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THE ROLE OF SCIENCE & TECHNOLOGY IN NATIONAL DEVELOPMENT: *The Miracle of Malaysia and the Future for Nigeria*[1*]

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[1] A Vision to be one of the top 20 economies of the world by the year 2020.

Abstract
This paper discusses the role of Science and Technology in the national development of Nigeria with an examination of Malaysia as a case history. Clearly, and incontrovertibly, we arrive at the conclusion that technology is the engine of growth. Within this framework, business and industry are the drivers, government is the catalyst and academics the fuel. Technology-based developments can occur only with concerted efforts to revitalize education, develop personnel, and create integrated industries that will involve close collaboration between government, industry/business and academia. Careful planning focused implementation and unwavering discipline form the tripod for successful technology-based development. If Nigeria can imbibe the discipline of Malaysia, it can equally achieve the miracle of development seen in Malaysia, and be able to realize her economic blueprint, vision 20-2020[2].

Introduction

I have often been asked why I am always passionate about Malaysia. The answer is simple. Malaysia shares some similarities with Nigeria apart from size. Like Nigeria, Malaysia was formerly a British colony and gained independence in 1957, three years before Nigeria. It is a multi-cultural society with three major ethnic groups, Malays, Chinese and Indians. Their economy at independence was dominated by the agricultural sector. In essence, both Nigeria and Malaysia have almost a similar beginning, but the difference is that Malaysia has been able to leverage science and technology not only for the diversification of the economy but also as a platform for the rapid transformation of the country to an industrialised nation status by the year 2020.

Malaysia has made significant progress in national development efforts. In the first 15 years of their Vision 2020 roadmap (which was launched in 1991), Malaysia maintained a steady growth in excess of 8% per annum, and have virtually transformed from an agricultural and commodity-based economy to an increasingly industrialised country. Obviously, the current global financial crisis would have slowed them, but the fact remains that the foundation has been laid. Nigeria also has a vision to be one of top 20 economies of the world by the year 2020. Nigeria therefore has a lesson to learn from Malaysia and other countries with similar development profiles.

From a personal experience, I spent eight and half years in Malaysia during which time I worked as Technical Advisor and Technology Custodian at PETRONAS, the national oil company of Malaysia. That was the period during which the company transformed from a National oil company to a full-fledged international oil company operating in many parts of the world. I came to Malaysia at the onset of their vision 2020 plan. I was therefore privileged to participate in the first phase of the implementation of the reform agenda. I will therefore in this paper attempt to explore the role that science and technology plays in nation building with examples from Malaysia that has effectively leveraged science and technology for national development.

Technology can be traced historically to the beginning of time to be man's quest to improve his way and quality of life. Technology is indeed the total and complete

[2] A Vision to be one of the top 20 economies of the world by the year 2020.

application of man's Knowledge, Skills, Tools and Materials. Naturally we ask ourselves, if natural instincts direct us and compel the application of technology for the wellbeing of man, why is it that humankind have not exploited this in equal capacity?

In this paper, I will also explore the role of technology in national development, examining the successes of many and failures of others in the quest for development and application of technology for their economic wellbeing. It is also pertinent to examine in particular how Nigeria can overcome the challenge of poverty and limited economic development. Essentially, technology will be proposed as the primary engine of economic transformation.

Science and Technology education holds the key to the present and future development of Nigeria or any other country for that matter. The sooner Nigeria realizes that her escape from poverty is predicated on her investment in science and technology education, the better for her. Prof. Alexander Animalu[3] said that there is a "technological power vacuum in Nigeria waiting to be filled by whichever geo-political zone that cares to mobilize its people through dedicated and selfless service".

In this paper, we shall understand education (formal or informal) to mean the process by which people acquire knowledge, skills, habits, values and attitudes. Science is a branch of knowledge that is concerned with the observation and classification of facts, and formulation of general truth. From the word science, comes scientists, the curious seeker of answers to the unknown in a methodical and orderly manner. By seeking the truth, we are able to free ourselves from the bliss of ignorance

Technology is the use of scientific knowledge to develop and produce goods and services useful to man. It is a practical problem-solving enterprise, which is propelled by scientific discovery or by societal needs. No doubt, our needs are many, and we must be propelled by the same measure. Science and technology education will not only prepare the youths of Nigeria and indeed any other nation, for fulfilling career prospects, but also train their minds to address social problems with scientific mind. Youths equipped with science and technology education are also endowed with high employment opportunities.

