiscal incentives (tax breaks, waiver of tax levy, etc.) to private sector participating in STI manpower training.
		Improve remuneration	Establish an enhanced remuneration package for STI professionals.
7	Increase in share of Science and Technology related services in GDP by 20% by 2015	Promote entrepreneurship development.	Incorporate entrepreneurship training in the curricula of polytechnics and universities.

Objective 3: To forge a National Innovation system that encompasses all existing and new ST&I			
S/N	**Goals/Targets**	**Strategies**	**Initiatives**
1	5% of R&D output should be patentable by 2015(50,000 patent applications) and 20% by 2020 (100,000 patent applications). In addition 30% of the	Massive Investment in creating Science and Technology and Information System	Strengthening existing Human Resource Development institution
			Establish six (6) new Centers of Excellence in Biotechnology, Nanotechnology and Advanced

Objective 3: To forge a National Innovation system that encompasses all existing and new ST&I			
S/N	**Goals/Targets**	**Strategies**	**Initiatives**
	R&D patent should be commercialized by 2015 and 50% by 2020		Materials, Software Development, Cinematography, Traditional Medicine Research by 2015.
			Restructure the organization and performance of Technology Research and Development Institutions.
			Strengthening existing Higher Institutions & Research Institutes Consultancy outfit to provide IP support.
			Baseline study of RDI on their organization and performance.

Objective 4: To enhance the level of investment and participation in R&D and innovation activities by the public and private sectors			
S/N	**Goals/Targets**	**Strategies**	**Initiatives**
1	Increase R&D investment as percentage of GDP to 1.0% in 2015 and to 1.6% in 2020	Establish a National Foundation for Science, Innovation and Competitiveness (NFSIC).	Set up Governing Board and implementation blueprint for NFSIC.
		Tax incentives for Private Sector Organizations in R&D Investment.	Encourage large R&D Joint Ventures for companies in same industry.
		Re-establish the National Science and Technology Trust Fund (NSTF) into which 20% of the Education Trust Fund and 50% of Foreign Technology Transfer Proceeds will be paid.	Set up joint R&D initiatives with internationally established R&D organizations, academic institutions, government agencies and multi-national companies.

Objective 4: To enhance the level of investment and participation in R&D and innovation activities by the public and private sectors			
S/N	**Goals/Targets**	**Strategies**	**Initiatives**
		Strengthen Venture Capital Investment Scheme through Funding and Workable Interest Rates to provide Capital for commercialization of R&D results.	Provide input for a comprehensive 'Gap analysis' to identify areas that need funding.
			Directing R&D funds toward core technologies.
			Channeling 2.5% of SMEs Funds for Commercialization of R&D Results.

Objective 5: Build Capacity in new Technologies such as Biotechnology, Nanotechnology, New and Advanced Materials			
S/N	**Goals/Targets**	**Strategies**	**Initiatives**
1	Increase human capacity in nanotechnology, biotechnology and advanced materials by training of 5000 M.Sc. graduates by 2015 and 3000 Ph.Ds by 2020	Create studentship for postgraduate training in nanotechnology, biotechnology and advanced materials.	Establishment of undergraduate research Fund to be supported by private, public and development partners.
2	Increase yield in agricultural products such as cassava, maize, rice, millet and wheat through application of modern agronomy and biotechnology by 25% by 2015 and by 50% in 2020	Establish linkages between Nigerian Universities and International Institutions with expertise in nanotechnology, biotechnology and advanced materials	Establish research laboratories to be supported by Corporations benefiting from public funds in research areas relevant to their operation in the country.
		Strengthening Research Institutes with the mandate for the production of cassava, maize, rice, millet and wheat varieties.	Public sector grant for start-up companies in biotechnology, nanotechnology and advanced materials.

Objective 5: Build Capacity in new Technologies such as Biotechnology, Nanotechnology, New and Advanced Materials			
S/N	**Goals/Targets**	**Strategies**	**Initiatives**
		Transform SHESTCO into an advanced Science & Technology Research Park.	Transform SHESTCO into an advanced Science & Technology Research Park.
		Recruit international experts to manage six Centers of Excellence in Biotechnology, Nanotechnology and Advanced Materials.	Recruit international experts to manage six Centers of Excellence in Biotechnology, Nanotechnology and Advanced Materials.

Objective 6: To attain Capabilities in Space Technology as an Essential Tool for Socio-Economic Development			
S/N	**Goals/Targets**	**Strategies**	**Initiatives**
1	By 2020 Nigeria should build	Recruit and train the best brain for the space project.	Advanced training for existing engineers/scientists and training of 50 additional engineers/scientists to be determined by NEEDS assessment.
		Strengthen the national space agency by partnering with reputable international space agencies.	Provide the national space agency with state-of-the-art equipment for the production of satellite components and subsequent production of its own satellite.
			Embark on a programme of reverse engineering in space technology aimed at building Nigeria's own satellite.

