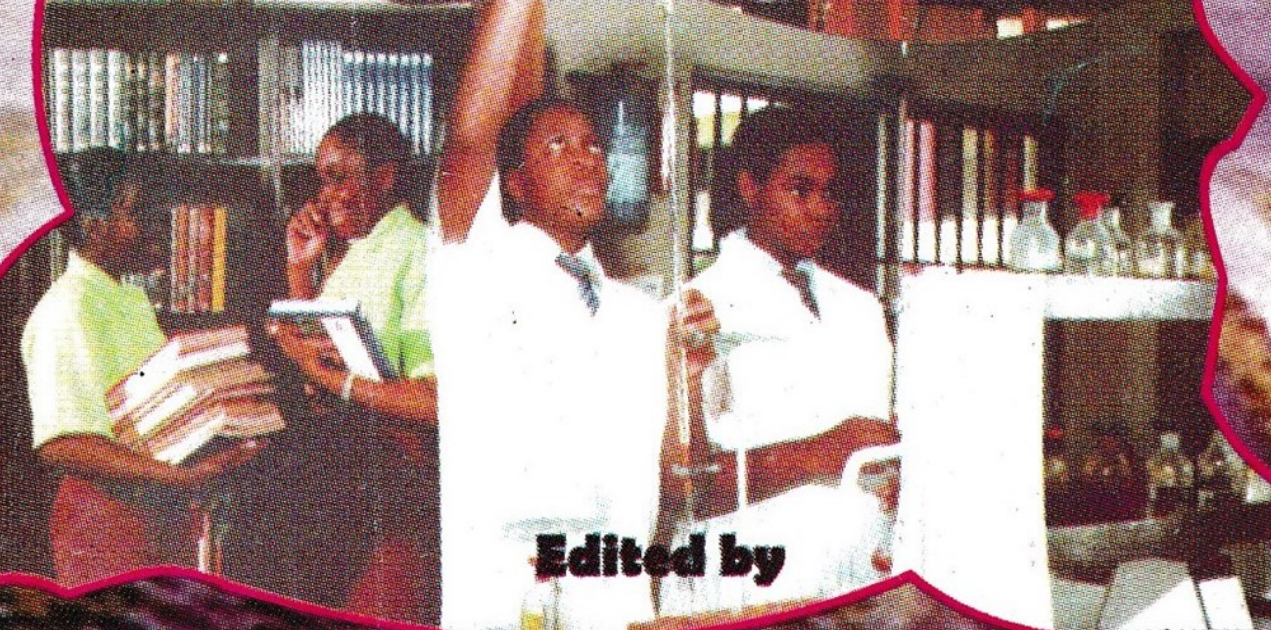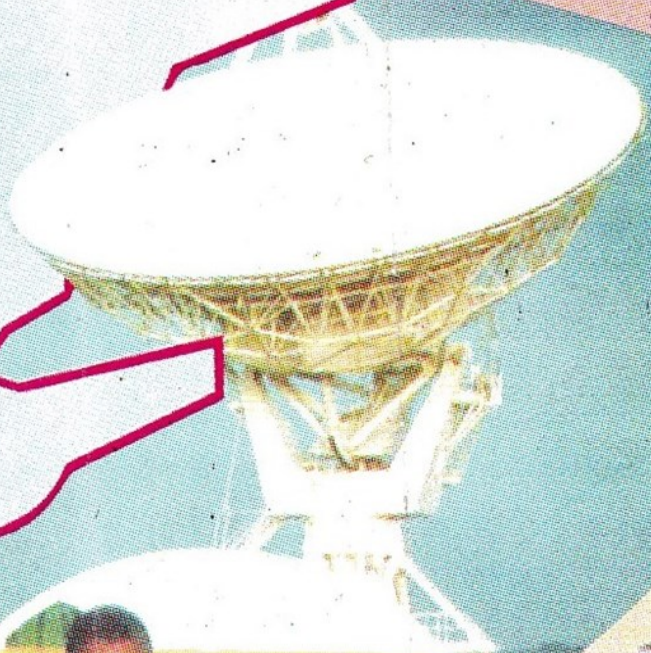# SCIENCE AND TECHNOLOGY IN AKWA IBOM STATE:
VISIONS AND PERSPECTIVES

