

ENGINEERING AND TECHNOLOGY: A STIMULATING TRANSFORMER FOR NATIONAL DEVELOPMENT

France O. Akpojedje¹, Yussuf O. Abu² and Monday E. Onogbotsere³

¹Department of Electrical/Electronic Engineering Technology, National Institute of Construction Technology, Uromi, Nigeria.

²Department of Science Laboratory Technology, University of Benin, Benin City, Nigeria

³Department of Electrical/ Electronic Engineering, Delta State Polytechnic, Oghara, Nigeria

Abstract: This paper aims at x-raying "Engineering and Technology" as a stimulating transformer for national development. The present state of engineering and technology, issues, challenges and setback were critically reviewed to see their shortcomings, strength and prospect offered to national development. From the survey carried out, it was revealed that there were lapses and shortcomings in the development of appropriate engineering and technology in Nigeria that will transform meaningful national development. The paper then, further proposes national development building model and way forward in enhancing the national development through the application of appropriate engineering and technology.

Keywords: Appropriate; Engineering and Technology; Model; Science; National Development; Transformer; stimulating

I. INTRODUCTION

Engineering and technology are considered to be the key factors for stimulating national development. The development of any nation depends on the level of engineering and technological transformation and their dependency for its productivity. Hence, the concept of local technology and engineering transformation in Nigeria and her counterpart nations in Sub-Saharan Africa is inevitable, if the fortune of the region must change in terms of nations building and development [1]. Engineering and technological development are generally regarded as catalyst for national development because they offer among other things: the necessary support for change in all the major sectors of the economy, most especially in agricultural and industrial sectors [2]. Therefore, engineering and technology are unarguably the prime source of change, that is, of innovations and improving production methods needed to propel growth and development of any nation [2].

One of the foremost issues facing the engineering and technological advancement in Nigeria and her counterpart nations in Sub-Saharan Africa and Africa at large is the failure of the governments, stakeholders and the people of the region to thoroughly examine the viability of local engineering and technological knowledge in the region [1].

The answer to this fundamental problem is that the local technology and engineering practices should be given critical consideration by all stakeholders and the appropriate place they deserve [1]. It has been noted by some scholars that local knowledge in engineering and technology should serve as the basis for engineering and technological development for any nation [3].

The use of indigenous engineering and technologically based viable alternatives to transform key sectors for wealth creation and development in the third world while developing competent, resourceful and skillful man power that can add value to the engineering and technological development cannot be over emphasized [4] in national development.

Sustainable development is an evolving process which involves the judicious use of available local engineering and technological knowledge to create wealth, raise the standard of living of people, and enhance economic and social prosperity for both present and future generations in a secured environment [4]. The concept of modern indigenous engineering and technological inventions if prudently exploited will minimize waste, poverty and maximize value in critical sectors [4] of the economy for national development. Hence, there is the need to critically review the terms "Engineering" and "Technology" and its importance to national development.

1.1 ENGINEERING

Engineering is one of the oldest professions, along with divinity, medicine and law [5]. While the linear model has led to the perception of engineers as an applied science [5], engineering is distinct from but related to science, and in fact predates science in the use of the scientific method - engineers were the first scientists [5]. Science is the pursuit of knowledge in its purest sense without any concern to the needs (or interpreted needs) of society, whereas engineering is the combination of both [6]. Engineering connects pure science to society unlike science [6]. According to Oxford Advanced Learner's English Dictionary "Science is a knowledge about the structure and behaviour of the natural and physical world, based on facts you can prove while engineering is the activity of applying scientific knowledge to the design, building and control of machines, roads, bridges, electrical equipment, etc". Hence, engineering can be accepted as the application of scientific knowledge to meet man needs. According to wikipedia [7], "Engineering is the application of Mathematics and scientific, economic, social, and practical knowledge in order to invent, innovate, design, build, maintain, research, and improve structures, machines, tools, systems, components, materials, processes and organizations". From the definition of engineering, engineering is a vital tool for national development. Consequently, if a nation must develop, then engineering must be given its rightful place it deserves. According to Unesco Report [5] "Engineering is the field or discipline, practice, profession and art that relates to the development, acquisition and application of technical, scientific and mathematical knowledge about the understanding, design, development, invention, innovation and use of materials, machines, structures, systems and processes for specific purposes".

