SCIENCE AND NATIONAL DEVELOPMENT

Delivered by

Dr. Timothy Oluwole Farinre
(Member, GCI Class of 1952)

October 2008

EXTRACT

This paper seeks to explore the relationship between scientific progress and national development and the role played by science in enhancing this development in sustainable way. We will examine how this has played out in the development economies using examples from specific areas of national life. We will also examine and learn from the recent experience of developing countries Asia, India and Latin America. We will examine the role of Government in enhancing the process through policy formulation, economic and other incentives. In the concluding part we will propose initiative to be taken by Government to ensure maximum impact of pure and applied science so that Nigeria will leap frog the progress and join the ranks of developed economies in the shortest possible time frame.

INTRODUCTION

In this paper, I shall define science as process of systematic enquiry into a natural phenomenon **so** as to understand it's beyond nature so that we can benefit from its attributes and further develop those attributes to reap greater benefits. This approach covers both basic science and applied science. Also by its very nature it is a never ending process. Thus scientific progress will continue as we gain greater understanding of this particular phenomenon. The so called CANI (Continuous and never ending improvement) principle if applied to science is a recipe for progress.

National Development comprises the aggregate of progress in every sector of national life. A nation is developing when activities progress on a broad form to tackle a specific problem and provide solutions. Although in practice the rate of progress may differ from one sector to another no sector should be neglected or left behind. We will show later in this presentation that environment and to a large extent government policies will determine the range of activities and sectoral rate of progress.

EDUCATION

The foundation for development is laid in the education system. It is no longer debatable that the rate of progress and development of a nation is directly related to the level and quality of its investment in education. Much has been said and written in recent years about the UNESCO guideline proposing a 25% of the national budget as the appropriate level of the annual expenditure on education. Of course many sections are competing for funding in an environment of limited resources. It is therefore unrealistic to expect this level of funding to be attained in our country in the near future. I believe the highest level that has been achieved so far is about 12% but even that level has not been sustained. What is important is to accept that investment in education is a function and responsibility for all tiers of government. The private sector, voluntary agencies, the family and individuals. The aggregate of all these expenditure may well approach the 25% level

Many of us in this gathering today as Old Boys of Government College lbadan owe our educational and professional achievements to the acceptance of this cooperative and collaborative endeavour. In our days, a large percentage of GCI boys were in school on government scholarships, fees remitted arrangements, sponsorship by local village councils, and even by some churches. Such

was the high value given to education that the burden or sacrifice was readily accepted. Let me illustrate this point by relating an incident that happened about 25 years ago when the Lagos state government proposed the abolition of private schools. The Parent-Teachers Association organised a meeting to deliberate on the appropriate response. A taxi driver rose to speak and to the surprise of the majority of those present many of whom were Engineers, Doctors and other professionals who were obviously stronger economically stated calmly, clearly, and firmly 'I am prepared to work as hard as possible, forego other pleasures or needs to ensure I send my children to the school of my choice so that they will have better opportunities than myself to compete effectively in an increasingly competitive world.' The clarity of his understanding of the stakes involved helped to galvanise opinions and a decision was made to mount a legal challenge. The government proposal was defeated in court.

Without necessarily recognising it, all such investment provides the needed foundation for future national development. As will become clearer when we consider individual economic sectors an educated citizenry is a pre-requisite for democratic governance and the growth and substance of a democratic culture and democratic institutions. Only educated citizens will understand and make informed decisions about those who seek their mandate. They are also the ones who will be enlightened enough to defend their democratic rights and fight for those rights when violated.

Aside from general education, science-based education is required in a knowledge-based post industrial society. Most of the economic leaps of the twentieth century and later have been driven by new scientific discoveries. These discoveries were harnessed to yield innovative products and service. These in turn resulted in immense economic gains and creation of new wealth. Science led to the invention of radio, television, mobile phones and information technology to name just a few.