Edited by

LINUS O. ASUQUO

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HARNESSING, ORGANISING AND DISSEMINATING SCIENCE AND TECHNOLOGY RESOURCES FOR DEVELOPMENT: AN INPUT INTO SCIENCE AND TECHNOLOGY POLICY FORMULATION BY FELICIA E. ETIM

1. INTRODUCTION

The role of Science and Technology in development has not only gained increasing recognition in developing economies but also has actually taken on a new significance. This is partly due to the multiplicity and intensity of awareness creating activities in conferences, workshops, research studies and also due to the recognition by the respective societies that other developing countries which have embraced Science and Technology as a major engine of growth have generally faired much better in their development efforts and have achieved much faster and more substantial economic growth.

Indigenous technology cannot be bought, borrowed, stolen or even transferred but can only be developed from within, if technology is to take a strong root, grow and come to fruition in our society. Technological revolution through importation of sophisticated equipment, establishment of assembly parts and importation of half – finished goods and services is a mere illusion unless Science and Technology education is made more relevant to our societal needs.

Akwa Ibom State, created in 1987, with a population of about three million is rich in minerals. Agriculture is the bedrock of its economy. Over 70% of the state's workforce is mostly engaged in subsistence farming. The industrial sector is small, dominated by government owned companies. Recognising that technology determines the level of industrialization and status of societies as well as the quality of life of the people, the Bureau of Science and Technology was established to promote the application of Science and Technology in the transformation of the society. Some of the Bureau's objectives include:

(i)   Development through education and training, high quality human resources and recognize excellence in their distribution;

(ii)   To promote and sustain the development and co-ordination of Science and Technology relevant to the needs and circumstances of the State and nation, and,

(iii) To utilize the results of worldwide research and development to strengthen such productive sectors as agriculture and industry.

This paper seeks therefore to make an input into Akwa Ibom State Science and Technology policy by suggesting the harnessing of all Science and Technology educational resources of man (through capacity building), materials (information sources, laboratories) and money (adequate funding) for technological advancement. It also seeks to propose a science and technology information system network as the bedrock for technological development.

SCIENCE AND TECHNOLOGY EDUCATION AND DEVELOPMENT

Ukeje (1979) defined education as the "process of transmitting, preserving, developing and advancing the culture of a people. Fafunwa (1971) a few years earlier had stressed that the future objectives of education should aim at providing:

"A well-integrated person who is socially adjustable, morally dependable, mentally and physically alert, intellectually honest, economically efficient, scientifically literate, vocationally equipped, nationally and internationally oriented, and culturally adjusted."

According to him, the new objectives would call for a formal education structure that would provide extensive support for the classroom teacher in the form of well-equipped laboratories, workshops and relevant curriculum.

Science education takes place at all levels of formal education - primary, secondary and tertiary institutions. To ensure quality and survival of science education system, it is pertinent to conceptualize the three levels of education as sub-systems of science education, which through different functions are interdependent, interrelated and interact with one another within the science education system. The implication of this is that science education is a priority that ought to be nurtured. Consequent on this, Fafunwa (1990) identified measures to remedy the poor situation of science education as:

a)   The introduction of Teacher Vocation Course (TVC) in six science subjects namely agricultural science, biology, chemistry, physics, integrated science and mathematics.

b)   Provision of standard textbooks in various subjects for distribution in the states.

c)   Introduction of the concept of Junior Engineers, Technicians and Scientists Organization (JETSON) to popularize Science and Technology among pupils in our schools.

d)   The introduction of special science school in all the states.

e)   The development of new curricula in mathematics, junior science and senior science.

In spite of these efforts, Eze (1990) opined that the enrolment in tertiary institutions and poor performance of students in science and related courses cast some doubt on the possibility of attaining the expected objectives of Science and Technology education in Nigeria.

The task of developing Akwa Ibom State capability for technology therefore would cover issues like the training of manpower comprising engineers, technologists, technicians and skilled craftsmen; development and maintenance of institutional capacity in technology research, product design, development of plant, machinery and capital equipment.

