<table>
<thead>
<tr>
<th>Serial No</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Author 1</td>
<td>C.U Ogbuehi (Mrs)</td>
</tr>
<tr>
<td>Author 2</td>
<td>A.O Okorie (Prof)</td>
</tr>
<tr>
<td>Author 3</td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>Critical Perspectives of the Role of science and Technology in the Development of Sustainable Economy</td>
</tr>
<tr>
<td>Keywords</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>Category</td>
<td>Journal of Liberal Studies (JOLS)</td>
</tr>
<tr>
<td>Publisher</td>
<td>School Of General Studies</td>
</tr>
<tr>
<td>Publication Date</td>
<td>2003</td>
</tr>
<tr>
<td>Signature</td>
<td></td>
</tr>
</tbody>
</table>
Mrs. M.N. Awarbie
The Natural Sciences Unit
School of General Studies
University of Nigeria, Nsukka

Dr. P.O. Udachakw
The Natural Sciences Unit
School of General Studies
University of Nigeria, Nsukka

Dear Madam,

Letter of Acceptance of Article

On behalf of the Editorial Board of the Journal of Liberal Studies (JOLS) I am pleased to inform you that your article:

Critical Perspectives of the Role of Science and Technology in the Development of Sustainable Economy

has been accepted for publication. It will appear in Vol. 10 No. 1 of 2002/2003.

Congratulations.

[Signature]
Oghuehi, C.U. (Mrs.)
A critical look at the role of science and technology
(S&T) in development is undertaken. The fact that on S&T depends
the standard of living of a nation and that technology is an index
of power are firmly established based on the experiences of indus-
trialised countries. Developed nations dominate the field of S&T,
About 95% of all research and development (R&D) is executed by them
while developing countries carry out only about 5%. These countries
spend about 3-7% of their Gross Domestic Product (GDP) on R&D while
developing countries spend only about 0.2%. Nigeria had her indige-
nous technology which was interrupted by slave trade and colonisation.
At present the growth of S&T has been erratic with emphasis changing
with change in leadership, with the result that the country is,
inspite of her great potentials, lagging behind. Efforts to bridge
the gap are being made particularly with transfer of technology from
abroad but the yields have been so far unsatisfactory. Adaptation
technology is advocated as possibly the nation's best option as the
technology can be modified after research and analysis to suit our
local environment. This will provide a spring board that will launch
the nation into the envisaged S&T revolution of the 21st century.
The envisaged revolution in information technology and biotechnology
and the status of Nigeria and how she can join in these new technolo-
gies are discussed. Finally, the role of the government in promoting
R&D and therefore S&T is emphasised.
Introduction

On science and technology depends the standard of living of a nation. Today, the “Third World” is only slowly waking up to the realization that in the final analysis, creation, mastery and utilization of modern science and technology is basically what distinguishes most developing countries (South) from most developed countries (North). 1

Developed countries continue to dominate the field of science and technology to the extent that around 95% of all research and development is executed by them, while developing countries, which represent 70% of the population of the world, have only about 5% of the world’s research and development capacity. The industrialized countries have, through their control of science and technology provided themselves with an immense power to enhance the human environment, increase production and improve the standard of living of their population.2

In other words: science and technology form the foundations of modern existence.

Among the motivations for research and development (R&D) are included war, economic growth or competitiveness, prestige, welfare and science for its own sake. While military research takes precedence over civilian research in a few countries, economic growth remains the prime motivation for science in all countries. Armed forces in many Third World countries have been quick to understand that if they initiate themselves to modern weapons and communications technology, they can easily control the direction and speed of social change occurring within their societies.3 Technology is thus something
more than a resource capable of creating new wealth, it is also a powerful instrument and a decisive tool for acquiring political leverage (by using the threat of war), gaining some competitive advantage in warfare and in trade.

Technology is therefore the primary index of power. This is believed to have become more pronounced since the end of the cold war in 1989, because since then, emphasis has shifted from naked military power to economic power thereby making the strength of a country’s currency far more strategic than the strength of its army.4 Also while the UN security council is made up of technologically strong nuclear powers (US, UK, France, Russia and China) and are therefore ruling the world militarily and by extension politically, the G7, consisting of US, UK, France, Germany, Japan, Italy and Canada are, by virtue of their advanced technological development, ruling the world economically.

The scientific size of a country is significantly correlated with its GDP (Gross Domestic Product) – the more productive a country is in the sciences, the larger its GDP tends to be. For instance, Salam (1979) vividly spotlights the alarming disparity between developed and developing countries – the former, generating an income of $5 trillion, spends $100 billion (2% of the earnings) on non-military science and research, while the latter, with an income of $1 trillion, spends a shameful $2 billion (0.2% of the earnings) when they should actually be spending $20 billion, according to the percentage norms of the richer nations.5
Science is concerned with the material universe, seeking to discover facts about it and to fit these facts into conceptual schemes called theories or laws, that will clarify the relations among them. Technology on the other hand deals with the application of scientific knowledge to solve human problems e.g. the development of new and better products and processes for consumers.