Therefore, any nation ignore science at its own peril while those nations which invest heavily in education, especially science education, have a much higher probability of developing new products and services. This is the secret of the economic miracles from Japan, Korea, India, Malaysia, Singapore and Brazil. The countries of the former Soviet satellite of Eastern Europe are also jump-starting their economies by following similar trends. We will return to this theme in the concluding part of this paper when we consider necessary government initiative and policy directions to promote a stronger science-based national economic development. But first we must now survey the various sectors to highlight the impact of science on recent progress.

MEDICINE

The medical world has witnessed spectacular advances in recent years as a result of basic scientific discoveries and development of new diagnostic tools and techniques. In addition to the time-honoured X-ray, new tools such as ultrasonic scans, CT, MRI, etc have made possible early and accurate diagnosis of many serious and life-threatening diseases. Modern electronic imaging techniques enable medical specialists to view and study the condition of many internal organs in a non-invasive way. Consequently, diseases which were considered incurable some two decades ago are finally yielding to slow and steady improvements in their prognosis. As a result of better scientific understanding of their nature, many cancers can now be treated to yield total remission or improved survival rate.

Techniques such as invitro fertilization (IVF) have made it possible for once childless couples to now have their own children. The positive effect of this on the happiness and well-being of many in our society cannot be overestimated especially in a cultural environment where marriage is considered to be of little value in the absence of children.

Pinhole surgery through the application of laser tools has resulted in less invasive surgery and faster post-operative recovery.

Stem cell research is leading to the growth of cells designed to tackle specific organ needs. The result could be the availability of more organs for transplant thus saving many lives. A byproduct of this research is the growth of special skin cells applicable in the treatment of burn victims.

Through laser surgery, many eye ailments can now be corrected to give improved sight to people who hitherto would have resigned themselves to permanent impairment or even blindness.

Advances in genetics and DNA technology have made it possible to solve many crimes even when forensic evidence is scanty. Understanding and application of these techniques will help in solving many of the unsolved murder cases currently in our case files. It would lead to improved administration of justice in our country by ensuring that only those who are truly guilty are punished. Even in an advanced country like the US where criminal investigations are usually very thorough, DNA techniques have helped to reduce miscarriage of justice.

The list goes on and on. But the main point is that basic and applied medical science and research continues to bridge new frontiers in medicine leading to better ways of managing disease for improved quality of life. We in Nigeria cannot afford to remain aloof from these developments. We must participate actively and carve out suitable niches for our country.

AGRICULTURE

In spite of urbanisation, Nigeria remains essentially an agricultural country since about eighty percent of our population continues to engage in agriculture. As the rural to urban migration increase and the quality of our top soil diminishes agricultural yields may decline unless we employ scientific techniques. Fortunately science had made inroads in agriculture. What we need is educated farmers who will apply these science based results already proved in laboratories and research farms here and abroad.

Through genetic engineering disease resistant crops are being developed. Soil quality is being enhanced through suitable application of fertilisers, crop yields can multiply so that the harvest per hectare of land continues to rise. For many crop varieties the number of planting per season has also increased as a result of reduced maturity periods achieved through research leading to overall higher yields still.

The scientific break-through is occurring not only in food crops but cash crops used as raw materials in many industrial productions. These are all welcome developments for a country with a rapidly increasing population because a nation unable to feed its people is unlikely to record

rapid economic development. The application of science and technology has made it possible to carry out agricultural activities in areas hitherto considered impossible. A good example is the state of Israel which has successfully engaged in agriculture in the desert through intelligent application of irrigation and information technology. Israel has literally made the desert bloom. With increased crop yields a new problem arise namely storage and retardation of spoilage. Again science and technology come to the rescue. Modern storage silos designs and chemical fumigation are available to facilitate long term storage without spoilage. A nation whose population suffers extensively from protein deficiency is unlikely to achieve meaningful economic development.

Abundant natural protein is available from meat, poultry and fish. But such natural protein must be free from communicable diseases. Achieving safe natural protein requires the application of scientific methods in animal husbandry, poultry and fish farming.

Recent scares about mad cow disease and the deadly avian flu brought these issues into the public domain in a very dramatic way. It became clear that we must employ science and scientist not only to help detect disease conditions but also help cure the disease and control its spread before a national epidemic ensues.