The policy statement should include that:

> *The educational system shall emphasize science and technology at all levels. The policy objective would be to inculcate science and technology in the thinking and working processes of the society in order to create a Science and Technology culture.*

Proffered Strategies

a)   Making it possible for the average child to have early contact with the concepts of and materials related to Science and Technology even before attaining primary school age.

b)   Ensuring a sound science foundation during the primary

and secondary stages of the educational system through:

i)   Entrenchment of science teaching in the school   curriculum.

ii)   Promotion of computer literacy

iii)   Provision of adequate teaching aids, laboratories and workshops.

iv)   Provision of well-trained and well-motivated science teachers, and

v)   Introduction of gainful practical activities such as model-making, handicrafts, gardening, woodworking and metal working

c)   Enforcing strictly an absolute minimum of 60:40 ratio of science based courses to other courses in students' yearly enrolment into the nation's universities.

d)   Orienting Science and Technology curricula of the polytechnic.

e)   Enforcing strictly admission into the polytechnic and the state university of Science and Technology to reflect a strong Science and Technology bias aiming at not less than 80%.

f)   Developing special Science and Technology postgraduate programmes in the state and federal universities with the aim of creating an inroad into the area of high technology.

g)   Initiating and supporting continuing education programmes aimed at specific training for top level scientists, science teachers, engineers, technologists and technicians.

h)   Initiating and supporting programmes for the training of scientific and technical personnel on a scale adequate to fulfil the country's needs in education, agriculture, medicine, engineering, industry, defence, etc.

i) Working towards establishing at least one Trade Centre/ Vocational School in each local government area of the country to provide both theoretical and practical training in craftsmanship.

j) Ensuring that adult education includes learning how things work in addition to learning how to read and write.

k) Encouraging Akwa Ibom scientists, engineers, technologists and technicians working outside the country to return home and contribute to the development of science and technology in the nation.

l) Encouraging and promoting the writing of mathematics, science and technical textbooks at all levels.

m) Promoting and encouraging the publication of learned journals in Science and Technology.

n) Encouraging individual initiative for the acquisition and dissemination of knowledge and for the generation of new knowledge in Science and Technology.

o) Ensuring appropriate and adequate industrial attachment programmes for all science – based courses at the tertiary level.

p) Creating avenues for science and technology management training at the tertiary educational levels.

q) Evolving programmes for the recognition, encouragement and development of scientific and technological talents at all levels.

r) Honoring, with special awards, deserving scientists, engineers, technologists and technicians involved in Science and Technology activities, in recognition of their contributions.

Generally, institutional arrangement for Science and Technology management should be supported with the objective of stimulating and facilitating the overall management of science and technology systems and interdisciplinary scientific knowledge.

SCIENCE AND TECHNOLOGY INFORMATION DISSEMINATION

The evolution and orientation of scientific and technological research seems to have been determined at different times and places by the need for a strategy which will meet two major needs of the society concerned. First, is an entirely new and perhaps much more powerful method of gaining a deeper insight into the scientific disciplines that will permit the society to innovate and use science. Secondly, there is the need to develop and acquire technology as know-how or adapt existing technologies for improving the society's life style and solving problems encountered in self – sustaining economic and social development. That is the value of scientific research, the advancement of science depends on the accumulation of data and every scientist stands on the shoulders of hundreds of other scientists. Industrial productivity could be achieved by the rapid application of existing research findings and technologies.

The impact of research and training in Science and Technology can only be maximized if research findings and technologies derived thereby are made available in forms suitable for absorption and used by those who need the information. For Nigeria and other developing countries in Africa, this information comes primarily from scientists and technologists trained in institutions in and outside the country. Other main sources of

this information are articles in the literature, seminars, conferences and technology investments particularly those embodied in economic investment projects. The effectiveness an information system derives thereby can be measured by the extent to which:

a) The content of the information is full and responsive to the needs of the users

b) It facilitates or hinders the performance of the functions   for which the systems are set up in the first instance.

The critical challenge facing Akwa Ibom State therefore is to evolve a Science and Technology information system, which will transform the state from the present consumption pattern to a production pattern. The   science and technology information system generated must be responsive to the needs of a society fighting to come to terms quickly with a rapidly changing technological world environment. Akwa Ibom state must seek technological information that can be absorbed and used on a self-sustaining basis. This calls for an inclusion in the S&T policy, statements about Science and Technology information resources acquisition, processing and dissemination for optimal utilization. Akwa Ibom State is poised to create an independent, integrated and self-sustaining economy. Therefore all available Science and Technology information resources ought to be exploited, harnessed, acquired, processed and directed to specific user groups for utilization for technological advancement. The science and technology policy must gear towards achieving this goal. In formulating the policy, statements should be made which express the intentions, objectives, strategies and the resources to be employed in organizing and utilizing Science and Technology information for the overall development of the State.