Objective 7: To Develop a Science Based Traditional Medicine and Indigenous Knowledge			
S/N	**Goals/Targets**	**Strategies**	**Initiatives**
1	Co-recognition of Indigenous with orthodox medicine by 2015 and by 2020, Nigeria should fully integrate indigenous/traditional medicine into orthodox medicine	Mass Mobilization to Generate Awareness among Orthodox, TMP and the Public.	Mobilization program to commence at all levels of government on Incorporation of Indigenous Medicine.
		Review Existing Laws on Medicine and Pharmacy Practice.	Enact Laws legalizing the practice of science based traditional medicine with orthodox medicine.
			Provide regulatory standards for quality, safety and efficacy of each traditional remedies and practices.
		Review Medical and Paramedical training Curriculum to Incorporate Indigenous Medicine.	Include in the curriculum of medical and paramedical students traditional techniques of herbal medicine and treatment of conditions like infectious diseases, psychiatric illnesses, bone setting, and traditional birth attendant in preclinical as well as clinical years.
			Commence Specialized training in indigenous medicine.
		Facilitate Patenting and Intellectual Property Rights of Indigenous Medicine.	Enact laws recognizing individuals' and communities' rights to traditional innovations and knowledge.
			Establishment of Boards of Traditional Medicine.
			Implementation of provisions of Convention on Biological Diversity (CBD), Trade Related Intellectual Property Rights (TRIPS), African Intellectual Property Organization (OAPT) and African Regional Property Organization (ARIPO).
		Develop Official Records/ Pharmacopoeia for Indigenous Medicine.	A National Pharmacopoeia and Record Committee to be established to collate

			information on safety, efficacy and quality of traditional remedies.
			Promote and collect all relevant information on plant and animal species.

4. Implementation Roadmap

4.1. Implementation Plan

Objective 1: Engender a Culture of ST&I in the Society							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
Goal 1*: Improvement of Status and Remuneration of professionals working in STI sector to be at par with those in the oil & gas and finance sectors.*							
Mass mobilization for S&T consciousness	Establish programme for popularization of S&T in all MDAs.	2011			All MDAs	Development Partners	FGN, Development Partners
	Establish media programme devoted to S&T issues to be aired during a prime time on NTA.	2011			FMST, NTA	FMI&C, NCC	FGN
	Establishment of national scientific information centre with branches in every state to provide STI information services, document delivery, online data and bibliographic services.	2011			FMST	State Govts.	Federal & State Governments.
	Strengthen existing programmes for the promotion of STI such as Junior Engineers and Technicians (JETs) Club, Science Clubs, 'Catch them young' etc. through better	2011			FMST, FME, State Ministries of Education	UNESCO, NGOs	Federal & State Governments, UNESCO.

Objective 1: Engender a Culture of ST&I in the Society							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
	financial and logistic support.						
	Provide S&T infrastructure for sports development.	2011			Fed. Min of Sports	FMST	FGN
Strong direct government advocacy on STI	Establish a National Foundation for Science, Innovation and Competitiveness (NSIC) with the President as the Chairman of the Governing Council.	2011			FMST, NPC	OPS, Development Partners	OPS, Development Partners, FGN
	Strengthen STI-related departments/division/units in all MDAs.	2011			All MDs	Development Partners	FGN
	Strengthen the Secretariat of National Research and Development Coordinating Council (NRDCC).	2011			The Presidency, FMST	NPC	FGN
	Inclusion of the Minister of Science & Technology in the National Economic Council.	2011			The Presidency	National Economic Council	FGN
	Establish permanent sites for S&T Fairs at State and LGs.		2015		FMST, State & LGs	Fed. Min. of Commerce & Industries	FGN, States, LGs
	Create the department of Technology Policy and Planning in the National	2011			The Presidency, National Executive	FMST, Other Ministries	FGN

Objective 1: Engender a Culture of ST&I in the Society							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
	Planning Commission (NPC).				Council		
Revise existing laws, policies and regulations concerning emoluments of S&T professionals.	Establish a new remuneration package for S&T professionals	2010			Federal Ministry of Labour & Productivity, Federal Ministry of Science & Technology, Salaries & Wages Commission, Federal Ministry of Justice.	Federal Executive Council, National Assembly	FGN
Goal 2: *By 2015, Government and Organized private sector should provide special scholarships to S&T students in tertiary institutions (full scholarship)*							
Increase present amount allotted to Government agencies such as ETF, PTDF, Federal Scholarship Boards, etc and private sector.	Full reconstitution and invigoration of Federal Scholarship Board to award full scholarships to all Nigerians who study Science & Technology discipline	2010			Federal & State Ministries of Education	ETF, PTDF, Commonwealth , Scholarship Scheme, UNESCO, UN etc.	FGN, State Govt , Developmen t Partners.
	Establishment of National Foundation for Science, Innovation and Competitiveness (NFSIC).		2015		Federal Ministry of Science and Technology	Federal Ministry of Education, UNESCO, Development Partners,	FGN, State Govt , Organised Private Sector

Objective 1: Engender a Culture of ST&I in the Society							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
						Organised Private Sector	

