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IN SEARCH OF APPROPRIATE TECHNOLOGY FOR NIGERIA♣

By

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SYNOPSIS

It will be a fact to say that Nigeria has not been able to exploit optimally her developmental potentials in human and natural resources. This can be attributed to the fact that science and technology policy and institutional framework had been afflicted by inconsistencies and instability. There is gross under funding of the educational institutions including the few research and development centres. This is so evident that the Economic Adviser to the President (Prof. Ode Ojowu) publicly declared "…science and technology has not been able to attract and retain the requisite manpower and the few that remained are on the verge of frustration." There is need to address this urgently if we must provide "qualitative" life for the citizenry. The National Economic Empowerment and Development Strategy (NEEDS) document has set a tone. It is hoped that it will be religiously adhered to so that it does not go the way of the VISION 2010.

In addressing the topic of discussion, '***In search of appropriate technology for Nigeria***', I have subdivided the presentation into seven parts namely: Introduction, some notable engineering achievement – which are strictly the results of research and development and painstaking exhibitions and collaborations to improve product quality, The Nigerian experience – typically in the areas of transportation, energy and communication, appropriate technology – what we need to do to make technology relevant to the nation, Technological research and development, Reversing the current trend and then the conclusion.

From the presentation, it is imperative that Research and development should be one of the nations' focal points in developing any type of technology bearing in mind our cultural norms. Exhibitions and competitions such as the one we are witnessing today should be translated into concrete reality by the relevant agencies concerned – most importantly the government.

1.0 INTRODUCTION

The dawn of the new millennium presented an opportunity not only to look ahead to the future, but also to reflect on the ingenuity and inventions of the past. Civilization is the process whereby man learns to overcome the obstacles in his way and become a master of his environment. This is exemplified by the ability of the society to feed her citizens, provide good Medicare, good communication network, adequate and reliable water supply and electricity, adequate housing and a reasonable degree of opportunity for leisure. The stage of industrialization and technological developments are major parameters that can be used to estimate the degree to which a nation can provide these good things of life [1].

Throughout human history, the acquisition, control and utilization of science and technology constitute key determinants of sustained economic development [2]. Science and technology are central to industrialization. They have opened unending vistas of opportunities which have resulted in total emancipation of the human mind and release of its capabilities in developed countries. In such countries, the issue of development is no more what can be done but what should be done.

A close survey of world conditions reveal striking contrasts. While high flying jets zoom across the sky bringing peoples of different parts of the world together, the peasants in the Nigerian society still transports few kilograms of yams by the use of the head, shoulder, back or a pitifully malnourished animal. While affluent nations are surrounded by plenty, millions of less fortunate people unable to cope with nature live under the threat of famine, drought and pestilence. While citizens of advanced nations are in constant communication with the news centre of the world, in backward areas; men live in ignorance and superstition, unaware of what is happening in the next village.

Technology maybe defined as the science or study of the practical or industrial arts and applied science. It is the totality of the means employed by people to obtain material objects for human sustenance and comfort. There is a general agreement among economists and others that one of the most powerful forces influencing the American economy is technological change – the advance in knowledge relative to the industrial arts which permits and is often embodied in, new methods of production, new designs for existing products and entirely new products and services. The National Commission of Technology, Automation and Economic Progress (NCTAEP) go far to state: “It is easy to oversimplify the course of history; yet if there is one predominant factor underlying current social change, it is surely the advancement of technology.” I want to quickly add here that this does not mean that all efforts of technological change has improved

working conditions and added many new dimensions to life, it has also made possible the destruction of mankind on an unprecedented scale, thrown whole communities into distress and polluted certain parts of the environment. Nonetheless, most economists would agree that technological change has on the balance, been beneficial to man.

The quantum leap in industrial development of the south East Asian Tigers has been made possible because the countries single-mindedly acquired and utilize modern production technologies. New technologies, especially in information, communication, biotechnology and material science are changing the structure of the world trade and marginalizing countries which depend on export of raw materials for foreign exchange earnings. Industrialized counties are developing substitute materials for replacing agricultural produce which constitutes Africa's major export commodities.

This trend in material substitution is likely to be on the increase in the coming decades. This will in turn reduce the strategic importance of Africa as a source of raw materials. Tissue culture is being used for producing large clones of most tropical Africa's export crops. It is being used to alter the resistance of crops to environmental factors [2]. Before too long, crops which are traditionally known as tropical crops will be grown in temperate countries. The potential of the hydrogen fuel cell as an alternative energy source to petroleum is formidable. It is claimed that when fully developed and made commercially available, it could do for the energy sector what the microchip did for the computer industry [2]. This has great implications for the petroleum exporting countries and it can reduce the strategic importance of those countries.