INFORMATION/COMMUNICATION–CLARIFICATION OF CONCEPTS

Saunders (1980) defined information as "*…facts, data, opinion and the like, including, but certainly not confined to what is revealed in the results of study, research and scholarship in all fields of knowledge.*" Communication, on the other hand, can be defined "*not only as exchange of news and messages but also as an individual and collective activity embracing all transmission and sharing of ideas, facts and data, (McBride 1981).*

While information is the substance or message, communication is the process of transmitting the message. Information and communication are therefore so interwoven that some people use the two words synonymously. Worse still, some have mistaken the process for the substance and so focus more attention on communication than information. While information is fact and is objective, it cannot be distorted. Communication is subjective and can be altered to suit a particular purpose.

There is a prevalent misconception of the existence of a National Communication Policy. There is no existing National Information Policy. The National Science and Technology policy statement (unpublished) has touched tangentially some aspects of information in sections 3.6 – Information Technology and 4.3 – Popularization of Science and Technology.

Section 3.6.2 states objectives as:-

a)   To ensure that information technology resources are readily available for national development

b)   To guarantee that the country benefits maximally from and contribute optimally to the continuous enlarging pool of the world's knowledge and informatics

c)   To ensure efficient diffusion of information nationwide.

Section 4.3.2 objective states

> *To ensure that members of the public are fully informed about the opportunities offered by science and technology to improve their general well being and content of their daily lives and proffered strategies.*

A closer look at their objectives reveals a mere enhancement of computer literacy and the use of the electronic and print media to give prominence to science and technology. It should be noted that information technology is only a tool to facilitate information service. Akwa Ibom State should in recognition of this gap, evolve a Science and Technology policy with strong components of an information policy to guide the implementation of technological development.

SCIENCE AND TECHNOLOGY POLICY RELEVANT TO LIBRARY AND INFORMATION SERVICE

The library is defined as an organized collection of books and other non-book materials used for study, research and recreation. It could be housed in a room, a complex building as electronic formats of compact discs, and the memory of any computer.

Information science is the study of information and related phenomena. It is a science concerned with the properties of information, the processes of information transfer, the management of these processes, the environment and policies that affect the users of information. The information scientist is therefore positioned to acquire and evaluate information sources, for which purpose appropriate, process, store, retrieve and

disseminate packaged information to different user groups in formats acceptable by them. Thus while the librarian deals with documents as information sources, the information scientist deals with data and concepts in relation to target audience. It covers the growth of recorded knowledge; models of information transfer; the information theory; bibliometrics; the philosophy of information; information economics and ethical issues.

Thus, an actualization of the Science and Technology policy objectives, the services to be offered by a library and information scientists within the set up of Akwa Ibom State Science and Technology Information System Network would be: -

a. Harnessing indigenous science and technology information and processing into a standardized database.

b. Establishing and operating a science and technology information extension services to Science and Technology Information (STI) parks and industries.

c. Establishing links with sectorial, national, regional and international S & T information networks for purposes of co-operation and resource sharing.

d. Data representation of Science and Technology concepts and variables, and management of indexing and search procedures

e. Current awareness services to Science and Technology working groups.

f. Knowledge organization including classification, thesauri/ keyword listings, indexing and abstracting services.

g. Study of the behavior patterns of science and technology user groups with a view to individualizing services.

h. The development and design of Akwa Ibom State Science and Technology Information Systems Network. (Akwa STIS-NET)

DESIGN AND DEVELOPMENT OF AKWA IBOM SCIENCE AND TECHNOLOGY INFORMATION SYSTEMS NETWORK (AKWA STIS-NET)

About three decades ago, some international organizations, having realized the critical position of information for developing countries, assumed responsibility for aspects of international information communication. Prominent among them were the United Nations Educational Scientific and Cultural Organisation (UNESCO), the International Federation for Documentation (FID) and the International Council for Archives (ICA). Realising that the functions of these organizations are interrelated, and in furtherance of their common objectives, UNESCO tried to bring these organizations together for a joint plan of action. Out of this meeting in 1974, the concept of National Information Systems (NATIS) was born. The concept and objectives of NATIS embraces all services involved in the provision of information for all categories of users. The development of NATIS required the achievement of twelve objectives by the national governments and four by the international organizations. The first of the objectives for national action was the formulation of a national Information Policy. This was to give both government and those involved in the planning and execution of NATIS a sense of direction. Over three decades after, Nigeria still has no information policy and therefore no workable national information system. The development and design of an Akwa Ibom State Science and Technology Information system is therefore imperative to any successful implementation of the Science and Technology policy.