The term "Engineering" is derived from the word "Engineer" used in the 1300s for a person who operated a military engine or machine - such as catapult or, later, canon etc [5]. So, who is an Engineer? According to Oxford Advanced Learner's English Dictionary, "An Engineer is a person whose job involves designing and building engines, machines, roads, bridges, etc or a person who is trained to repair and controls engines". The word "engine" in turn derives from the latin word ingenium for ingenuity or cleverness and invention [5]. While meanings change, the concept of engineering derives from the dawn of human history as our ancestors developed and designed tools that were essential for their survival [5].

Science and engineering are essentially part of the same spectrum of activity and need to be recognized as such; while engineers use both scientific knowledge and Mathematics to create technologies and infrastructure to address human social and economic issues, and challenges [5]. Engineers connect social needs with innovation and commercial application [5] for national development.

The engineering profession plays a major role not only in the growth and development of a country's economy but also improving the quality of life for its citizens [5]. The linkage between a country's indigenous engineering capacity and its economic development [5] is inevitable and cannot be overemphasized if the country fortune must change in terms of economy and infrastructural development. The Engineers are people who are qualified in or practice engineering [5]. While technological change and innovation is one of the major drivers of economic, social and human change; so engineering, technology and the social sciences are more closely connected [5].

1.2 TECHNOLOGY

Technological development and management are considered to be key driving force in the development of any economy [8]. The economic growth of both developed and developing countries depends on it [8]. Hence, the concept of technology as a transformer for national development is jaded if not considered as a critical factor or element to be tackled by stakeholders in any nation. Consequently, what is technology? According to Oxford Advanced Learner's English Dictionary, technology is defined as "Scientific knowledge used in practical ways in industry, for example in designing new machine". But the term technology has different representations and meanings to different people and their culture. Also, according to abdukkaream, technology is defined as the "Art and science of applying man's knowledge in human endeavour's so as to satisfy man's needs" [9]. The International Technology Education Association defined technology as the "Use of knowledge, skills and resources to meet people's needs and wants by developing practical solutions to problems, taking social and environmental factors into consideration" [10]. Furthermore, Ibeanu and Okonkwo [3] defined technology as the "Systematic knowledge and action usually of industrial process but applicable to any recurrent activity". They went further to say that by application; technology utilizes knowledge acquired and experience gained to satisfy man's needs. Therefore, technology is a scientific knowledge aimed at satisfying the basic man's needs [3]. It is classified into three broad categories [3]:

- i. The human-embodied technology such as skills, knowledge and experience,
- ii. The capital-embodied technology such as machines, equipment and tools, and
- iii. The disembodied technology, which includes blue-prints, products and products specification.

In totality, according to Akpojedje and Abu [1], "Technology can be accepted as putting human knowledge, acquired skills, experiences, philosophy and resources to meet people's or communities needs and wants".

1.3 THE PRESENT STATE OF ENGINEERING AND TECHNOLOGY IN NIGERIA

The present state of engineering and technology in Nigeria is regrettable because over decades of existence of Nigeria, she still largely depend on foreign borrowed or imported

machines, goods and technological needs. In the midst of numerous and abundance of natural resources, and human capital, Nigeria still wallows in a state of quagmire in engineering and technological sector as seen today. It is bothersome and worrisome that Nigeria as a giant of Africa as they say; cannot produce its required goods and services through indigenous engineering and technology; all machineries and equipment used today are imported.

Today in Nigeria, especially the North East, Boko Haram has been invading various villages in Borno State, Yobe State etc with sophisticated weapons while the Nigerian government is looking for countries that can sell fighting jet for her military when the French nation jettisoned their initial offer to sell their fighting jet produced by America.

In the midst of abundance, Nigerians wallow in abject poverty and today, recession has gripped the Nigerian economy; all as a result of under utilization of abundance of natural resources through engineering and technological means.