Without restricting the permissible tools used in engineering to any subset of knowledge, we can define engineering in simple terms as the professional art of and optimum conversion of the great resources of nature for the use, benefit and convenience of man. As an art, it calls for the systematic application of knowledge and skill according to a set of rules for the proper execution of certain works.

The people in the fore front of technology are the Engineers, Engineering technologists, Engineering technicians and Engineering craftsmen. These form the members of the engineering family [3]. This group of individuals may not be free to select problem(s) that interests them. They must solve them as they arise and in some cases when they are challenged. Their solutions must however, satisfy society's conflicting requirements.

2.0 SOME NOTABLE ENGINEERING ACHIEVEMENTS

The greatest discoveries and inventions of engineering technology were made by men and women of positive attitude and peaceful mind. To have a peaceful mind, you must create it; create an atmosphere, circumstances and environment about you to be peaceful. To have a peace of mind, fill your personal, group, public conversations and discussions with positive, optimistic and satisfying expressions [4]

The words we speak, how we utter these words have definite effect upon our thoughts and actions. Thoughts create words for words are the vehicle of ideas [5]. Words affect thoughts and help to condition if not create attitudes. What passes for thinking mostly starts with a talk. Great men who influenced the world technologically, include: Bill Gates, who brought the personal computer into our homes; Charles Townes, inventor of the laser; Robert Kahn, one of the originators of the Internet; Bill Anders, the Apollo 8 astronaut who took the famous "Earthrise" photograph while in lunar orbit; and Wilson Greatbatch, inventor of the pacemaker [6]. A few of the greatest engineering achievements of the last century are reviewed as food for thought:

2.1 Automobile

Of the 10,000 or so cars that were on the road by the start of the 20th century, three-quarters were electric or had external combustion steam engines, but the versatile and efficient gas-burning internal combustion power plant was destined for dominance. Partnered with ever-improving transmissions, tyres, brakes, lights, and other such essentials of vehicular travel, it redefined the meaning of mobility, an urge as old as the human species.

Through continuous improvement and the ingenious application of new technology, the automobile reconfirmed and updated its status as a triumph of engineering throughout the 20th century. The first semiconductor computer chip went onboard in the mid-1970s. Before long, microprocessors were improving just about every aspect of the vehicular emissions, fuel economy, safety, security, engine and transmission performance, ride and handling, even seat positioning. Electronics also transformed cars and trucks into mobile entertainment and communication centers

Today the automobile remains the most voracious consumer of new technology of any product in the marketplace. And promising new technological developments, such as the use of fuel cells as a power source, will undoubtedly keep the automobile on the leading edge of technology in the 21st century.

2.2 Agriculture

Throughout most of its long history, agriculture particularly the growing of crops was a matter of human sweat and draft animal labour. Oxen, horses, and mules pulled ploughs to prepare the soil for seed and hauled wagons filled with the harvest up to 20 percent of which went to feed the animals themselves. The rest of the chores required backbreaking manual labor: planting the seed; tilling, or cultivating, to keep down weeds; and ultimately reaping the harvest, itself a complex and arduous task of cutting, collecting, bundling, threshing, and loading. From the early times, people with an inventive flair perhaps deserving the title of the first engineers developed tools to ease farming burdens. Still, even as late as the 19th century, farming and hard labour remained virtually synonymous, and productivity hadn't shifted much across the centuries.

At the turn of the 20th century the introduction of the internal combustion engine set the stage for dramatic changes. Right at the center of that stage was the tractor. It's not just a figure of speech to say that tractors drove the mechanization revolution. Tractors pulled ploughs. They hauled loads and livestock. Perhaps most importantly, tractors towed and powered the new planters, cultivators, reapers, pickers, threshers, combine harvesters, mowers, and balers that farm equipment companies kept coming out with every season. These vehicles ultimately became so useful and resourceful that farmers took to calling them simply GPs (General Purpose) [6].

2.3 Computers

When the programmable digital computer was born shortly before middle of the 20th century, there was little reason to expect that it would someday be used to write letters, keep track of supermarket inventories, run financial networks, make medical diagnoses, help design automobiles, play games, deliver e-mail and photographs across the Internet, orchestrate battles, guide humans to the moon, create special effects for movies, or teach a novice to type. In the dawn years its sole purpose was to reduce mathematical drudgery, and its value for even that role was less than compelling. One of the first of the breed was the Harvard Mark I, conceived in the late 1930s by Harvard mathematician Howard Aiken and built by IBM during World War II to solve difficult ballistics problems. The Mark I was 51 feet long and 8 feet high, had 750,000 parts and 500 miles of wiring, and was fed data in the form of punched cards an input method used for tabulating equipment since the late 19th century. This enormous machine could do just three additions or subtractions a second.