THEORETICAL BASES OF AKWA – STIS- NET

Etim, 2001, discussed extensively the interrelations among science and technology information (STI); STI source characteristics – availability, accessibility, relevance and dissemination; and industrial/technological development. It was found that STI source characteristics as independent variables interact either singly or jointly to influence STI utilization and consequently technological development.

The production of STI was also found to vary across industrial /technological sectors. This is because STI production is sector oriented, that is the producer targets very often a particular manufacturing sector. Technological development implies the progress of the different sectors from a lower state to a higher state in terms of the technological sophistication of the manufacturing processes. This transition is activated by the supply of STI to the different sectors and how STI used can affect the technological progress observed as development. Since variability exists in the technological sectors, a model of STI flow for technological development across the varied sectors is shown in appendix 1. The model proposes maximal utilization of STI for technological development.

BASELINE STATUS OF INFORMATION SERVICES IN AKWA IBOM STATE

The Bureau has started a project on Science Information and Technology Park (SIT Park). An Internet service has been installed as a provider of Science Information Park (SIP). There is some level of infrastructure put in place by the state government. In the area of human capacity building, staffs have been exposed to in-house training in the computer laboratory while a few have

been sent outside the country for training. The database in the computer system has information on investors, researchers and innovators but presently there is no coordination of the Science and Technology information resources in the Bureau and the school libraries, public libraries, polytechnics library, college of education library and the university library. They are all-independent and have no platform for networking.

There is the tendency for a duplication of efforts in research and acquisition of materials. The state library board appears to be charged with the responsibility to supervise the state public libraries only hence, the need for a total harnessing, organization and effective dissemination of Science and Technology educational resources for technological development in Akwa Ibom State.

There is also the problem of standardization of processes in cataloguing, computer software packages, adoption of formats and retrieval strategies. Information services targeted to different sectoral groups is non-existent. Akwa – STIS – NET would therefore be an attempt at the coordination of these resources for optimal utilization.

OBJECTIVES OF AKWA STIS-NET

Objectives of Akwa STIS – NET would be:

a. Tap all available indigenous Akwa Ibom State Science and Technology information / patents from schools, polytechnic, college of education, university and other R&D institutions for easy accessibility and coordination.

b. Establish a science and technology information service tailored to the information needs of technologists and industrialists.

c. Set-up a training unit for the development of manpower in Science and Technology information works.

d. Stimulate user awareness of already existing literature for utilization.

e. Access users needs with a view to providing a baseline for evaluation of services provided.

f. Provide bibliographical control of state, national publications and products.

g. Advice and assist Science and Technology parks in setting up their in-house information outfits.

h. Ensure that the Akwa STIS-NET is linked to the information superhigh way- the Internet.

i. To build gradually, over a period of 20 years, a Science and Technology digital library.

Generally, the primary objective of any development information system is to rationalize the development process by accelerating its pace and maximizing the costs. This achieved by identifying, classifying, describing, publishing and updating the inputs into the system .

STRATEGIES FOR IMPLEMENTATION OF THE OBJECTIVES

a. Develop an information policy as an addendum to the Science and Technology policy. Components of the information policy would be:
   i. Standards on information presentation and infrastructure.
   ii. Institutional R & D structures, libraries, archives, public records and telecommunications.
   iii. Structures of information management in government in relation to the private sector.

iv   Methods of collection and acquisition of science and technology information.

v.   Information access and control

vi.   Information industry policies and legal backing

vii.   Freedom of information, confidentiality, personal privacy and security issues.

viii.   Information standards, protocol on formats, presentation, copyright and transponder data flows.

b.   Survey science and technology information needs of real and potential users.

c.   Design and distribute questionnaires to R & D organizations and S & T Park to gather data for input into the databases.

d.   Recruit and train library and information personnel in various aspects of information service both locally and abroad.

e.   Identify, acquire and install computers, audio-visual aids and other accessories necessary.

f.   Identify state, national, international, public and private sector organisations concerned with the promotion of Science and Technology advancement with a view to developing active linkages with them.