The Key Role of Technology in Societal Development

Technology plays a fundamental role in wealth creation, improvement of the quality of life and real economic growth and transformation in any society. The United Kingdom and France benefited immensely from the industrial revolution in the 19th century. Similarly, the United States emerged from an agrarian economy in the 19th century into an industrial superpower in the 20th century. More recently, Taiwan and Korea have exploited advances in silicon microelectronics from the early 1960's. China and India have emerged as industrial leaders in manufacturing and information technology respectively. Malaysia has followed in the footsteps of these later Asian successes.

It is to be noted that in the recorded achievements, all these countries invested heavily in people, factories and infrastructure that provided the foundation for today's industries. These successes were all based on carefully designed roadmaps of plans and strategies.

[3] Prof. Alexander Animalu of University of Nigeria, Nsukka, Nigeria, in a Distinguished Lecture in 2001

Unfortunately, however in many if not all the non-developed/"yet-to-develop" countries, technology is seen or viewed as a consumable item, and not something that can be produced or created.

Essentially, technology is the primary engine of economic growth. It is the key and fundamental requirement for value addition to raw materials and people. It provides the key to unlocking any country's potential in terms of decreasing overhead costs associated with outsourcing and creating employment opportunities. Common examples are:

- Bio and Nanotechnology areas.
- Basic needs arena (food, clean water, improved public health, shelter etc).

Analysis of technologically advanced economies shows that at each level of the economy, science and technology provide the engine for economic growth. For example, in the case of primary products, application of science and technology significantly increases the yield from agricultural production and mineral beneficiation.

Similarly, new and existing industries do stimulate economic growth at the intermediate level, while the overall volume of activity at the tertiary level is amplified by increased use of science and technology associated with information technology and improved distribution/ marketing networks. Therefore, the need for countries with the intention to grow, to invest significantly in science and technology cannot be overemphasized. This is achieved by developing the talent, the human capacity required to compete in a globally competitive world of today.

The Case Study of Malaysia

Malaysia's journey to reform can be traced back to the period immediately following their independence, a time they started the transformation to an industrial economy. The story of how they took the oil palm seedling from Nigeria in the 1960s, and then transformed to be the world's largest producers and exporters of palm oil is legendary.

The reform took a different momentum in the early nineties following the 1991 announcement by the Prime Minister Dr. Mahathir Mohammed at the Malaysian Business Council, of his thoughts on the future of Malaysia. The Prime Minister's speech, 'The Way Forward' encapsulated what is now known as Malaysia's Vision 2020. The objective of this vision is to transform Malaysia into an industrialised and a fully developed nation by the year 2020 (within a period of 30 years).

The Vision or the plan is being implemented in three interlocking phases, as follows:

- Short-term Plan: 0 – 5 Years – BUILDING THE FOUNDATION
- Mid-term Plan: 5-15 Years -- LEVERAGING TECHNOLOGY
- Long-term Plan: > 15 Years -- GLOBAL COMPETITIVENESS

Leveraging science and technology was seen as a key component of the plan, and this has led to the desired economic growth and transformation and the country is on the last leg of becoming a developed nation by the year 2020.

Here are some examples of how Malaysia has transformed some sectors of her economy, notably oil and gas, agricultural sector and growth of small and medium scale industries, through effective use of technology.

Oil and Gas (PETRONAS)

Petroliam Nasional Berhad, PETRONAS, the Malaysian state owned oil and gas company, by consistently applying selected new and proven technologies, has put itself in a state of rapid growth and expansion, adding value to the company's business. This achievement was propelled by the realization that technology advances were critical to economically developing hydrocarbon reserves in complex settings and hostile environments. Furthermore, state-of-the-art technology would provide much needed opportunities for keeping current operations profitable as they reach maturation and beyond.

As the Technical Advisor and Technology Custodian for PETRONAS in the early nineties, I emphasized and advocated that technology is not static. In fact it is extremely dynamic, and the company's continuous adaptation to its application would be the key to success and continued growth. Consequently, the company must position itself to take advantage of new technology for the benefit of the company's domestic and international competitiveness. The company and indeed any company must be technologically competent in order to compete effectively.

Technology is achieved through a combination of knowledge, Methods, Tools and Skills.

This four-element definition of technology offers the details and clarity required for technology enhancement planning that must necessarily include knowledge and skills upgrade (training) and acquisition of methods and tools including hardware and software systems. The idea here is the understanding of human elements (knowledge and skills) and the tangible elements (methods and tools) of technology. Accordingly, it was essential to enhance the capabilities of the staff on one hand, and on the other hand to acquire the necessary tools and methods.