Nigeria as today is a consuming nation and not a producing nation. Nigeria has been turned to a dumping site where all manner of engineering and technological productions are being dumped for usage. This situation is in the presence of abundant human and natural resources.

The true picture of Africa States was painted by the Prime Minister of Israel in the year 2016 and the causes of the underdeveloped state of the region was brought to limelight, with a clearer view pointing to Nigeria true state. According to the Israeli Prime Minister, Benjamin Netanyahu [11], "Let us all accept that the black man is a symbol of poverty, mental inferiority, laziness and emotional incompetence; give them money for development they will fight and create hatred and enmity for themselves". He then went further and said as well that they (Africans) have minerals but they cannot do anything with it [11]. Wrapping up, according to Akpojedje and Abu [1], "The Sub-Saharan Africa Region and Africa as a whole is abundantly blessed with natural resources that can be properly harness through appropriate engineering and technology to transform the fortune of the region". From statistics of the total world mineral resources, Africa mines 90% of the diamond marketed, 81% of cobalt, 62% of platinum, 70% of gold, 50% of magnesium and chromium, 30% of copper, 66% of the world cocoa produce, 66% of sisal, 95% of groundnut, 25% of coffee, beans, cotton and other rich reserves of coal, oil and iron ore [12]. Figure I below shows the percentage of Africa mines of the world total mineral resource [1]. Despite these abundant natural resources in Africa, Africa contributes only 2% of the total industrial output of the world's market economies [12]. This is due to the inappropriate transformation of local engineering knowledge and technology [1].

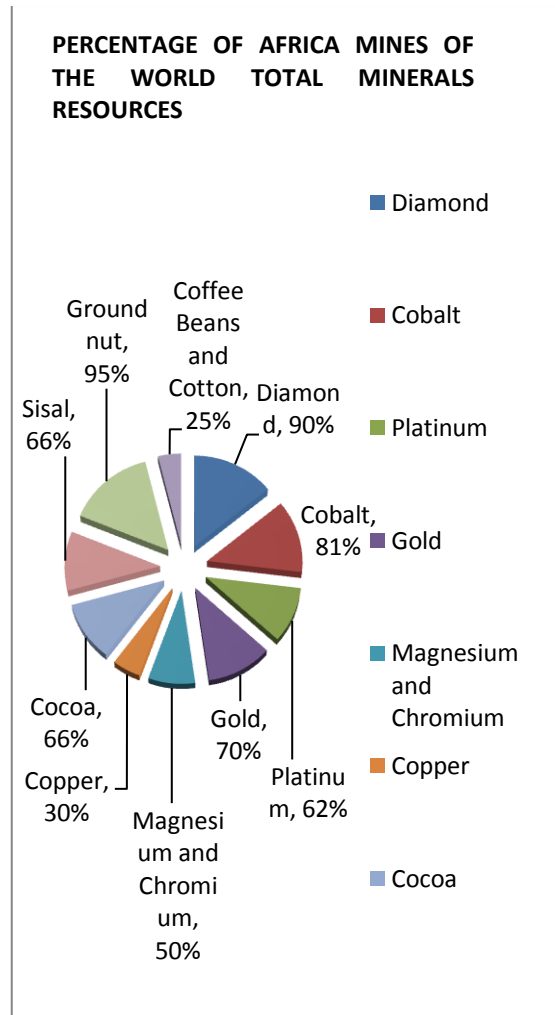


Figure I: Percentage of Africa Mines Natural Resources, Source: [1]

Therefore, we can say as at today, despite the enormous availability of natural resources and human capital, the engineering and technological development in Nigeria is grossly low and inadequate to drive meaningful national development and productivity. A nation is said to be technologically backward and its engineering sector is in bad shape if [1]:

- i. it is unable to produce her own military hardware with which to defend herself, if the need arises
- ii. it depends on other countries for the supply of spare parts for industrial machinery
- iii. it is unable to explore and export her natural resources except with the help of expatriates (Foreigners)
- iv. it cannot produce capital goods such as tractors, lathe machines, milling machines, drilling machines, cars, trains and other earth moving equipment.
- v. it exports her raw materials to other nations as against finished product.