COMPONENTS OF THE SCIENCE AND TECHNOLOGY INFORMATION DATABASE

Possible components of the database could be the following. This suggestion is however subject to a current survey of resources and needs.

1.   **Case -** *Current Awareness Services On The Economy.* This is a database on newspaper and magazine information of

techno-economic nature.

2. **Compress** - Company and SIT park profiles for extension and similar services. This is a database of detailed information about Akwa Ibom industries and companies.

3. **Data** - *Data on Akwa Ibom Technologies.* This would comprise patented and non-patented Akwa Ibom technologies.

4. **Step**- *Scientific Technical and Economic publications.* Inputs into this database would be generated from current scientific periodicals in and outside Nigeria.

5. **Pipe**- *Product and SIT Park /Industry Extracts.* Entries in this database would be industry profiles.

6. **Radio** - *Research and Development Information Online.* Inputs here would be ongoing research and development projects in Akwa Ibom and Nigeria at large in the area of science and technology.

7. **Aid** -*Answered Inquired Data.* All technical enquires handled by the centre.

8. **Pair** - *Patent Information Retrieval.* Records in this database are available patents worldwide that would be relevant to the Akwa Ibom Science and Technology community.

9. **Item** - *International Technology Market.* This covers foreign technology market available for licensing and their items.

10. **Latin** - *Latest Technology Index* – source of, title and time of development of technology in Akwa Ibom State.

This list is by no means exhaustive. Creation of databases is a continuous process depending on needs.

KEY INFORMATION PERSONNEL REQUIREMENTS

1. **Librarians** - Acquire, process and preserve printed information materials.

2. **Information Resource Managers** -Plan, develop, coordinate and control information systems as well as the human and material resources needed for their optimum utility in a given environment.

3. **Information Systems Designers**-Analyze specific information problems and design appropriate systems or networks for their solution.

4. **Information Resources Analysts** -   Concerned with information as it is codified or compressed for transmission or display. They may be designated as **indexers** responsible for the provision of entry keys to the organized body of information; **abstractors** responsible for the condensation of information packages for rapid utilization; **cataloguers** responsible for the provision of analogue displays for unified or related information collections; and **bibliographers** who are responsible for describing individual records and their relationship in any system developed.

5. **Information Brokers** - Provide information services for a fee. Such services include: research, abstracting, compilation of bibliographies, current awareness services, directory compilation, publishing, translations, document delivery, literature search, etc.

6. **Information Technologists** - Operate, adapt, maintain, control and evaluate the technologies used in the processing and management of information.

7. **Information Science Researchers:** Concerned with investigating the theoretical elements of information,

conducting experimental surveys into all aspects of information science, developing and testing of specific monitoring mechanisms and methods to ensure updating and developing prototype information systems design.

8.   **Information Science Educators** –Responsible for formal and continuing education of all categories of information professionals, Para-professionals and non-professionals.

CONSTRAINTS AND ISSUES

The fundamental constraint to the implementation of any information programme is lack of information consciousness/awareness of its critical role by government functionaries and policy makers. Consequently, finance and other resources are not provided to develop a suitable information environment.

Policy makers must be enlightened to change their view of information as publicity and propaganda materials produced by radio, television, and newspaper houses. Information must be seen as facts and data tailored to serve all segments of the society and necessary for planning, decision-making and the execution programmes in Science and Technology.

An effective implementation of Akwa STIS-NET would require skilled manpower. Hitherto, there has been no survey to determine the available personne land future requirements for the State.There should be specific guidelines for the education and training of different categories of information personnel. The proposed University of Science and Technology should offer programmes in information science and information technologies. Within Akwa Ibom State, a large proportion of the populace is under privileged and has no access to modern technologies. These issues therefore have implications for education and training of

personnel; research and SIT park manufacturers as key players in the Science and Technology system. There will be need for in-house workshops and training on computer literacy and applications.

There will also be need to increase the available Science and Technology resources. Scientists and technologists should be encouraged to research into different areas of priority in Akwa Ibom State.