Objective 2: Build competitive workforce that is science-based							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
Goal 1*: Increase Science based competitive workforce by 20% by 2015 and to 50% by 2020*							
Accelerate training in science and Technology disciplines.	Enforce the 60:40 Science/Art admission ratio by 2015 and Increase Science/Art admission ratio to 70:30 by 2020.		2015	2020	Federal & State Ministries of Education.	NUC, NBTE, NCCE	Federal & State Govt., UNDP, UNESCO
	Improve Teacher/Student ratio to 1:15 by 2015 in science based disciplines.		2015		Federal Ministry of Education.	NUC, NBTE, NCCE	Federal & State Govt., UNDP, UNESCO
	Enforce compliance with the original mandates of technology institutions.	2010			Federal & State Ministries of Education.	NUC,NBTE, NCCE	Federal & State Govt.
Goal 2: *Increase in share of manufacturing sector in GDP from 4% to 20% by 2015*							

Objective 2: Build competitive workforce that is science-based							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
Revive and enhance training in technical and vocational skills. Improve training quality	Promote Technical and Vocational Education and Training.	2010			Federal Ministry of Education.	NBTE	Federal & State Govt., UNESCO
Strengthen institutions involved with the development and utilization of local raw materials, and process equipment	Upgrade identified institute to serve as Centre of Excellence for the development of SME process equipment		2015		FMST	Development Partners, OPS, RMRDC, NBTE	FGN, Development Partners
Goal 3: *Progressively develop technological capability for sourcing 30% industrial Raw Materials locally within the first 3 years, 50% in next 3 years and 75% by 2020*							
Encourage research and development of local raw materials and process technology by research institutes and industries	Establish Electronic System for Acquisition, Processing, Storage and Dissemination of information on raw materials and Process technology to researchers, entrepreneurs and policy makers		2015		RMRDC	MAN, NASSI, NASME, SMEDAN, AMAFAN, ACADEMIA,UNIDO, UNDP,ACRM	FGN, Development Partners
	Establish legal frame work to monitor the progressive attainment of the local technology and raw materials content of manufacturing industries.		2015		National Assembly, FMJ	RMRDC, Fed. Min. of Foreign Affairs	FGN, Development Partners
	The Local Contents Award	2011			National Merit	MAN,	FGN, MAN,

Objective 2: Build competitive workforce that is science-based							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
	(for industries utilizing local raw materials and researchers engaged in raw materials value addition) should be accorded a higher status equivalent to the National Productivity Award.				Awards Office in collaboration with RMRDC	SMEDAN, NASSI, NASME, AMAFAN,	SMEDAN, AMAFAN,
Goal 4: *Develop technology for converting at least 25% of crude oil and gas produced in Nigeria to knowledge-intensive New and Advanced materials*							
Encourage research and development on New and Advanced Materials by research institutes and industries	Establish Electronic System for Acquisition, Processing, Storage and Dissemination of information on new and Advanced materials to researchers, entrepreneurs and policy makers		2015		RMRDC, EMDI	ACADEMIA,UNIDO, UNDP	FGN, Development Partners
Goal 5: *Develop technological capability for producing 30% of Process Equipment used in Small and Medium Scale Industries by the year 2015 and 70% by the year 2020*							
Promote application of appropriate Engineering design and calculation in the production of process equipment.	Prototypes of designs emanating from Annual National Process Equipment Design Competition to be produced and publicized		2015		National Foundation for Process Equipment Design, FMST.	MAN, NASSI, RMRDC, National Academy of Engineers, AMAFAN, Academia, UNIDO,	FGN, Development Partners

Objective 2: Build competitive workforce that is science-based							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
						UNDP,ACRM	
Goal 6*: Improve productivity of workforce by 25% by 2015 and to 50% by 2020*							
Promote vibrant real and services sectors to absorb skilled labor.	Provide fiscal incentives (tax breaks, waiver of tax levy, etc.) to private sector participating in STI manpower training.	2011			Fed. Ministry of Finance, National Salary & Wages Commission.	MAN, NACCIMA	Federal Govt.
Improve remuneration	Establish an enhanced remuneration package for STI professionals.	2011			Salary & Wages Commission.	Fed. Ministry of Science and Tech.	Federal Govt.
Goal 7: *Increase in share of Science and Technology related services in GDP by 20% by 2015*							
Promote entrepreneurship development.	Incorporate entrepreneurship training in the curricula of polytechnics and universities.	2011			Tertiary Institutions	NUC, NBTE,NCCE	Federal & State Govt.