A critical examination of Nigeria state reveals that all points itemized above are present in the Nigeria as a country today [1]. According to Donald Trump [13],

"There is no shortcut to maturity and in my view, Africa should be recolonized because Africans are still under slavery". In my view, the slaving of Africans is mental and leadership slavery. The picture painted by Netanyahu and Trump on Africans is a true reflection of the Nigeria state today where Nigerians wallow in abject poverty because of misappropriation of engineering and technological priorities. Nigeria will continue to wallows in abject poverty and remains underdeveloped until engineering and technology are given their appropriate priority and the right place they deserved.

1.4 FACTORS MILITATING AGAINST ENGINEERING AND TECHNOLOGY IN NIGERIA [1]

As a matter of fact, the factors militating against the engineering and technological advancement in Nigeria to drive meaningful national development are enormous. It is important to recap here that engineering and technology are the stimulating transformer for national development. Consequently, the following are some factors being highlighted that are pressing against social, economic growth and national development.

- i. **Infrastructural Decadence:** The rate of infrastructural decay in Nigeria public infrastructure and her counterpart nations in Sub - Saharan Africa posed a prime frustration to the local (indigenous) technological development and advancement in the region. The pace at which public infrastructure decay in the region is bothersome. A state where there are no good public facilities such as good roads, pipe borne water, good schools, good library of world class standard, healthcare etc. Since they are in a state of decadence, They have led to struggle and frustration of the development of local technology in the region.
- ii. **Inadequate Synergy:** The synergy between the industries and academic institutions in the region is inadequate to foster technological development. In Nigeria today, there is no proper or serious synergy between the industries and research institutions as it stands now. This lack of synergy has lead many good types of research and inventions in the institutions to end up in the office shelves of the researchers in the research Institutes. This is because the government has not created the enabling environment for the bilateral relationship.
- iii. **Over - Reliance on Foreign (Imported) Technology:** The over-dependent on imported technologies constitute a serious threat and setback to the development of indigenous technology [14]. Consequently, most of the technology in the markets of developing countries in Sub - Saharan Africa are imported (foreign) [14]. In other words, many Nigerians and people of her counterparts in Africa are just like the people of India having a penchant for foreign technologies [14].
- iv. **Non - Commercialization of Academic Research:** The non - commercialization of academic research from institutions is a prime challenge. Today, academic research papers and publications are obtained mainly for the purpose of routine academic promotions and recognitions. But the producer/user synergy and bilateral relationship determine the commercial values of these research papers. The commercial values of most research papers and publications are very low and less market value in relation to the industries.
- v. **Operations of Research Institutes:** Almost all the research institutions and other higher research institutes operate and conduct researches outside the relevance of industries today; perhaps one of the prime reasons industry/academic synergy remains very weak today in the Sub - Saharan Africa.
- vi. **Inadequate Funding:** The inadequate funding of engineering and technological institutions and other research Institutes is a major setback factor to technological development in the region. The funding of technological sector in Sub - Saharan Africa is grossly poor. In the case of Nigeria for instance, between 1985 and 2000, research funds averaged only 0.08% of the Gross National Product (GNP) and this is a far cry from the UNESCO recommended target of 1.0% [15 &16].
- vii. **Exploitation of Knowledge:** The exploitation of indigenous knowledge and technology by foreign technologies [14], is another setback to technological drive in the region. A case study of Kinodo basket of Kenya. Though the basket was weaved and used in the Kikugu and Kamba communities but the Kenya communities received none of the proceeds that accrued from the trade [14].
- viii. **The Death of Unwritten Technology:** Most local technology is unwritten and if not transferred; by the time the man (originator) dies, the technology dies with him/her. The Sub - Saharan Africa has lost indigenous technologies and knowledge through the death of this unwritten local technology originator.
- ix. **Low Human Capacity Building:** The failure of the government to recognize potential local technology within the region and encourage it by adequately supporting the local intellectuals has led to the low human capacity building in the region. This has exacerbated the backwardness of local technological development and drive in the region of Sub - Saharan Africa today.
- x. **Policy Instability:** The instability of government system in policy making and keeping (continuity) has jeopardized the development of local technology in the region due to lack of continuity in the governmental system in the region. One government will make policy and

another will step - it down. This has grossly hindered local technological advancement in the Sub - Saharan Africa.