In 1993 and 1994, an assessment of the PETRONAS' technology level was carried out by the company's experienced managers and senior line staff under my leadership as the technology champion. The result indicated that in most areas, technology was assessed to be of the proven type. The mission therefore, was to apply base and key technologies and move from the then company's weak position to a strong position by the turn of the century.

The next step was to develop a realistic plan to upgrade the expertise and technology in the areas identified. The plan was implemented under the understanding that technology has some human elements (*knowledge and skills*) and some tangible elements (*methods and tools*).

PETRONAS' objectives were multi-fold, including for staff to become more knowledgeable. In addition to other industry programs, the company intended to enhance its level of technology through:

- individual development
- individual technical skills
- knowledge upgrade through formal training.
- Secondment to Joint Venture partner's organizations for knowledge imbibitions and technology transfer.

In addition, strategic alliances and partnerships for technology acquisition was emphasized and preferred. The implementation of the above in PETRONAS gave rise to the company's successful global operations. Thus justifying the belief that technology-driven initiatives would help the company and the country to significantly enhance their asset base, improve staff efficiency and productivity and create value. Alliance was center point of PETRONAS Technology Plan for the remainder of the 21st century and beyond. The success of this partnership and the huge value it has brought to Malaysia should serve as serious incentive for non-developed countries' emulation of it.

In an address entitled "Performance Challenge" to launch the Technology Enhancement Initiatives, the Managing Director of PETRONAS, Dato' Mohammad Idris Mansor, recognized that technology would be the key to the company's continued success in the near and long term, and accordingly called for focus of attention on technology development/acquisition and its application in order to maintain a competitive edge and create value for stakeholders.

The results of the company's successful global operations have justified the belief that new technology-driven initiatives would help the company and the country to significantly enhance their asset base, improve staff efficiency and productivity and create value. The oil industry plan was then integrated into the National Business Plan for Malaysia in what is known as "VISION 2020" – a roadmap to the country's transformation to a developed nation by the year 2020.
The strategy for the plan implementation is as follows:

- Establish a plan to develop industry sectors and employment opportunities for sustained growth.
- Develop suppliers capable of expanding outside of the oil and gas industry.
- Monitor and encourage competition.

The National Business Plan has a full and comprehensive Personnel Development and Education Plan whose principle was to create educational and development opportunities to broaden in-country technical and business skills. The Strategy for implementation includes:

- Investing in technical and business education to build a competent local workforce.
- Supporting the efforts of international companies operating in the country to integrate qualified local personnel into all aspects of development and operations.
- Emphasizing proficiency in international business languages.

The plan has a principle to leverage expertise and capital from international organizations in order to transfer knowledge and build in-country capabilities through:

- Promoting long term partnerships between international and national companies (for oilfield supply and service sector development);
- Ensuring transparency in procurement process; and
- Maintaining long term focus to realize positive return on supplier development investments.

As a result, the Malaysian state owned oil company, PETRONAS, by consistently applying selected new and proven technologies, has put itself in a state of rapid growth and expansion, adding value to the company's business.

This achievement was propelled by the realization that technology advances were critical to economically developing hydrocarbon reserves in complex settings and hostile environments. Furthermore, state-of-the-art technology would provide much needed opportunities for keeping current operations profitable as they reach maturation and beyond.

The entire Malaysian oil and gas industry has been effective in transfer of technology and in expanding involvement by Malaysians in the industry.

PETRONAS has been successfully transformed from a national oil company to a fully fledged international oil company now operating in over 30 countries of the world, providing leadership in Oil & Gas Exploration, Production and Petrochemical businesses.

The Agricultural Sector

Notable impacts of technology on national development are best illustrated with the "Palm-Tree" value chain in Malaysia.

Malaysia imported the palm seedling from Nigeria in the early sixties and through well planned research and development and technology applications, they have developed commercial values from agricultural growth of the entire palm-tree.

The Palm fruit was significantly enhanced to yield large quantities of palm oil, palm kernel and large shell.

Apart from commercial industrial uses of palm oil, through Research and Development (R&D), palm oil was converted into an environmentally friendly and biodegradable drilling fluid- "Petrofree" which sells for more than $40/barrel. Palm kernel is also being converted to industrial uses in soap, detergent and animal feed. The broom stick derived from the frond is crushed and compressed to make high quality table tops in furniture and car seat manufacturing. The interior of the palm trunk is treated with protein and converted to animal feed.