ENGINEERING

Modern engineering had many divisions which made impacted by scientific breakthroughs to varying degrees. Covering the entire spectrum of engineering disciplines will unnecessarily widen the scope of this paper. We will sample a few sub-divisions to highlight the impact of science in this area.

In general engineering is the practical application of implementation of the finding of basic science. Improvements in engineering products and services will come as a result of new scientific discoveries and innovation. Without science, engineering is essentially dormant and will soon become a victim of obsolescence.

(a) Civil Engineering

Civil structures continue to gain in innovations applicable to building materials and techniques. This made possible the construction of extremely tall structure over 1000 feet high. Some of these buildings are found in earthquake and hurricane regions. Thus they must withstand high vibrations and very high wind velocities. Nearer home our civil structures must maintain integrity in spite of heavy flooding and soil erosion. Our roads suffer rapid deterioration because of problems of mismatch of soil conditions and paving materials. Our scientists and engineers must solve this problem through basic science and engineering research. If we succeeded we can then sell the products and or services to other parts of the world faced with similar conditions. Solutions which are being applied in advanced countries may not be cost effective or affordable in our environment. For example in the United States most roads are built on concrete infrastructure. The initial cost is relatively high but the roads remain stable for much longer periods in spite of large temperature swings between the winters and summer seasons.

(b) Electrical and Mechanical Engineering.

Like civil engineering these two disciplines are relatively old and could be considered stable. But the impact of science is no less noticeable. Power generation is now possible from a variety of source such as nuclear energy, coal, wind, solar, gas, oil and hydroelectricity. The economics of each approach will depend on the specific application. Whichever approach we examine, science is constantly making it possible to realize higher efficiency and better economic viability.

In electric power transmission and distribution the application of computer technology in the switching and network inter-connectivity is yielding better optimisation to minimize unit cost.

Mechanical devices are more robust and reliable because of the use of new materials with improved structural properties. The result is lower energy cost and sharply increased mean time between failures. The use of composite materials in aircraft construction means stronger components, lighter weight and higher fuel efficiency. This is why resent jetliners are sharply more fuel efficient than the jetliners of the early l970s they are replacing.

(c) Chemical engineering

Many of the wonder materials of the mid to end 20^{th} century owe their development to advances in chemical engineering and materials science. Examples are nylon, Teflon, cellophane, PVC. There are hundreds of plastic materials used in appliances, plumbing, construction etc. the list is almost endless. As science and engineering match, on this list will continues to grow as newer and better materials evolve from the chemical and industrial laboratories.

(d) Computing and Telecommunication

The most pervasive and almost universal development of the late 20th century is first of all the development of the electronic computer and later its marriage to telecommunications to produce Information Technology. The digital revolution has so completely changed the world that it is inconceivable to imagine life without it. Yet the major changes crystallized around the mid 1960s. Modern television was invented around 1930, the first electronic computer at the end of world war II around 1945, the first transistor about 1948 and the first large scale integrated circuit and microprocessor about 1971. The rest as they say is history. The internet used universally today started in 1964 as a US Defence department project to enable staff working in various location using their local computers to share information in their computer files. Now it is impossible to imagine a world without internet or e-mail. This phenomenon aptly illustrates how a basic software project can be catapulted into a completely new industry encompassing the whole world. It has generated a lot of multi-billion dollar industries around the world and the end is not yet in sight. The marriage of computing and telecommunications to produce Information Technology (IT) is what has made possible;

- Mobile Communication and mobile phones
- Digital Satellite Networks
- Satellite Television

- On-line banking
- Internet Baking
- ATM
- E-commerce
- E-learning
- E-government etc

The information age is forerunner of the knowledge-based society. We no longer have nay excuse to be ignorant about any subject or about innovations wherever they occur. It we need to all that is required is to enter the information highway and access readily available information and data on our desired subjects.

(e) Industrial development

Science has always been the foundation for any industrial undertaking. This was the situation even in the pre-industrial revolution period. That close link has become even closer today. The rudimentary products come from basic research and discovery in science. Their refinements to make them fit for purpose again come out of more science and engineering and the cycle continues.