Nigerian Indigenous Technology and its Interruption

In Nigeria we have the Nok Culture, the Igbo-Ukwu iron works, the Ife textiles and the Benin bronze. The development of these technologies was interrupted by the slave trade.

In the colonial era, science and technology was discouraged, disorganized and generally not perceived as a crucial mechanism that could meaningfully contribute to the development of the African continent generally. Its recognition in contemporary Africa is a significant achievement and step forward even though much still remains to be done to make science and technology an integral part of the national development strategy of African countries. Science and technology did not feature in the colonial policy nor was it seen as important for understanding and solving the numerous problems facing the continent. Rather, it was an instrument for demonstrating the gap between the colonial powers and the colonies. It established the obvious scientific and technological underdevelopment and dependency of African countries.

The creativity of the African nations were fettered in this period and the people were not only unable to participate in the development of
world culture, science and technology but also lost much of what they
had created while they were still independent.

Methods of acquiring Technological Advancement as outlined by former
Minister of Science and Technology - Brig.-Gen. Sam Abacha

Technological Advancement can be achieved in the following ways:

Technology transfer: This refers to the process by which the productive
sectors of the economy import from another country, not only the bulk of
its productive machinery and equipment, but also the experts that will
organize the systematic transfer of the technology wanted.

Disadvantages: Technological transfer terms are generally capital
intensive for the recipient country e.g. the building of petro-chemical
industries, steel/industrial complexes, dams, electric power stations,
refineries etc. More often than not, the terms are reluctantly added to by the
donors who use many opportunities (which quite easily occur in
an unstable economy/leadership) in ensuring that the terms are never
fulfilled.

So far, the Nigerian experience with transfer of technology has
been very unsuccessful as a result of local instability and the fact
that the foreign donors do not really want to transfer their hard earned
technology nor lose their technological lead over others. Some are
simply out to exploit and amass wealth for themselves and for these
reasons, transfer of technology may not serve the nation as a means of
sustained technological development.

- Acquisition Technology - an advanced form of Technology Transfer.
- Unpackaged technology: This refers to technology obtained through
relevant softwares and during the repairs/maintenance of the item. Through such exposure, a local replication of the technology is made possible.

Advantages/Disadvantages: This will be definitely a cheaper way of acquiring the required technology but the instructions/manuals may be sketchy and component parts/materials required to build from scratch may also be difficult to obtain locally.

- Poached technology: This is the covert taking away of technology without the consent of its originator or possessor. This is generally achieved through spies or unscrupulous private entrepreneurs, with at times the tacit support of their government. Sometimes core scientists behind important innovations are abducted or attracted to seeking countries by monetary inducements.

These activities infringe on patent law and the international property rights and no self-respecting country will lay itself open to such charges and the possible imposition of sanctions on it by others.

- Adaptation Technology: It is a process that encourages fast acquisition of technology from other sources usually foreign countries and multinationals. First obtain access to their technology i.e., tools, equipment, machinery, engine, plant etc. Dissemble the technology into component parts and research, analyze and reproduce them adapting them to our local environment. It is for sustainability, copied with infused local input and based essentially on useful indigenous technology.
Advantages: It leads to great technical transformation of the society and provides a good start-point from which to catch up and even overtake the originators.

Adaptation Technology - The Best Option for Nigeria

From the experiences of other countries such as Japan, China, South Korea, India, Indonesia etc. which practised more of Adaptation Technology, one can agree with Brig. - Gen. Musah that the best option of Technological strategies for Nigeria is Adaptation Technology. At present, Centres of Adaptation Technology (CAT) are being established in various parts of the country. This should be encouraged since it is only research and development that can ensure sustainability of any developmental efforts in vital areas and technological progress can only be achieved through research and development.

Global Technology - Current Status and Future Trends

The world is heading for vast information revolution explosion and most advanced countries are feverishly making plans to participate and benefit from it. The forthcoming information revolution will involve the building of an information superhighway using new infrastructure resulting in the merging of the technologies of computing and telecommunications. This information revolution will necessitate a shift from analog to digital phones, a change from transmission of messages over copper wires to either fibre optic, wireless or satellite systems. Electronic equipment that will integrate the functions of TV, computer, phone, etc. will emerge and possibly change the way we live, run our offices, use our leisure times, etc.
According to Geyer (1982), man's basic needs are both physiological i.e. food, clean air, water, health care, shelter, and social i.e. education, communication, transportation, security etc; the extent to which these needs can be managed and met will depend amongst other things on the ability of the human society to generate, transfer, disseminate, store, process and use information, or intelligence. The so-called post-industrial society, according to him is nothing other than one whose progress is information-based.