In effect, by appropriate R & D and technology applications, the Malaysians demonstrated success in taking the palm raw materials through secondary and tertiary processes that yield significant value.

Growing SMEs through 'Technopreneurship'

The Malaysians have continued to innovate themselves to impressive national development. The Ministry of Science, Technology & Innovation, in conjunction with private sector partners, launched the Technopreneur Development Division (TeDD) in November 2001.

Technopreneurship is a combination of "technology" and "entrepreneur". It is "a technology innovator and business man rolled into one"; or better still "an entrepreneur whose business involves technology related activities".

The objective was to facilitate the development of technopreneurs, start-ups and existing information and communication technology companies; to catalyze and nurture a cluster of ICT SMEs into world-class companies. Currently, there are well over 50 incubators in Malaysia's technology park, providing funding, facilities, mentoring, training, etc.

The government believes that developing technopreneurship is crucial in placing Malaysia amongst world-class, high-tech nations, while also enhancing wealth and employment creation.

The Asian experience of tehnopreneurship success includes India where the Indian Ministry of Science & Technology in conjunction with related agencies launched a novel programme known as "Technopreneur Promotion Programme (TePP)". Under the programme, any Indian having an original idea/invention can apply.

Selected proposals/ideas are converted into working prototype and from there a profitable business is generated, with the inventor enjoying patent rights. The objective of the TePP include to tap the vast innovative potential of the Indian citizens and to promote individual innovators into technology based entrepreneurs by helping them source for

finance and other needs. It has helped establish thousands of Indian Technopreneurs whose dream and vision would have died but for the support.

The future of Nigeria may also lie in technopreneurship. Technopreneurs are naturally gifted, smart, creative, but not necessarily formally educated; aggressive young men and women passionate for success; mostly assemblers and at times innovators, and they can be found in most commercial cities in Nigeria (Otigba in Ikeja, Aba, Ibadan, Nnewi) etc. Nigerian technopreneurs should be empowered "to thrive, for their good, for our good and for the good of the entire economy".

The Nigerian Situation

From its creation in 1914 until present times, the government of Nigeria has never had a sustained focus on the development and application of technology for the transformation of the national economy. The education curriculum was not designed to deliver leadership base in science and technology as basis for progressive national development. This led to nationalists to clamor for modifying the school curriculum.

Led by Dr. Nnamdi Azikiwe, the leading nationalists attacked the University College, Ibadan "the million dollar baby", as academic, classical, expensive and utopian. They observed that while programs existed in the college for training Nigerians in Greek and Latin, no serious programs existed for training Nigerians as Engineers, Scientists and Technologists.

They were anxious to establish a national University with practical oriented curricula. In fact, quoting from the publication "The Origin and Philosophy of the University" the author, *Professor B. I. C Ijomah*, said of *Dr Azikiwe* that the main point that was made in the latter's 1937 book "Renascent Africa" was that there was no indigenous University in Africa which could reflect the culture, values and aspirations of Africans as advocated in 1920, by a group led by Ghana's *Casley Hayford*. Thus, *Dr Nnamdi Azikiwe* was determined to found an African University in which Africans would study in an African environment and within curriculum that will usher technology in the National mindset.

Those aspirations have been fulfilled in the creation of schools and curriculum in many of the nation's institutions of higher learning, including the establishment of the Faculty of Engineering at the University of Nigeria, Nsukka (UNN) thus putting UNN in a technology leadership position. Many other universities with engineering and technology curricula followed, including notably the creation of Faculty of Technology in the University of Ibadan.

In the 1970's there was a lot of debate concerning the preparedness and technological take-off of Nigeria. At a conference on Development of Indigenous Technology at Enugu (February 1981), Egbogah presented "Minimum Necessary Conditions for the Technological Take-off of Nigeria", presenting analysis of the lopsided nature of Nigeria's development in technical education (mainly at the Yaba College of Technology, Lagos, Nigeria) where there was an average of 1 technician/technologist to about 9 engineers in Nigeria, exactly the opposite required for technological development of any economy.

The situation has worsened today as many vocational and middle level manpower development institutions, the polytechnics (Yaba College of Technology and Kaduna Polytechnic, and others as currently being proposed) are being converted to degree-awarding institutions. Historically, no economy has ever become developed with this skew in their system of education and training for national manpower supply and/or human capital development.