Products design, production and manufacturing techniques and processes require unrelenting scientific input. The innovators will always acquire the higher end of the value chain while the mere routine builders are left with the ruminants. As time progresses these routine builders face the risk of being replaced by other machines and robots who take no rest or vacations. Thus as production and manufacturing methods become more efficient, higher quality products come off the factories and assembly lines at very competitive costs. In an era of globalisation where the world is the market place these are the products likely to win. The resultants effect on the economy is profound.

Ready examples can be found in Asian countries and the Indian subcontinent. Today high quality and reasonably priced and competitive cars and trucks come from Japan and Korea. The Republic of Korea is now the world number two in ship-building even though the main company Daewoo is only about forty years old.

Korea has carved out a niche for itself in computer memories and large scale plasma television displays. Indian similarly has excelled in computer software. Today the biggest advances in electronics come from Taiwan and Mainland China. Such is the power of science and engineering that almost ninety percent of all components and devices used in building microcomputers, pcs and laptops worldwide are developed and made in a few factors in Taiwan and China. It is equally fascinating that this advance has all been made within the time frame of a single generation. The major computer manufactures like IBM, HP and Acer source their components and subsystems from these Chinese factories. So does our own OMATEK for our assembly lines and factories Nigeria and Ghana.

GOVERNMENT POLICY DIRECTIONS

We have established in the early part of this presentation that science plays a significant role in most area of economic activities. What then is the appropriate Government Policy to foster rapid national development? Our premise is the acceptance of science and its application as the basis for such development. Therefore we need those policies and practices which will encourage the application of basic and applied science through the country.

a. Education

Science must be given a pride of place in our educational institutions. Teaching of science must be compulsory in all our primary and secondary schools. The implementation of such a policy requires adequate investment in science laboratories, science books and equipment, and of course the recruitment and training of science Teachers. Ministries of education at the state and federal levels have the responsibility for planning and implementation of such a comprehensive program but suitable guidelines backed up with adequate funding is a pre-requisite. We propose that at least 60% of the total fund available should be devoted to science subjects across the board. This includes work programs in curriculum development, equipment of science laboratories, test centre, demonstration projects and computer assisted learning. To achieve greater cost effectiveness it is proposed that common programs be developed for use across the state or even across geo-political zones. This approach has been used successfully in multinational companies to develop computerised of the group operating in different countries around the World. Elimination of duplication or re-inventing of the wheel has resulted in huge cost savings of 40 to 60 percent in such applications. Additional cost advantage accrues when modifications become necessary to accommodate changes and new developments and business processes.

Exposure to science subjects should start in the second or third year of primary schools and increase in intensity as the students' progress through junior and senior secondary school levels. The focus on science should be supported by adequate incentives and rewards with the primary objective of reversing the current lop-sided enrolment against science and technology subjects in our tertiary institutions. The idea is to make science attractive, interesting and rewarding through appropriate re-branding and support.

Establishment and staging fairs should become an annual event in our junior and secondary schools. During such fairs students will be encouraged to present their science projects to compete for suitable prizes. The publicity and recognition at such events will serve as valuable motivation for students to excel in their chosen science subjects. In the spirit of private/public sector cooperation private companies especially those deemed to be potential beneficiaries of good science-based education will be encouraged to sponsor these science fairs. Appropriate fax incentives could serve as a good lever for such encouragement.

The tertiary institutions are in a special category because of their maturity and academic independence. But science-based programs and projects still be promoted through special grants and research sponsorships. The National Academy of Science, Medical Research Council and the National Engineering Academy can play a significant role in administering such sponsorships.

For example, many landmark research achievements in the United State originated through projects sponsored by their National Science Foundation either in basic science or specific product targets. Universities and other tertiary institutions should be encouraged to send their research project proposals to the appropriate academy where such projects are collated, prioritised and then sponsored in accordance with criteria developed from time to meet National Economic development goals.

b. Research Centres

Various research centres have been set up by the government in the past fifty years. These include

- Institute of Industrial research
- Institute for Oil Research
- Institute of Agricultural Research
- Medical Research Institute - etc,