Today, computers are linked up into a network as Internet. The development of computer networks has provided the base that combines geographically dispersed researchers, computing resources and information into a single integrated computer and communications environment and enables the sharing of programs and data. Since scientists see themselves as an international community where ideas are more important than national origin, they were the first to adopt the new electronic media as their principal means of day-to-day communication. Computer networks are today ubiquitous around the world including the E-mail which is the most prevalent, File Transfer Protocol, Telnet, Usenet, and Talk and Internet Relay Chat. According to him, the developing countries will be forced to change from the telecommunications technology of the industrial era to the new technology of the information era whether they could afford it or not, otherwise they will be totally isolated from the developed world.
Another area of great technological advancement is in the area of biotechnology. Biotechnology can be broadly defined as the application of science and engineering principles to the processing of materials of biological origin for the provision of goods and services, for the benefit of mankind. Biotechnology has clear potentials for contributing significantly to the solution of problems in the area of medicine, agriculture and industry, that are relevant to improving our economy and quality of life.

Global interest in this new technology has grown so much and the industrialised countries of the world such as USA, Japan etc. are already benefiting from biotechnology, especially in the development and production of vaccines and drugs and are investing huge amounts of money into further research in the subject. It is believed that biotechnology is ushering in a new industrial revolution.

The Nigerian Status and Future Options

In terms of information technology in Nigeria, at present, use of fax machines, mobile telephones services, domestic windishes for reception of satellite, radio and TV broadcasts from foreign stations have become common. Through private initiatives, limited cable television services are being currently provided in parts of Lagos and part of Kano. Telecommunications system for Abuja is based on an optical fibre network and digital telephone exchanges. Digital telephone exchanges are also becoming common in other parts of the country. E-mail is also in use in private sectors and some institutions of higher
Learning much as Obafemi Awolowo University (OAU), Ile-Ife and University of Nigeria, Nsukka. OAU, Ile-Ife is also connected to the Internet.

For advancement in information technology, Obaya suggested that information technology should be developed as part of the overall national development plan. This will involve establishing a computer network system that links all tertiary institutions, social and scientific research institutes as well as the relevant government ministries and parastatals; developing national computer centers which will provide adequate computing facilities and also link up Nigerian computer education and research network to the Internet. This will enable researchers in Nigeria to be in touch with one another and their counterparts worldwide and also exchange information, data and other research resources at will; establishing National Institute for Information Technology to carry out R&D in the area using adaptation technology and developing indigenous technical manpower; encouraging private entrepreneurs to establish commercial network nodes in Nigeria for the link up of private computer users to the Internet; introducing computer science as a general study into the school system; setting up national bodies to plan for computer set ups mentioned above; restructuring the telecommunications sector of the economy to incorporate the digitalization of the trunk routes and the exchanges and the use of optical fibers and satellite links.
In terms of Biotechnology, Nigeria is affiliated to the International Centre for Genetic Engineering and Biotechnology (ICGEB) in New Delhi and Trieste and has a National Centre for Genetic Resources and Biotechnology (NACGRAB) at Ibadan to co-ordinate and promote biotechnology R&D in Nigeria.

Also biotechnology projects are going on in various institutions of higher learning though progress has been minimal.

To develop biotechnology in Nigeria, (Chafe) recommended that the National Agency for Science and Engineering Infrastructure (NASRENI) should prepare a directory of workers in biotechnology, organise short courses in specific biotechnological techniques and invite Nigerians working in the area abroad to come and give seminars and interact with home-based workers. The government should set up a Board for Biotechnology that will advise NASRENI on research and development in biotechnology, establish a Centre for Genetic Engineering and Biotechnology, and set up well-equipped satellite laboratories in existing universities and institutes all over the country with funds from the Centre, introduce courses in molecular biology, plant and animal tissue culture and fermentation technology in tertiary institutions.

Sustained technological advancement in Nigeria: suggested roles for the government

1. Sound educational system.

In many developing countries, basic science is not considered and being of immediate relevance to national needs but if it is realised
that the ultimate goal of science and technology is to serve national development and to improve the well being of humanity as a whole, then Nigeria needs to give particular emphasis to science in its educational system. The introduction of computer education at all levels of the educational system should be encouraged.

2. Funding: Research and development cannot go on successfully without adequate funding so far technological advancement to occur meaningfully in Nigeria, the government should increase the funds allocated to R&D from 0.2% to at least 2% of her GDP.

3. International Collaboration:

Many developed nations of the world e.g. Japan, South Africa, are willing to undertake collaborative research with Nigeria through exchange and linkage programmes. The Nigerian government should encourage such collaboration by fulfilling her own part of the requirements. The government should sponsor researchers to such countries and ensure that they come back (by sending them) to train others.

4. Incentive to Researchers:

Researchers should be given adequate incentives such as equipment, good salaries, national awards etc. to spur them up in their research.

5. Organising National Workshops and Conferences:

Once in a while researchers in a particular field of study in the nation will be called to a workshop or conference to exchange ideas in their field.
6. Throwing Open Challenges

Individual members of the society and companies should be challenged to contribute and compete in various areas of research. Greatest contributors and best competitors will be accorded national recognition. Also research foundations should be set up by groups/clubs in their areas of interest e.g., for finding out the cure/control of various diseases and the public encouraged to donate to such research foundations.

7. Establishment of more Centres for Adaptation technology (CAT) should be encouraged.

8. The government should give priority to such new technologies as Information technology and biotechnology.