The utter disregard for science and technology education as an instrument of development has caused incalculable damage to our corporate existence. The problems of mismanaged economy, mass unemployment, collapse of health and educational services, insecurity, inflation, collapsed infrastructure, etc can all be traced to the inadequate attention paid to science and technology in Nigeria. It is the lack of science and technology initiative by Nigerians that has led people to turn their energy to the lust for power, greed and self-destruction. Sadly enough, every Nigerian finds every other person guilty as charged, except himself or herself.

Government's policy on education has among other issues emphasized but not driven the following objectives:

- The training of the mind and the acquisition of appropriate skills, abilities and competencies – both mental and physical – as equipment for the individual to live and contribute to the development of the society.
- Ensuring that all schools are properly equipped to promote sound and effective teaching, and in particular, that suitable textbooks and libraries are provided for schools.
- Secondary education should be six-year duration and be given in two stages, a junior secondary school stage and a senior secondary school stage. The junior secondary school (3-year duration) will be both pre-vocational and academic. It would be free. The senior secondary school would be for those ***able*** and ***willing*** to have a complete six-year secondary education.
- A greater proportion of education expenditure would be devoted to science and technology and a greater attention paid to the development of scientific orientation.
- The ratio of Science to Liberal Arts students in the Universities was fixed at 60:40.

However, it is common knowledge that three decades after these objectives were set out to improve the standard of education in the country, not only have none of the objectives been realized, but also the standard of education has fallen far below what it was before.

Some aspects of government's policy on Science and Technology which are relevant to our discussions here include:

- Science and Technology shall form the basis for our development and shall influence our thinking and working processes.
- We must ensure adequate development of manpower in Science and Technology to guarantee the efficient utilization of abundant natural resources and reduce the drain on our treasury, and independence on outside sources for industrialization.
- The nation should be technologically self-reliant in the production of capital and consumer goods and raw materials.

- The educational system shall emphasize science at all levels and re-orient the entire society towards scientific thinking in order to develop new technologies and adapt existing ones to improve societal well being and security.
- Major government projects involving imported technology shall be procured in an unpackaged" form.

How Then Can Nigeria Be Technologically Self-Reliant?

Instead of procuring the "unpackaged" form of technology, as stated in the policy framework, Nigeria not only buy "packaged", but "packaged, polished and sealed" technologies, thereby foreclosing any idea of adaptation. This has to STOP as technological institutes should lead the development and/or refinement of new technological break-through fit for the Nigerian environment.

Frustrated out of the system by lack of facilities to work with, Nigerian intellectuals and professionals have been seeking and receiving refuge abroad where facilities are provided and their services and contributions appreciated.

A Development Strategy for Nigeria

To imitate the success of Malaysia, a three-phased strategy mentioned earlier is proposed for the development of Nigeria, but the duration is adjusted to fit the remaining timeline to 2020 and immediately afterwards. This will assure that short term and medium term phases will produce significant economic growth along with increased employment and prosperity.

The short/medium term strategy should focus on the development of value addition through minerals and agro-processing. These are the niche advantages for Nigeria, which is a country that is endowed largely with fertile land and a rich array of mineral deposits. The main focus should be how to develop local expertise and local companies to extract and process oil and minerals such as gold, platinum, anthracite, bitumen, tantalite-columbite, tin and many gemstones that are currently untapped.

Real industries need to be organized around these materials in ways that add value to extracted materials. In the case of bitumen, for example, Nigeria has enough bitumen in Okitipupa and surrounding areas to tar all our bad roads. The rest could be sold to regional markets in West Africa and beyond. Similarly, our local clays could be used to make ceramics for household goods and liners for furnaces and insulators.

Conclusion

In this paper we have discussed some ideas on the role of Science and Technology in the national development of Nigeria with an examination of Malaysia as a case history. Clearly, and incontrovertibly, technology is the engine of growth. Within this framework, business and industry are the drivers, government is the catalyst and academics are the fuel. Technology-based developments can occur only *with concerted efforts to revitalize education, develop personnel, and create integrated industries that will involve close collaboration between government, industry/business and academia.*

It is the Malaysian model that we here advocate for Nigeria, a model whose success in the world is incontrovertible and admirable.

When I went to Malaysia in 1991, PETRONAS was a US$5.7 billion local company, but today it is it is No 93 in the list of the world's 500 fortune companies and diversified with

over 100 upstream and downstream companies, including aircraft manufacturing division. It now operates in over 30 countries of the world, providing leadership in oil and gas exploration, production and petrochemical businesses.

If we can imbibe the diligence and discipline of Malaysia, we can duplicate their stunning success and with reliance and focus on science and technology, can achieve the nation's vision 20-2020.