Objective 3: To forge a National Innovation system that encompasses all existing and new ST&I							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
Goal 1: *5% of R&D output should be patentable by 2015(50,000 patent applications) and 20% by 2020 (100,000 patent applications). In addition 30% of the R&D patent should be commercialized by 2015 and 50% by 2020*							
Massive Investment in creating Science and Technology and Information System	Strengthening existing Human Resource Development institution	2011			FMST, FME, FMI & Development Partners.	Research and Dev. Institutions such as NASENI, NABDA, NITDA, NNMDA, NIPRID Fed. Min. of Agric, NUC, NBTE, NCCE, OPS, NAS, NAE	Federal Government of Nigeria , OPS,
	Establish six (6) new Centers of Excellence in Biotechnology, Nanotechnology and Advanced Materials, Software Development, Cinematography, Traditional Medicine Research by 2015.		2015		Ditto	Ditto	Federal Government of Nigeria , OPS,
	Restructure the organization and	2011			Federal And State Ministries	NUC, NBTE, NCCE	Federal Government

Objective 3: To forge a National Innovation system that encompasses all existing and new ST&I							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
	performance of Technology Research and Development Institutions.				of Science and Technology, Agric & Water Resources, Health		of Nigeria , OPS,
	Strengthening existing Higher Institutions & Research Institutes Consultancy outfit to provide IP support.	2011			Federal And State Ministries of Science and Technology, Agric & Water Resources, Health and Education	Research Institutes and Universities	Federal Government of Nigeria , OPS,
	Baseline study of RDI on their organization and performance.	2010			Federal Ministry of science and Technology	RMRDC, NOTAP, NASENI	Federal Government of Nigeria.

Objective 4: To enhance the level of investment and participation in R&D and innovation activities by the public and private sectors							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
Goal 1: *Increase R&D investment as percentage of GDP to 1.0% in 2015 and to 1.6% in 2020*							
Establish a National Foundation for Science, Innovation	Set up Governing Board and implementation blueprint for NFSIC.	2011			Federal Ministry of Science and Technology and	UN Commission on *Science and*	FGN, United Nations, OPS and

Objective 4: To enhance the level of investment and participation in R&D and innovation activities by the public and private sectors							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
and Competitiveness (NFSIC).					Presidency.	*Technology* (CST). FMF, OPS, NPC and Development Partners.	Development Partners.
Tax incentives for Private Sector Organizations in R&D Investment.	Encourage large R&D Joint Ventures for companies in same industry.	2011			Federal Ministry of Finance	MAN, IFC	OPS and Private Banks.
Re-establish the National Science and Technology Trust Fund (NSTF) into which 20% of the Education Trust Fund and 50% of Foreign Technology Transfer Proceeds will be paid.	Set up joint R&D initiatives with internationally established R&D organizations, academic institutions, government agencies and multi-national companies.		2015		FMST and Foreign Affairs	UN Commission on *Science and Technology* (CST), Multinational Companies.	FGN, OPS
Strengthen Venture Capital Investment Scheme through Funding and Workable Interest Rates to provide Capital for commercialization of R&D results.	Provide input for a comprehensive 'Gap analysis' to identify areas that need funding.	2011			FMF, CBN	Bank of Industry, NACRDB, MAN, SMEDAN and IFC.	CBN, Private Banks, OPS.
	Directing R&D funds toward core technologies.	2011			FMF, CBN, NFSIC.	UN Commission on *Science and*	CBN, Private Banks, OPS.

Objective 4: To enhance the level of investment and participation in R&D and innovation activities by the public and private sectors							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
						Technology (CST).	
	Channeling 2.5% of SMEs Funds for Commercialization of R&D Results.	2011			Federal Ministries of Commerce and Industry, Science and Tech., CBN.	SMEDAN, NASSI, NASME, R&D Institutes.	FGN.

Objective 5: To attain Capabilities in Space Technology as an Essential Tool for Socio-Economic Development							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
Goal 1: *By 2020 Nigeria should build, launch and maintain own satellite in space*							
Recruit and train the best brain for the space project.	Advanced training for existing engineers/scientists and training of 50 additional engineers/scientists to be determined by NEEDS assessment.	2011			FMST, National Space Centre, NASENI.	FME, FMI&C., NCC, Telecommunication Companies	FGN., PTDF, NCC, ETF.
Strengthen the national space agency by partnering with reputable international space agencies.	Provide the national space agency with state-of-the-art equipment for the production of satellite components and	2011			FMST, NASRDA	International Space Research & Development Agencies,	FGN and International Space Research & Development

Objective 5: To attain Capabilities in Space Technology as an Essential Tool for Socio-Economic Development							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
	subsequent production of its own satellite.					NAMA.	Agencies
	Embark on a programme of reverse engineering in space technology aimed at building Nigeria's own satellite.			2020	FMST, NASRDA.	FMI&C, NCC, NUC Telecommunication Companies	FGN

Objective 6: To develop a Science Based Traditional Medicine and Indigenous Knowledge							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
Goal 1: *Co-recognition of Indigenous with orthodox medicine by 2015 and by 2020, Nigeria should fully integrate indigenous/traditional medicine into orthodox medicine*							
Mass Mobilization to Generate Awareness among Orthodox, TMP and the Public.	Mobilization program to commence at all levels of government on Incorporation of Indigenous Medicine.	2011			Fed. Min. of Culture and Tourism.	Fed. Min. of Health, Fed. Min. of Info. & Communications	FGN and Development Partners.
Review Existing Laws on Medicine and Pharmacy Practice.	Enact Laws legalizing the practice of science based traditional medicine with orthodox medicine.	2011			Fed. Min. of Justice, NASS	FMH, FMST	FGN
	Provide regulatory standards for quality, safety		2015		NAFDAC	Pharmacist Council of	FGN