- xi. **Moral Decadence (Corruption):** Corruption is like a cancerous plague that has eaten deep into the Sub - Saharan Africa nations. It is generally known that Nigerian government measures progress and achievements in terms of funds allotment [2], but what they do with this funds allocated or shared are not accounted for. This has led to serious corruption in the governmental system in the region which has grossly hindered the advancement of local technology in the region.
- xii. **Poor Patronage of Local Technology:** The goods manufactured using traditional (local) technologies has been jettisoned by individuals and government from the region. There is low patronage from locally made goods from the region and this has led to low morale of local intellectuals and also, hindered the advancement of local technology. Although, recently in Nigeria, the government and individuals have started campaigning for locally made goods patronage which is a welcome development.
- xiii. **The Attitude of Government:** The attitude of government towards potential local knowledge and technology in Sub - Saharan Africa is worrisome today. They failed to recognize potential local technology and knowledge, like the case of Boko Haram and the Niger Delta activities in the North - East and South - South respectively of Nigeria where mini industries were setup to produce "Improvised Explosive Device (IED)" in the North - East, and illegitimate oil bunkering and mini-refineries in the South - South of Nigeria. These negative activities can be a blessing in disguise if the government of the day can properly transform and channel these local knowledge appropriately.

1.5 RELEVANCE OF "APPROPRIATE ENGINEERING AND TECHNOLOGY" (AET) TO NATIONAL DEVELOPMENT

The importance of appropriate engineering and technology to national development and socioeconomic well-being cannot be overemphasized. "Engineering and Technology" is the major key player for transformation of any nations development. The fusion of the relevant of both indigenous and modern technologies is what is popularly referred to as "appropriate technology [17]". According to Essien [17], "Appropriate Technology" stresses the socio-cultural and environmental importance of both indigenous and foreign technologies. Hence, appropriate engineering and technology is the application of engineering and technology at the simplest level that can effectively achieve the intended purpose in a given locality or nation. The development of any nation is always linked with the application of appropriate engineering and technology. According to Onipede [2], "Technology Development" is

generally regarded as a catalyst for national development, because it offers among other things the necessary support for change in all the major sectors of the economy, most especially in agricultural and industrial sector.

Therefore, it is unarguably the prime source of change; that is, of innovations and adaptations required for improving production methods needed to propel growth and development [2]. It is a well known fact that technological advancement divorced from its cultural context, is destined to grow without a soul [17]. "What actually makes the best economic sense to national development is to combine foreign and local technological elements by balancing the two for a better result [17]". In fact, the best appropriate technology is the combination of local and imported technology to built human capacity for progressive national development.

The development of a nation does not depend on the abundant of raw materials deposited or available, rather by their ability to utilize the available materials [12] for national development through appropriate engineering and technology. The available or abundant natural resources and materials become relevant to national development if the people or citizens have the capacity to identify and convert the resources for wealth creation and development.

There is an apparent dearth of engineering and technology entrepreneurship capital in Africa; a situation that has led to the near non-existent productive capacity of the continent, with very minimal potentials for value addition [4]. The result of the foregoing scenario is low capacity for wealth creation and increasing levels of unemployment [4]. Entrepreneurship (especially technological entrepreneurship) and innovation (technological innovation) are the twin pillars of socio economic development in this modern era [4] since, knowledge and innovation are the two key drivers for sustaining economic growth in the 21st century [4]. Then, Nigeria should key into harnessing its strong appropriate engineering and technology for foundational ecosystem to industrialize relevant research with a strong focus on commercialization, and to extend the ecosystem to facilitate innovation and enterprise [4] for national development.