Weak linkages between existing universities, polytechnics, R&D institutions and industries must be checked. There should be a coordination of activities by these institutions in pursuit of a common goal of advancement of science and technology for development.

Poor telecommunication infrastructure and services in the state and unreliable power supply could dampen the awareness and enthusiasm raised by workshops and training. Efforts should be made to provide good telecommunications facilities.

With these constraints addressed, the development of Akwa Ibom State through Science and Technology is imminent.

BENEFITS OF THE DEVELOPMENT OF AKWA STIS-NET TO AKWA IBOM STATE.

Most developing societies suffer from a dearth of readily available, reliable information, with adverse consequences for achieving their numerous developmental objectives. Worse still, the spread of information (IT) across all types of industries and services in industrialized countries is so fast and pervasive – with consequent improvement in price competitiveness, design and quality of products – that developing societies like Akwa Ibom State find it difficult to compete internationally. The development and successful implementation of Akwa STIS-NET can be

beneficial in many ways. It will provide greater opportunities for Akwa Ibom to participate in global trade and production; alleviate information in poverty by providing access to tap fast-expanding global knowledge; improve public sector   management and will promote environmentally - friendly development by reducing the environmental impact of industrialization and urbanization.

VISION FOR THE NEXT 20 YEARS

With the establishment of Akwa STIS-NET, it is expected that in the next twenty years, Akwa Ibom State would have had enough foundation for the building of the digital library.

A digital library is a distributed library information service, located either in a physical or a virtual space, or a combination of both, in which a significant proportion of the resources available to users of that service exists only in digital form. It is an electronic database on the Internet, the World Wide Web, CD-ROM and proprietary services such as dialogue, Lexis/ Nexis, STN, Westlaw, Info-America, CDB Infotek and IOP-EJ. In this context, the word library is a collection of full text bibliographic information sources rather than buildings and incorporates services (such as electronic publishing, personal information management and distance education) and information technology tools (such as those to support browsing, authoring and communication).

The introduction of digital libraries in Akwa Ibom State has implications for improving educational standards, enhancing the application of science and technology and the creation of an informed society. The challenges facing African governments in the implementation of digital libraries in Africa have been

discussed by many scholars (Feldman, 1997, Wresch, 1998, Ojadokun 2000). Challenges, however, remain on how to improve information and communication technology (ICT) infrastructures in the state. There is also the challenge of how to provide an affordable access to and encourage the use of information technology in Akwa Ibom State. Rowlands and Bawden (1999) have proposed methods of building the digital library on solid research foundations. Their proposition is based on Yates (1989) work-oriented model of documents, work and technologies. These three domains could be the basis of phases for the building of the digital library in Akwa Ibom State.

PHASE I: Work/Social Domain

This phase would be concerned with the laying of a foundation for the digital library. Research into the social contexts surrounding the digital library, which includes psychological, cultural, organizational, economic, legal and policy elements. Information skills and literacy; impacts on work and organizations, information laws and policy concerns would be   delineated. This can take the first five years.

PHASE II: Documents/Information Domain

Documents/Information here would represent enduring communicative records. Information retrieval in distributed network environments poses many challenges. Phase 11 of the development of the digital library would entail design of semantics and syntactics across large heterogeneous document collections. Information objects will be fully documented with contextual information relating to their source creation, processing and current status as well as flags signifying their content. World

wide accepted standards would have to be adopted. This will take the next five years.

PHASE III: System/Technologies Domain

Documents are created and maintained using technologies. Issues to tackle in this phase include human factors e.g. human systems interaction; knowledge organization discovery (e.g. software materials and formats) and impacts on the information transfer chain. Information retrieval in a distributed network environment poses many challenges so this can also take another five years.

PHASE 1V: Emergence of the Digital Library

Against a background preparation of the phases I, II, and III spanning fifteen years, the digital library would emerge – a network of distributed repositories where information objects of any type can be searched and retrieved using technologies that can transparently handle variations in protocol and formats.