Objective 6: To develop a Science Based Traditional Medicine and Indigenous Knowledge							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
	and efficacy of each traditional remedies and practices.					Nigeria	
Review Medical and Paramedical training Curriculum to Incorporate Indigenous Medicine.	Include in the curriculum of medical and paramedical students traditional techniques of herbal medicine and treatment of conditions like infectious diseases, psychiatric illnesses, bone setting, and traditional birth attendant in preclinical as well as clinical years.		2015		National Universities Commission (NUC)	Universities	Federal Govt.
	Commence Specialized training in indigenous medicine.		2015		NUC	Universities	FGN
Facilitate Patenting and Intellectual Property Rights of Indigenous Medicine.	Enact laws recognizing individuals' and communities' rights to traditional innovations and knowledge.	2011			Federal Ministry of Justice, NASS	Federal Ministry of Culture and Tourism, FMST	FGN
	Establishment of Boards of Traditional Medicine.	2011			Federal & State Ministries of Health.	Federal Ministry of Justice	Federal & State Govts.
	Implementation of provisions of Convention on Biological Diversity (CBD),	2011			FMST, FMC&I	NOTAP and NNMDA	Federal Govt.

Objective 6: To develop a Science Based Traditional Medicine and Indigenous Knowledge							
Strategies	**Initiatives**	**Time Line**			**Implementing Agencies**	**Collaborating Agencies**	**Sources of Funds**
		Short Term	**Medium Term**	**Long Term**			
	Trade Related Intellectual Property Rights (TRIPS), African Intellectual Property Organization (OAPT) and African Regional Property Organization (ARIPO).						
Develop Official Records/ Pharmacopoeia for Indigenous Medicine.	A National Pharmacopoeia and Record Committee to be established to collate information on safety, efficacy and quality of traditional remedies.	2011			Pharmacist Council of Nigeria, FMH, FMST	NAFDAC, NNMDA.	Federal Govt., WHO
	Promote and collect all relevant information on plant and animal species.		2015		Federal & State Ministries of Health & FMST	Federal Ministry of Culture and Tourism, Federal Ministry of Information & Communications State Ministries of Culture, MDS, NUC MBS.	Federal & State Ministries of Health, LGAs.

4.2. Implementation Monitoring Framework

Initiatives	Monitoring Agency	Monitoring Frequency	KPI	% Completion	Issues	Risks	Mitigation
Establish programme for popularisation of S&T in all MDAs.	NPC	Yearly	Number of programs	0%			
Establish media programme devoted to S&T issues to be aired during a prime time on NTA.	NPC	Monthly	Number of program aired	0%			
Establishment of national scientific information centre with branches in every state to provide STI information services, document delivery, online data and bibliographic services.	NPC	Yearly	Number of Centers	0%			
Strengthen existing programmes for the promotion of STI such as Junior Engineers and Technicians (JETs) Club, Science Clubs, 'Catch them young' etc. through better financial and logistic support.	NUC	Quarterly	Number of Clubs				
Provide S&T infrastructure for sports development.	NUC	Yearly	Number of sport upgraded to state of the				

Initiatives	Monitoring Agency	Monitoring Frequency	KPI	% Completion	Issues	Risks	Mitigation
			earth equipment				
Establish a National Foundation for Science, Innovation and Competitiveness (NSIC) with the President as the Chairman of the Governing Council.	Selected Committee of experts involving Nigerians in Diaspora.	Half yearly	Number of R&D output commercialized	0%		— Insufficient funds — Lack of political will	— Fed. Govt. to give high priority establishing NFSIC.
Strengthen STI-related departments/division/units in all MDAs.	NPC	Yearly	No. of the depts/divs/unit strengthened	0%	-	-	-
Strengthen the Secretariat of National Research and Development Coordinating Council (NRDCC).	Vision 2020 Monitoring Committee, NPC	Half yearly	Reconstitution of Council	25%	— Non-cooperation of MDAs	— Lack of interaction of RDIs' activities	— Change of attitude — Increased commitment
Inclusion of the Minister of Science & Technology in the National Economic Council.	Vision 2020 Monitoring Committee, Fed. Executive Council	One-off	-	0%	— Non-recognition of S&T in economic development	— Inconsonance in socio economic planning	— Commitment of leadership to reforms.
Establish permanent sites for S&T Fairs at State and LGs.	FMST, Governor's. Offices	Yearly	Percentage of target achieved	0%	— States not yet mobilized for S&T	— Nonchalance of S&T issue	— Mobilisation of stakeholders
Create the department of Technology Policy and Planning in the National	Head of Service, Office of Secretary to	Quarterly	Deployment of personnel & equipment	0%	— Lack of coordination	— Bureaucratic bottlenecks	— Sensitization of all stakeholder