Computing has made many evolutionary leaps over the decades-from the command line to the graphical user interface, from stand-alone PCs to a globally connected Internet. They can recognize speech and handwriting, create realistic

animation, and enable people to collaborate, communicate, and find information around the world [7].

2.4 Aviation

The first of aviation's hurdles was getting an airplane off the ground with a human controlling it in a sustained flight. This presented a number of distinct engineering problems: structural, aerodynamic, control, and propulsion. As the 19th century came to a close, researchers on both sides of the Atlantic were tinkering their way to solutions. But it was a fraternal pair of bicycle builders from Ohio who achieved the final breakthrough [6].

Not a single human being had ever flown a powered aircraft when the 20th century began. By century's end, flying had become relatively common for millions of people, and some were even flying through space. The first piloted, powered, controlled flight lasted 12 seconds and carried one man 120 feet. Today, nonstop commercial flights lasting as long as 15 hours, carry hundreds of passengers halfway around the world.

Boeing produced the twin-engine Boeing 777 aircraft. It is one of the biggest two-engine jet ever to fly and the first aircraft produced through computer-aided design and engineering in 1995.

Between 1996 and 1998, NASA teamed with American and Russian aerospace industries in a joint research program to develop a second-generation supersonic airliner for the 21st century.

3.0 THE NIGERIAN EXPERIENCE

Constraints to development have chiefly been identified in the 1997 – 1999 National Rolling Plan [8]. The major constraints being in the communication, transportation, manufacturing, education, health and agricultural sectors. The emergence of effective energy grids, communications and transportation makes a meaningful development of any society. The main bedrock of providing these three key services is substantially foreign in Nigeria. A peep into these three will reveal some striking revelations:

3.1 Transportation

A transportation system may be defined as consisting of fixed facilities and the control system that permit people and goods to overcome the friction of geographical space efficiently in order to participate in a timely manner in some desired activity [9]. The transportation system can further be categorized into four

major systems according to the medium on which the flow elements are supported. These are: Land, Air, Water and Pipeline transportation.

In 1973, the Federal government of Nigeria set up six centres for vehicle assemblies for Mercedes in Enugu, Volkswagen in Lagos, Leyland in Ibadan, Peugeot in kaduna, Fiat in Kano and Steyr in Bauchi. The Federated Motor Industries Works in Lagos was also initiated not long after this. The assembly plants were with the ambitious goal that within ten years, over 90% of their components would be made locally [4]. Today, over 30 years after, not even 20% of the products are locally made with the exception of the Mercedes at Enugu. Volkswagen, Fiat and Leyland have gradually disappeared from the vehicular map of Nigeria.

Additions to the existing stock of vehicles are now made largely by importation of many used and disused vehicles (popularly called *tokunbos*) from Europe.

Part of this failure has been the failure of the completion of our steel projects in Ajaokuta, Aladja and Delta steel complexes. Even the steel rolling mills in Oshogbo, Jos and Katsina are a mere shadow of their existence. The other reason for this collapse could be the proliferation of manufacturers, makes and models, low capacity utilization of the assembly plants, technology acquisition, low local content input, slow development of local components industry and lately high cost of foreign exchange.

3.2 Energy

Energy has a major impact on every aspect of the nation's socio-economic life. It plays vital role in the economic, social and political development of the country. Improvements in standard of living are manifested in increased food production, increased industrial output and the provision of efficient transportation, adequate shelter, healthcare and other human services. Thus future energy requirement will continue to grow with increase in living standards and industrialization

There are eight generating stations in Nigeria: Kainji, Jebba, Shiroro, Egbin, Sapele, Afam, Delta, and Ijora with installed capacity of about 5.8GW. None of them has "Nigerian – input" except for minor maintenance works. Even the civil works and overhauling were done by foreigners. The Oji thermal station in Enugu is currently non-functional.

For lack of maintenance as at when due, currently they are characterized by obsolete switch gears, broken down units and overloaded transmission lines and transformers. The estimated percentage of Nigerians having access to electricity supply from NEPA (now PHCN) is 36% [10]. There is therefore, need for a drastic surgery in the power sector.

3.3 Communication

This may be by word of mouth, the print media or the electronic media. Information is either transmitted fast or slow. Mails are slow and may not reach their intended targets.

Four years ago, the economic development index for Nigeria would read about $350 or thereabouts, and the teledensity of the country was some 0.4 lines per 100 of population. Today, with the explosion in mobile telecommunications, the number of telephone lines in the country has leapt significantly and now the teledensity stands at about 2% [11]. In the meantime, the GDP per capita has hardly changed from the old figure. The population growth of the country and the Naira depreciation against the dollar has combined to lower the teledensity and the dollar per capita at the same time.