1.6 ADAPTATION AND DEVELOPMENT MODEL OF "APPROPRIATE TECHNOLOGY" (AT) FOR NATIONAL DEVELOPMENT

The concept of "Appropriate Technology" or intermediate technology was promoted by E. F. Schumacher from 1950s through the 1970's, culminating in the publication of his book titled "Small is Beautiful" [18]. The term appropriate technology is typically used in two contexts [18]:

- i. The most effective technology to address the needs of developing areas
- ii. Socially and environmentally acceptable technologies in industrialized nations.

Schumacher's term "Intermediate Technology" is similar to appropriate technology; it refers to tools and technology that are significantly more effective than traditional methods, but still an order of magnitude (one tenth) cheaper than developed world technology [18].

The developmental processes of appropriate technology can be mirrored as a cyclic process [1]. Most of the developed countries advance their technologies through the adoption of the spiral process model cyclic during the developmental stages. The technological innovation of most advanced countries pass through this cyclic process [1]. First, the local firms start their technology innovation process from international transfer of technology, implementation or duplicative imitation. Second stage is the adaptation of the imported technologies by assimilation and make it more improved and developed, which is sometime called creative imitation stage [19]. According to Park, Ali, and Chevalier [19], "These imported technologies are further improved upon by processing the imported technologies using their own indigenous knowledge, local initiatives and technological capabilities"; and this is done using the spiral process model of technological advancement. Also, according to Park, Ali and Chevalier, countries like Japan, Korea, China, Singapore and Taiwan have developed their local technology to advanced stage through the adoption of this spiral process model [19].

Japan after the post world war II was able to develop their technology due to imported technologies and in the 1950s, many Japanese companies started their own technology innovation by implementing and assimilating the imported technologies which enabled them to challenge the industrial leadership in the US and Europe today [19]. Also, American mechanical capacities were developed due to implementation and assimilation of British technology in the late eighteen century, when the United State (US) imported steam engine technology from the Great Britain [19]. So it is evidenced that the US technological innovation capabilities also passed through the same pattern [19]. This pattern is called spiral process model of technological advancement and the spiral model is shown in Figure II below:

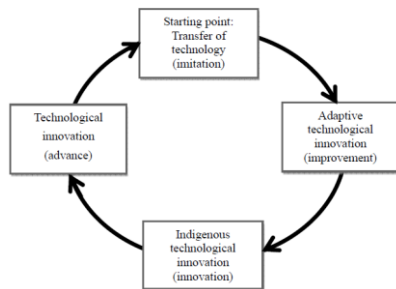


Figure II: Spiral Process Model of Technological Advancement, Source: [19]

The spiral process model of technological advancement has three stages. These three stages can be adopted by developing countries in Sub - Saharan Africa to develop their local or traditional technology. According to Park, Ali, and Chevalier, "Most developing countries like Sub - Saharan Africa lacks the ability in the selection of appropriate technologies to be acquired for driving technological sector, in selecting the appropriate technologies to be developed for evolving and emerging

technologies to develop for the leading sector" [19]. They also said, the first stage for developing technology is by importing foreign technology. After successfully identifying the appropriate technology from the imported technologies, the next step (second) for the recipient country is the adoption of the technology, and the third stage is for the developing countries to establish their own technological innovation by using their own local knowledge [19]. The last stage of this technological advancement is called the derivatives platform and is the breakthroughs of technologies in the developed countries today, and this is called technological advancement [19]. Many developing countries in Sub - Saharan Africa can adopt this spiral process model of technological advancement to develop their own local knowledge base on imitation (implementation), improvement (assimilation) and innovation pattern [19].

1.7 ENHANCING NATIONAL DEVELOPMENT BY STIMULATING ENGINEERING AND TECHNOLOGY AS THE TRANSFORMER

To facilitate national development, "Engineering and Technology" must be given the right priority and the appropriate it deserves. Most underdeveloped countries have failed to develop their own engineering and technology capabilities through transformation of appropriate engineering and technology to create wealth and socioeconomic well-being of their citizens and national development.