Initiatives	Monitoring Agency	Monitoring Frequency	KPI	% Completion	Issues	Risks	Mitigation
Planning Commission (NPC).	Fed. Govt.						s
Establish a new remuneration package for S&T professionals	Fed. Ministry of Labour & Prod. Fed. Min. of Science & Tech and Salaries and Wages Commission	Every 3 years	Number of S&T professionals retained.		— Bureaucracy	— Brain Drain	— Comparatively better pay.
Full reconstitution and invigoration of Federal Scholarship Board to award full scholarships to all Nigerians who study Science & Technology discipline	Federal Ministry of Education	Yearly	Number of candidates who obtained awards		— Ineffectiveness of the program	— Lack of transparency of the Management of the systems — Lack of sustainability of program	— Openness and political commitment
Establishment of National Foundation for Science, Innovation and Competitiveness (NFSIC).	NPC	Yearly	Number of Commercial R&D outputs	0%	— Difficulty in coordinating all S&T activities	— Lack of Political Commitment	— Political Commitment
Enforce the 60:40 Science/Art admission ratio by 2015 and Increase Science/Art admission ratio to 70:30 by 2020.	Vision 2020 Monitoring Committee, NPC	Yearly	Complance to the ratio		— High level of non compliance	— Non availability of requisite S&T manpower	— Strict enforcement of the admission ratio

Initiatives	Monitoring Agency	Monitoring Frequency	KPI	% Completion	Issues	Risks	Mitigation
Improve Teacher/Student ratio to 1:15 by 2015 in science based disciplines.	Ditto	Ditto	Ditto		Ditto	Ditto	— Strict enforcement of the teacher/ student ratio
Enforce compliance with the original mandates of technology institutions.	Ditto	Every 2yrs	Compliance to enforcement		— Some of the institutes have deviated from their mandates	— Ditto	— Strict enforcement of original mandate of institutions
Promote Technical and Vocational Education and. Training	NPC	Yearly			— Parents Negative attitude to TVET	— Non availability of craftsmen and technicians	— Enlightenment of parents
Upgrade identified institute to serve as Centre of Excellence for the development of SME process equipment	NV2020 Implementing Committee, NPC	Quarterly	Number of institute upgraded		— Current low Technological base of SME in the country	— Inability to meet deadlines especially High-tech equipments	— Early placement of equipments
Establish Electronic System for Acquisition, Processing, Storage and Dissemination of information on raw materials and Process technology to researchers, entrepreneurs and policy	Vision 2020 Implementation Monitoring Committee	Quarterly	Number and Category of People Accessing the Information system		— Poor Accessibility of Information System	— Lack of awareness on part of researchers, entrepreneurs and policy makers	— Information system should be web based for ease of access nationwide

Initiatives	Monitoring Agency	Monitoring Frequency	KPI	% Completion	Issues	Risks	Mitigation
makers							
Establish legal frame work to monitor the progressive attainment of the local technology and raw materials content of manufacturing industries.	Vision 2020 Implementation Monitoring Committee	Continuous	Passage into law of the Framework		— Reluctance of House to pass the bill as a result of pressure from groups who profit from importation of raw materials and technology	— Law may not be passed	— Workshops should be held to popularize the concept and carry populace along. This will put pressure on House to pass the law
The Local Contents Award (for industries utilizing local raw materials and researchers engaged in raw materials value addition) should be accorded a higher status equivalent to the National Productivity Award	Vision 2020 Implementation Monitoring Committee	Annually	Number of Awardees		— Low value may be attached to the Award by the public	— Industries may ignore the award and the processes leading to award	— Publicity for program Prizes to lead to reasonable benefits to recipients
Establish Electronic System for Acquisition, Processing, Storage and Dissemination of information on new and	Vision 2020 Implementation Monitoring Committee	Annualy	Number patentable of Advanced Materials developed		— Absence of adequate Laboratory Equipment for such	— May not be able to meet target	— Researchers working on credible projects should have

Initiatives	Monitoring Agency	Monitoring Frequency	KPI	% Completion	Issues	Risks	Mitigation
Advanced materials to researchers, entrepreneurs and policy makers					Hi-tech projects		access to designated centers of Excellence for Advanced Materials research
Prototypes of designs emanating from Annual National Process Equipment Design Competition to be produced and publicized	NAFPED, NASSENI, RMRDC	Annually	Number of winning Equipment fabricated and made functional		— Poor response to competition	— Winning designs may not meet international standards	— Publicity for program and substantial financial reward for winners and runners up
Upgrade Existing Institute to serve as Centre of Excellence for the development of SME process equipment	NAFPED,NASSENI, SMEDAN,RMRDC	Annually	Number of prototype equipment designed, fabricated and transferred to commercial equipment producers		— Staff engage in private practice, not devoting full time to project	— Low Turn-out of designs and prototypes.	— Remuneration for staff should be tied to out put and should be comparable to those paid to professional in the private sector