It maybe premature yet to talk of the impact of telecoms on Nigeria's science and technology development, but it is generally recognized that profit-driven research and development are going to yield fruit faster than mere knowledge-seeking research. Indeed the kind of revenues, bank balance, and balance sheets of some new Nigerian telecoms companies are just the tonic required to promote result-yielding research, and Nigerian high technology may be arriving at a water shed [11]

4.0 APPROPRIATE TECHNOLOGY

If technology is needed by a set of people, it must be appropriate. In reference to developing countries, technology can be appropriate if it makes use of maximum available local raw materials. It must also be compatible with the tradition and value system of the target population. It must create maximum number of employment opportunity; demand minimum training and maintenance and it must be adopted by local firms constrained by poor financial, technical and managerial expertise. Technology must be in line with meeting the basic needs of the poorest members of the community in which it is to be applied. It must be decentralizable, efficient yet low cost and hence within the reach of the recipients – especially the poorest in the remotest area of the country concerned.

Technological transfer is a cultural process. When transferring some cultural values from one society to another, definitely conflicts cannot be avoided. Since technology is a part of culture an individual cannot develop it. The whole society must be involved in one way or another.

The two major ways known for the development of technology are "self – reliance" method and "imitation." In the self reliance method, everything is built upon traditional production techniques – everything starts from the scratch. On the other hand, the imitation method involves the acquisition of a developed system (product) from elsewhere. This is then copied and the exact or similar product is developed using available local materials. Here in Nigeria, "importation of technology" is preferred. The advocates for the importation are the administrative elites. The Nigerian society has always relied on Government to import technology. The government on their own part preferred to import already manufactured goods. Where a particular technology is acquired, no efforts are made to ensure that it is truly adopted.

To be self sufficient, whatever technology we are going to adopt, it should conform to our cultural and traditional norms. This means that the technology must make intensive use of surplus semi – skilled labour. It must have a solid foundation on the locally and domesticated inputs as well as national personnel as oppose to foreign experts. The technology must make sparing use of capital, highly trained expertise; have economic efficiency of small and medium scale production enterprises.

5.0 TECHNOLOGICAL RESEARCH AND DEVELOPMENT

For any advancement in technology, research and development is the key input that can ensure sustainable development. Avenues like the one we are having today (Zonal Poly Expo/Competition), Science and Technology exhibition at all levels; RMRDC (Raw Materials Research and Development Council) Techno-Expo etc should be sponsored by government and private companies to create awareness and for participants to share ideas. This should not end in shows alone but concretized by the relevant agencies for the advancement of the country.

Here in Nigeria, though some important discoveries and innovative designs have been made, for some peculiar reasons, they were only utilized by foreign companies. The end-products of these innovations, ironically find their ways back to Nigeria, purchased by hard-earned foreign exchange [4].

The number of patents granted is a measure of inventiveness of the society. Strictly, there are not much inventive activities in the country. Corporate research and development activities are more important than individual efforts as evidenced in developed nations especially in high technology areas of electronics, synthetic materials etc.

6.0 REVERSING THE TREND

Various written works exists which have tried to analyze and offer explanations for our attempts and failure in our quest for technological advancement. Some of them have proffered solutions as the NEEDS document has done. Strict compliance to this document will certainly put us on some sound footing. It is my fervent prayer that it does not go the same way as the VISION 2010 document. Continuity is a necessary condition and the sufficient condition is strict compliance.

Despite this, the following are required from the point of view of our discussion:

a. The development of the industrial sector calls for massive qualitative investment in human and capital resources as well as complementary supply-side stimulants supported by appropriately phased insulation from excess of global competition. The private sector has to be made the engine room of development.

b. Concerted efforts should be made to reduce unnecessary duplication of efforts and to eliminate mimicry and trivial research activities. Scholarship should be dedicated to the principles of intellectual enquiry and experimentation and it should be brought to bear on the National Development Programme [2]

c. Apart from this effort, Government and private concerns must set up adequate numbers in industrial institutes required to satisfy industry's technological and machinery requirements. These institutes must be properly funded and adequately equipped.

d. While capital is necessary to generate wealth, a nation's wealth is measured in today's world in terms of its skilled manpower, its technology and its ability to manage all aspects of industrial activities.

e. As the complexity of technological activities increases, it is necessary to have an addition to technicians for operating existing productive system, scientists, technologists and engineers that are capable of creating new technologies. This will certainly increase the nation's technological autonomy and reduce dependence on foreign technology.

7.0 CONCLUDING REMARKS

I have tried to bring to fore some of our constraints to development and proffer one method of solution: Research and Development backed by exhibitions of the kind that we are having today. I am aware a lot has been discussed on different occasions across the country. The fact that they are still issues for discussion

indicates that we have not successfully tackled them. Our solution to advancement in technology lies in the acquisition, adaptation, control and application of modern science and technology through research and development which should conform to our cultural and traditional norms. Exhibitions are platforms to chart this course.

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