CONCLUSION

Science and Technology has been recognized as a major engine of growth for sustainable development worldwide. The present government of Akwa Ibom State realizing that the state is a predominantly agricultural community with over 70% workforce engaged in subsistence farming has put in place the Bureau of Science and Technology with the specific mandate to promote the application of Science and Technology in the transformation of the Akwa Ibom State to industrial-driven economy. This position paper sees quality science education as the foundation for capacity building and conceptualizes the three levels of primary, secondary and tertiary education as subsystems of

science and technology education, which ought to be strengthened. It therefore suggests the harnessing, organization and effective dissemination of all Science and Technology educational resources of man, materials and money for technological advancements. Specific policy objectives in the area of capacity building should be to inculcate science and technology in the thinking and working processes of the society in order to create Science and Technology culture. Strategies have been proffered for implementation.

This paper has also put forward the fact that the impact of research and development (R & D) can only be maximized if research findings and technologies derived thereby are made available in forms suitable for absorption by those who need the information. A model has been proposed for maximal utilization of STI resources. The design and development of Akwa – STIS – NET is proffered as imperative of any successful implementation of the Science and Technology policy. Again policy objectives and strategies have been outlined. Problems and possible ways of overcoming them have been discussed as constraints and issues. The evolution of a digital library has been projected as a vision for the next 20 years realizing that the technological standards and models adopted today will shape the world of the future.

REFERENCES

Etim F. E (2001), Scientific and Technological Information Utilization and Industrial development in Nigeria. Nigeria, Heinemann 199p.

Eze D. N. (1990), Major issues in Nigeria Primary Science Education Programme: Implications for Qualitative Science Education by 2000 A.D. In *"Concepts and Indicators of Quality*

Education Nigeria: Totan Publishers Vol. 1 (1) Pp 88 – 96.

Fafunwa Babs (1997), The need for a Systematic Curriculum Development Process in Nigeria. In *Nigeria Educational Research Council. Guidelines on Primary School Curriculum,* Lagos: NERDC.

Fafunwa Babs (1990), Education in Human Development. Nigerian Libraries 2 (1) 23.

Feldman, Susan (1997), Advances in Digital Libraries '97: The Washington IEEE forum Delves into the implications of Technology, Information Today, 14 (7) 12 - 13, 55. http://www.infotoday.com

McBride S. (1982), "Many voices, one world: Communication and Society Today and Tomorrow". *Ibadan University Press, Ibadan, pp. 14*

Ojadokun A. A. (2000), Prospects of Digital Libraries in Africa. *African Journal of Library, Archives and Information Science.* 10(1) 13-21.

Rowlands and Bawden (1999), Building the Digital Library on Solid research Foundations. Aslib Proceedings. 51(8): 275 – 282.

Saunders W.L (1990), Information, the "unscarce" resource. In: The Nationwide Provision and Use of Information. *Aslib IIS, LA Joint Conference London: Sheffield Proceedings.*

UNESCO, (1974), *National Information Systems (NATIS):* objectives for National and International Action. Paris, Unesco.

Ukeje (1990), The Education of Teachers for a new social order. The Nigeria Teacher 1 (1) 6- 10

Wresch, William (1998), Information access in Africa: Problems with every channel. *The Information Society. 14: 295 - 300.*

Yates J. (1989): Control Through Communication. London: John Hopkins University Press.

APPENDIX I

A NORMATIVE MODEL OF STI FLOW FOR TECHNOLOGICAL DEVELOPMENT

S	M	C	R	E

Research Institutes	STI	INFORMATION SYSTEM 1 (PROCESSORS)	TECH/ INDUSTRIAL SECTORS	OPTIMUM USE OF STI

1

2

1. OPTIMUM AVAILABILITY

2. OPTIMUM ACCESSIBILITY

3. EFFECTIVE PROCESSING

4. EFFECTIVE DISSEMINATION

5. EFFECTIVE STI (RELEVANCE)

4

5(A)

DEVELOPMENT OF NEW PRODUCTS

3(A)

INFORMATION SYSTEM II (FEEDBACK SERVICES)

1. CHARACTERISTICS OF INNOVATION i.e

5(B)

ATTEMPT TRIAL PRODUCTION

(A) DEFECTS OF INNOVATION RESEARCH

(B) RELATIVE ADVANTAGE

(C) COMPATIBILITY

(D) COMPLEXIBILITY

(E) TRIAL ABILITY

(F) OBSERVABILITY

5(C)

PREPARE FOR REGULAR PRODUCTION

5(D)

SELL PRODUCTS IN LOCAL MARKETS

5(E)

IMPROVE TECHNOLOGY

5(F)

TECHNOLOGICAL DEVELOPMENT

3(C)