Initiatives	Monitoring Agency	Monitoring Frequency	KPI	% Completion	Issues	Risks	Mitigation
Provide fiscal incentives (tax breaks, waiver of tax levy, etc.) to private sector participating in STI manpower training.	NPC	Yearly			— Operating institutions such as ITF not effective	— Inadequate practical training	— Strengthen ITF
Establish an enhanced remuneration package for STI professionals.	Salaries & Wages Commission	Yearly	Retention rate of STI professionals		— Relatively poor remuneration to STI professionals	— Brain Drain	— Improve reward system
Incorporate entrepreneurship training in the curricula of polytechnics and universities.	NUC, NBTE, NCCE	Every 3 yrs	Percentage compliance		— Lack of requisite staff	— Skills needed for SME's may not be developed	— The program should emphasize SME skills.
Strengthening existing Human Resource Development institution	NPC, Vision 2020 Committee	Every 6 months				— Inadequate ST&I Manpower	— Adequate Funding — Political Commitment
Establish six (6) new Centers of Excellence in Biotechnology, Nanotechnology and Advanced Materials, Software Development, Cinematography, Traditional Medicine	NPC, Vision 2020 Committee	Yearly	Number of Established and functional centers	0%	— Lack of Infrastructure — Lack of manpower	— ST&I objective not achievable at 2020	— Political will to permeate all sectors of the nation.

Initiatives	Monitoring Agency	Monitoring Frequency	KPI	% Completion	Issues	Risks	Mitigation
Research by 2015.							
Restructure the organization and performance of Technology Research and Development Institutions.	NPC, Vision 2020 Committee	Yearly	Number of patent and commercializable products		— Lack of focus and duplication of activities.	Ditto	— National re-orientation towards made in Nigeria goods
Strengthening existing Higher Institutions & Research Institutes Consultancy outfit to provide IP support.	Fed. Ministry of Science & Tech., Fed. Ministry of Education, NUC, NBTE,NCCE	Yearly	% of total revenue generated by the Higher institutions consultancy outfits		— Lack of manpower — Lack of commitment and continuity	— Lack of patronage by government and others	— Institutions should nurture and support their consultancy outfits.
Baseline study of RDI on their organization and performance.	NPC, Vision 2020 Committee	Monthly	Availability of the completed document on baseline studies.		— Recruitment of appropriate organization to carry out the study	— Lack of political will and commitment	— Adequate funding.
Set up Governing Board and implementation blueprint for NFSIC.	NV2020 Monitoring Committee	Daily Routine/Full Time	Number of commercial/market-bound innovations per year	0%	— Funding from Private Sector	— None	— Designate Company Tax / Consumption Tax for the purpose
Encourage large R&D Joint Ventures for	FMC&I, and FMF, NV2020	Monthly	Number of commercial/mar	0%	— Adequate funding by	— Possibility of poaching of	— Prior laid down and

Initiatives	Monitoring Agency	Monitoring Frequency	KPI	% Completion	Issues	Risks	Mitigation
companies in same industry.	Monitoring Committee		ket-bound innovations per year		partner firms in the JVs	innovative ideas	enforceable rules of association in the JVs
Set up joint R&D initiatives with internationally established R&D organizations, academic institutions, government agencies and multi-national companies.	NV2020 Monitoring Committee/ Nigerian Missions abroad	Daily Routine/Full Time	Number of result-oriented exchange programmes achieved per year	0%	— Winning the confidence of foreign partners	— none	— Adequate campaign and commitment
Provide input for a comprehensive 'Gap analysis' to identify areas that need funding.	NV2020 Monitoring Committee						
Directing R&D funds toward core technologies.	NV2020 Monitoring Committee						
Channeling 2.5% of SMEs Funds for Commercialization of R&D Results.	NV2020 Monitoring Committee						
Establishment of undergraduate research Fund to be supported by private, public and development partners.	NPC, FMST	Annually	No. of graduates		— Inadequate number of applicants	— Shortage of manpower	— Promote STI at post-basic level

Initiatives	Monitoring Agency	Monitoring Frequency	KPI	% Completion	Issues	Risks	Mitigation
Establish research laboratories to be supported by Corporations benefiting from public funds in research areas relevant to their operation in the country.	NPC, FMST	Annually	Number of partnership		— Inability of local partners to meet obligation	— Sustainability	— Ensure commitment to make program work
Public sector grants for start-up companies in biotechnology, nanotechnology and advanced materials.	SMEDAN, NPC, FMST	Annually	Number of start-up companies		— Commercialization of R&D outputs	— Public acceptance of GMO	— Public enlightenment
Upgrade SHESTCO into an advanced Science & Technology Research Park.	NPC, FMST	Annually	Achievement of international status		— Provision of enabling environment	— Lack of transparency	— Strong Government commitment
Recruit international experts to manage six Centres of Excellence in Biotechnology, Nanotechnology and Advanced Materials.	NPC, FMST	Annually	Number of Diaspora and international experts attracted		— Adequate reward and appropriate research infrastructure.	— Derailment and eventual abortion of the project	
Advanced training for existing engineers/scientists and training of 50 additional engineers/scientists to be	NV2020 Monitoring Committee, NPC	Every 6 months	No. trained per annum	0%	— Commitment and funding	— Brain drain	— Political will extremely essential.