"Engineering and Technology" is the transformer through which the fortune of a nation can be transformed for socioeconomic well-being with the application of appropriate engineering and technology.

In dealing with the two transformers (Engineering and Technology) that will stimulate the national development, all stakeholders hands must be on deck. According to Adeodu, Daniyan, Omohimoria, and Afolabi [4] "Some of the challenges bedeviling the third world countries have been identified as inefficient use of available resources (human, financial, material etc.), low human capacity building, absence of good and safe infrastructure, and epileptic power supply amongst other". The shortage in manpower has remained a major setback to Nigeria's technological breakthrough [4]. This shortage is linked with the imperial educational system that gives little or no consideration to the technological needs of a rapidly changing industrial economy; that Nigeria today has to rely heavily on foreign assistance and expertise at the expense of local industrial research and developmental institutions [4]. "The cumulative effect is the graduation of half-baked graduate engineers, technologists and technicians that know little or nothing as regards the practical application of knowledge" [4].

Consequently, "The problem of underdevelopment is not lack of resources, but the lack of productive investment, ability and clear imaginative orientation which has hindered the gap between reality and aspiration" [4]. So, to enhance national development by stimulating the building model of national development through appropriate engineering and technology as the transformer,

stakeholders should support and government must mean business in terms of transforming local engineering and technology to appropriate engineering and technology in order to address the industrial needs and wants of the nation.

Ultimately, it would be more rewarding if Nigerian policy makers realize the need to look inward, recognize the technological need of the nation, and use same to develop a high competitive manufacturing and industrial sector toward a higher productivity so as to relieve Nigeria the burden of underdevelopment [4]. This can be done by putting the following into consideration:

- i. **Gaps in Workforce Training and Retraining should be Eliminated:** The skills, capacity for continuous learning, and effective management of a nation's workforce largely determine its ability to attracts development and retrains high-value - added, high-skill industries and its ability to absorbs and exploits new technology for economic benefits [20] and the nation's development. The Nigeria producers of goods and services must adopt more-productive approaches to the organization of work and the management and motivation of their workforce if they expect to cultivate and take advantage of their employees' skills, ingenuity and creativity [20].
- ii. **Government Support for Commercial Technologies should be Provided:** Government has a compelling rationale for directly enhancing the development [20] through adoption and stimulation of appropriate engineering and technology. Federal "Research and Development" (R&D) funding and procurement contributes substantially to the development of high-technology products [20].
The government has the role for supporting the development of commercial technologies and also facilitating the development of "path-breaking technologies"- those with the potential to create major new industries or transform existing industries and thereby yield high returns to society as a whole but such development poses risks too high to attract sufficient private - sector investment [20].
- iii **Educational System:** One of the major setback to national development can be attributed to the kind of educational system Nigeria runs today. The curriculums of most tertiary institutions are obsolete and inadequate to address current trends in engineering and technology. The schools' curriculum today is theoretically based but practically weak. Consequently, most graduates from the tertiary institutions have little or no practical orientation to match the current technological needs and trends in the industries. According to Onipede [2], "The imperial educational system that gave little or no consideration to technological needs, the cumulative effect is the graduation

of half-baked graduate engineers, technologists, and technicians that know little or nothing as regards the practical application of knowledge".