We should ask whether these research centers have ever met the objectives for which they were set up. Or have the research centers really impacted positively the Nigerian economy? I suspect that we will invariably get mixed and debatable answer to these questions. I believe that the original objectives in setting up these centers' may be laudable but somehow the mechanism for assessing and utilizing their products is either not properly implemented or out of step with current economic realities. For example a Malaysian delegation came to study oil palms in NIFOR only for that country to emerge some years, later as the World's biggest producer of vegetable oil based on oil palms. Statistics have been published indicating that Malaysia earns more revenue from vegetable oil than petroleum products. I propose the restructuring of these centers to provide a linkage between the Universities, the Research centre and industry. The universities will cooperate with the research centres in basic research while the centers will market their products to industry for further development and commercialization. The government is expected to channel research grant through the universities from research centre while royalties will accrues to the centres and universities form industry on the development and process.

c. Science and Industrial Parks

States should consider setting up science and industrial parks where the basic infrastructure will be provided. Such infrastructure should include buildings, electric power, communication and computing facilities. These will serve as incubation centres where the results of basic research can be further developed until marketable products emerge. These will then be further refined and prepared for launching in the general market. Once a product reaches the general market phase it should leave the industrial park for its own factory so that new candidates can come into the incubation centre. This cycle should continue so that Nigeria can have a high prospect of carving out a niche or which will exploit strengths of our science and engineering expertise.

d. Patents Policy

The administration of patents if handled properly will provide additional incentive for competent scientist and inventors. Needed reforms must be carried out to align our policy on patents with best

international practices. A just and fair reward system will always spur rapid economic development. The go-getters and achievers in our midst must be allowed to benefit from their achievement. Their achievements must be protected to serve as worthy examples for others so that their ranks will continue to swell.

Under a fair patent policy a single invention which is made available to the general public may open a new development direction and generate other inventions. The multiplier effect of this process is a good recipe for rapid and sustained economic development. For much the same reasons our policy must protect intellectual property rights. Thus our copyright and trademark laws must conform to international norms. Our legal system must be strengthened to ensure that all infringements of patents, copyright and trademarks are diligently prosecuted whether or not these are owned by domestic or foreign innovators.

CONCLUSION

We have illustrated and drawn a correlation between advances in science and national economic development. Fortunately this country is endowed with brilliant men and women who have distinguished themselves in the physical, biological and medical sciences, engineering and technology. The country is also rich in natural resources. Therefore we have no reason to remain underdeveloped if only we apply suitable policies to harness the available talents to achieve meaningful and sustained development.

We can borrow a leaf from Asian tigers to seek our own for focused advancement. This is the challenge for our leaders in all tiers of Government. It is equally the responsibility of our business leaders. Through determination, appropriate policies and cooperation it can happen. Let that future of rapid and sustained national development built on a strong science foundation begin now.

ABOUT THE LECIURER

Dr. Timothy Oluwole Farinre studied Electrical and Electronics Engineering in the United States of America. He holds a Bachelor of Science degree (Highest honors) from the University of Pennsylvania, a Masters degree from Princeton University and finally a Doctorate degree from the University of Pennsylvania. After working for a number of years at the David Sarnoff Research Centre of RCA Corporation, he returned to Nigeria in December 1970 to join the Information and Computer Services function of the Shell Petroleum Development Company of Nigeria Limited.

He has held several senior positions for shell in Nigeria until January 1993 when he became Information Technology Manager combining responsibilities for the Computing and Telecommunications functions, a position from which he retired in August 1993.

He has traveled extensively in Africa, Europe, Middle East and North America. He is a Business/Management Consultant and is a seasoned investor with extensive interest in Banking, Insurance, Manufacturing, Healthcare, Information Technology, Oil and Gas.

He is presently the Chairman and Chief Executive of Olivet Enterprises Limited. He is a Director of several companies including Olivet Enterprises Limited, Bafic Investment Limited, Mark of Time Limited, Best Oils Limited, Joint Project Development Company Limited (a property investment and development firm), Kinley Securities Limited, Omatek Ventures Limited, Omatek Computers Limited, Sowsco Well Services Limited and Multinational Technologies Limited.

His hobbies include reading, traveling, swimming and playing squash.

He is married and blessed with six children.