Initiatives	Monitoring Agency	Monitoring Frequency	KPI	% Completion	Issues	Risks	Mitigation
determined by NEEDS assessment.							
Provide the national space agency with state-of-the-art equipment for the production of satellite components and subsequent production of its own satellite.	NV2020 Monitoring Committee, NPC	Every 6 months	Type and no. of components produced	0%	— Establishment of relevant industries to manufacture components	— Insufficient fund	— Federal Govt. to give high priority to the project. — — Political will.
Embark on a programme of reverse engineering in space technology aimed at building Nigeria's own satellite.	NV2020 Monitoring Committee, NPC	Annually	No. of satellite successfully dismantled and reassembled	0%	— IPR	— International support and cooperation	— Strong political will and determination to succeed.
Mobilization program to commence at all levels of government on Incorporation of Indigenous Medicine.	Federal and State Ministries of Health.	Yearly	Number mobilized yearly	0%	— Low recognition and integration of traditional medical practitioners by orthodox medicine.	— Under-exploitation of traditional medicine	— Linkage between various levels of Health authorities.
Enact Laws legalizing the practice of science based traditional medicine with	Fed. Ministry of Health	Yearly		0%	— Same as above	— Quackery	— Promotes collaboration between

Initiatives	Monitoring Agency	Monitoring Frequency	KPI	% Completion	Issues	Risks	Mitigation
orthodox medicine.							all stakeholders
Provide regulatory standards for quality, safety and efficacy of each traditional remedies and practices.	NAFDAC	Annually	20 standards prescriptions yearly	10%	None		
Include in the curriculum of medical and paramedical students traditional techniques of herbal medicine and treatment of conditions like infectious diseases, psychiatric illnesses, bone setting, and traditional birth attendant in preclinical as well as clinical years.	National University Commission (NUC)	Continuous	Not applicable	10%	None	None	None
Commence Specialized training in indigenous medicine.	FMST, FMH, FME	Continuous	Number of trained specialists in indigenous medicine	0%	— Lack of specialists in traditional medicine	— Resistance by medical practitioners	— Scientific basis of traditional indigenous medicine.
Enact laws recognizing individuals' and communities' rights to traditional innovations and knowledge.	NV2020 Monitoring Committee	Yearly	Promulgation of law	0%	— Inter-ministerial cooperation	— Lack of political will	— Strong Government commitment

Initiatives	Monitoring Agency	Monitoring Frequency	KPI	% Completion	Issues	Risks	Mitigation
Establishment of Boards of Traditional Medicine.	NV2020 Monitoring Committee, NPC	Yearly	No. of Boards established	0%	— Ditto	— Ditto	— Ditto
Implementation of provisions of Convention on Biological Diversity (CBD), Trade Related Intellectual Property Rights (TRIPS), African Intellectual Property Organization (OAPT) and African Regional Property Organization (ARIPO).	NOTAP and NNMDA	Yearly	No. of treaties implemented	0%	— Ditto	— Ditto	— Ditto
A National Pharmacopoeia and Record Committee to be established to collate information on safety, efficacy and quality of traditional remedies.	Pharmacist Council of Nigeria	Annually	Establishment of Committee	0%	— Non existence of Pharmacopoeia	— Number of official standardization of traditional medicine	— Strong Government commitment
Promote the collection of relevant information on plant and animal species.	FMH, FMST, FME, FMA&WR	Yearly	No. of species of plant and animal covered	0%	— Lack of data on plant and animal	— Inter-ministerial cooperation	— Strong Government commitment

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Sign-Off Sheet

S/N	NAME	POSITION	SIGNATURE
1	Ibidapo-Obe Oyewusi (Prof.,OFR)	Chairman	
2	Onwualu P.A (Prof)	Coordinator	
3	Adeoti John Olatunji (Dr.)	Member	
4	Ayo Daniel (Dr.)	Member	
5	Az-Zubair M.Kabir (Dr.)	Member	
6	Bello Muhammad Yahuza (Prof.)	Member	
7	Garba Magaji (Prof.)	Member	
8	Iliyasu Musa	Member	
9	Andrew Igili	Member	
10	Itaketo Umana (Fnse, Dr.)	Member	
11	Kabo Aminu Usman (Mr.)	Member	
12	Keshi Chuba	Member	
13	Kumuyi A.J. (Prof.)	Member	
14	Lawal N.A.	Member (NPC)	
15	Makoju Joseph (Engr.)	Member	
16	Modibbo B.A (Dr.)	Member/Secretary	
17	Mujtaba Suleiman Abubakar (Dr.)	Member	
18	Othman Danladi	Member	
19	Umaru Alka (Dr.)	Member	
20	Odejide Abisoye (Mrs.)	Member	
21	Bindir Umar (Dr.)	Member	
22	Maduako Adanma	Member	
23	Megwa Patrick Eze(Engr. (Dr.))	Member	
24	Nasir Ka'oje M	Asst. Secretary	
25	Adegoke I.O (Prince)	Asst. Secretary	