- iv. **Adequate Funding of "Research and Development" (R & D):** The present state of leaving researches to waste away in institutions' library shelves is bad and is a drawback to the technology advancement in the region. The government should adequately fund and encourage a bilateral relationship between the industries and the research institutions in the region.
- v. **Commercialization of Research and Development:** The results of R & D should not be allowed to rot away in the institution's library shelves. The government should promote meaningful R&D in the educational sector and see how to cement the relationship between industries and institutions in the region by giving incentive and research scholarship.
- vi. **Synergy and Sustenance of "Public - Private Partnership" (PPP):** The government of the region most see how to revamp the PPP sector and encourages it by adequate funding, promotion, and sustenance by the strong synergy between the two sectors. The strong domestic researches are facilitated by the PPP in acquiring, absorbing and adapting new technologies that evolved.
- vii. **Strengthening Capacity Building:** The government should strengthen the capacity building of science, technology, and innovations in the region, as well as basic technical skills for both men and women which are also a prerequisite for the future development of local technology in the region.
- viii. **Technical Policy:** Policies that are technically inclined should be promulgated by policy makers in the region. Stakeholders should make policies that will drive the technological sector and jettison any policy that will hinder local technological development.
- xi. **Science and Technology:** One of the major pivotal for national development is science and technology. Nigerian government should invest heavily on science and technology and supporting research institutes. Technological institutions will go a long way in enhancing research and development of technological abilities of engineering workforce thereby leading to transformation of natural resources for wealth creation and national development for socioeconomic well-being of their citizens. "Science and Technology" is the bedrock for national development. Development at any phase is always linked with technology and technology happens when there is advancement in science [21]. Hence, science, technology and development are all proportional to each other [21]. For any meaningful development, particularly in today's quest for

knowledge based economy; science, technology and engineering are the basic requisites [21].

In enhancing and strengthening national development, the role of the educational institutions, technology managers/technical skilled people, science, R&D institutions, financial institutions and government support are inevitable at this stage [19] as shown in Figure III below.

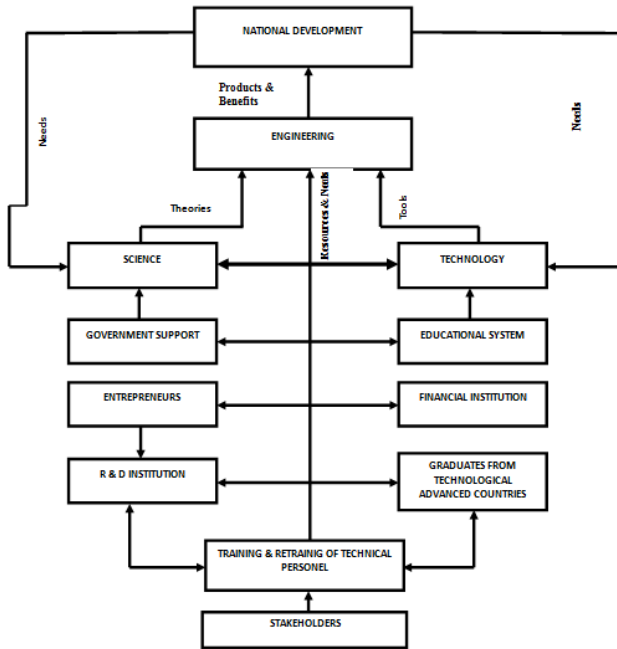


Figure III: Engineering and Technology Building Model for National Development, Source: Modified [19].

II. CONCLUSION

"National development is the ability of a nation to improve the lives of its citizens within the context of growing economy and with emphasis on the good of the nation" [22]. It is no more in doubt that the greatness of any nation is closely linked to its technological capabilities [12]; and not the abundance of untapped natural resources, local engineering and technology. In other words, "engineering and technology are created and fostered where inventors, visioners, tinkers, pioners and investors (risk takers) exist, side by side in synergy" [23].

This paper has successfully x-rayed "Engineering and Technology" as a transformer for national development. It examined the issues, challenges bedeviling engineering and technology in Nigeria for transformation. Also, the prospect offered by appropriate engineering and technology. The paper also proposed national development building model needed to engender sustainable development in Nigeria. For national development to be in view, Nigerian engineering and technological sector should be positioned and given the appropriate place it deserves to make it a catalyst that makes other things (development) happen faster; and this can setup a chain reaction [24] in the development of the technological and socioeconomic

well-being of the citizens for national development. These two things: (Engineering and Technology) I called the "Transformer". In dealing with the transformers that will stimulate our national development, all stakeholders' hands must be on deck. Government is business and all businesses that will strive must be taken seriously.

It is the belief of the authors that if the model proposed in this research is firmly and religiously pursued by all stakeholders, Nigeria economy will be well positioned and walk her into vision 2020 as one of the world best economy.

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