

Indispensability of the Engineering Profession in National Development

Full text of a public lecture at the 2018 Engineering week organised by the Nigerian Society of Engineers, Ajaokuta Branch, at the Ajaokuta Steel Company Ltd., Ajaokuta, on Thursday 15th August 2018 by:

Professor Babatunde Rabiu
Director/Chief Executive,
Centre for Atmospheric Research,
National Space Research & Development Agency,
Federal Ministry of Science and Technology,
Kogi State University Campus,
Anyigba, Nigeria.
Email: tunderabiu@carnasrda.com

Protocols:

1. Introduction: Basic Definition of Engineering

“Scientists investigate that which already is; Engineers create that which never has been”. Engineering is an application of science to the common purpose of life. Engineers turn dreams into reality. It is a profession in which a knowledge of the mathematical and natural sciences, gained by study, experience, and practice, are applied with judgement to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind (Theodore and John, 1950).

According to act of the Council for the Regulation of Engineering in Nigeria, (COREN, 2004), engineering profession is a family and is classified into four major categories: The Engineers, the Technologists, the Technicians, and the craftsmen. The level of education, training and the role of each of the groups is clearly stated and preserved by the Engineering Professional bodies (Nigerian Society of Engineers, NSE and the Council for the Regulation of Engineering in Nigeria, (COREN). Nonetheless, every member of the family is important and play significant roles in any successful Engineering project that will benefit the society. The fields of Engineering are: Aeronautical, Agricultural, mechanical, Civil, Chemical, Computer Electrical and Electronic, Industrial and Management, Mechanical, Mining, Nuclear etc.

The Engineering profession is saddled with the responsibility to invent, design, construct, install and maintain all necessary facilities that will enhance the functionality of the society. Engineers turn dreams into reality

2.0. National Development and Sustainable Development

For the sake of this lecture, the definition of national development is aligned with that of the United Nations for sustainable development which is simply defined as the "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs", (United Nations General Assembly, 1987; Dernbach J. C., 1998, 2003; Cerin, 2006). Sustainable development

includes all forms of developments such as economic development characterized by low growth rate, absence of pollution, and greatly diminished environment impact (Business dictionary, 2017); human development void of environmental damages and social developments that give room for future development. Sustainable development has at least three dimensions: the economic, social and environmental.

Rabiu (2018) opined that the United Nations General Assembly gave a new contemporary face to the term 'sustainable development' when on 25 September 2015, the 194 countries of the UN General Assembly UNGA adopted the 2030 Development Agenda titled Transforming our world: the 2030 Agenda for Sustainable Development. As a way of building on the successful Millennium Development Goals MDG (United Nations, 2015), the UNGA announced the 17 Sustainable Development Goals and 169 targets (United Nations General Assembly, 2015). They are integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental. The 17 Sustainable Development Goals SDG adopted by the UNGA are thus shown in Table 1.

Table 1: The 17 SDGs (Source: United Nations General Assembly, 2015).

Goal 1: No Poverty: End poverty in all its forms everywhere

Goal 2: Zero Hunger: End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Goal 3: Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages

Goal 4: Quality Education: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Goal 5: Gender Equality: Achieve gender equality and empower all women and girls

Goal 6: Clean Water and Sanitation: Ensure availability and sustainable management of water and sanitation for all

Goal 7: Affordable and Clean Energy: Ensure access to affordable, reliable, sustainable and modern energy for all

Goal 8: Decent Work and Economic Growth: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Goal 9: Industry, Innovation and Infrastructure: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

Goal 10: Reduced Inequalities: Reduce inequality within and among countries

Goal 11: Sustainable Cities and Communities: Make cities and human settlements inclusive, safe, resilient and sustainable

Goal 12: Responsible Consumption and Production: Ensure sustainable consumption and production patterns

Goal 13: Climate Action: Take urgent action to combat climate change and its impacts

Goal 14: Life Below Water: Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Goal 15: Life on Land: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Goal 16: Peace, Justice and Strong Institutions: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Goal 17: Partnerships for the Goals: Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development



Fig 1. Global Sustainable Development Goals (Global Goals). (Source: <http://www.un.org/sustainabledevelopment/news/communications-material/>, Accessed 14th June 2017)

National development denotes the competence of a country to provide and improve on the socio-economic welfare of her citizens, by providing amenities like quality education, potable water, infrastructures (power, transportation, internet, etc), medical care, increase in gross domestic product, improving literacy rates, improving medical facilities, etc. National development is thus characterised by the indicators identified as the SDGs and is epitomized in manifestation of solid infrastructure, effective security, public safety, healthy economy, citizenry prosperity, improved literacy rates, and other indicators of SDGs.

3. Nigerian current level of underdevelopment

It is sad to note that Nigeria is currently under-developed as evident in high level of infrastructural deficiency and economic turbulence as discussed in Rabiou (2016, 2018). It has been reported by the Center for Global Development (2012) that Nigeria, though the giant of Africa, ranked 93rd in the world MDG progress ranking tying with Congo republic and behind African countries such as Malawi, Ghana, Gambia, Burkina Faso, Egypt etc.

The national economy rolled out of recession in September 2017 and expanded 1.9 percent year-on-year in the first quarter of 2018, easing from an upwardly revised 2.1 percent growth in the previous period. It is the fourth consecutive quarter of expansion, as the oil sector continued to rise while the non-oil output growth slowed [Trading economics, 2018]. Earlier, during the recession, the federal government initiated series of measures to improve the economic outlook. On Tuesday, March 7th, 2017, the Federal Government of Nigeria released its Economic Recovery and Growth Plan 2017-2020 (ERGP). According to this ERGP, the real GDP of the country is projected to grow by 4.62 percent over the planned period from 2017 – 2020. It is expected to grow by 2.19 percent in 2017 and eventually achieve a growth rate of 7 percent by 2020.

Rabiou (2016, 2018) stated that our oil-rich nation has been be-deviled by epileptic power supply, lack of infrastructure, unfriendly business environment, high unemployment index, restrictive trade policies, persistent policy uncertainty, low crude prices, an inconsistent regulatory environment, real and disguised terrorism, slow and inconsistent judicial system, unreliable dispute resolution mechanisms, insecurity, disruptions in oil exports, infrastructural vandalism, economic leakages, restiveness, economic sabotage and 'chronic/fantastic corruption'.

4. Engineers and National Development

The current under-development problem in Nigeria is a problem and engineers are problem solvers! The role of the engineering profession in the national development of any nation cannot be overemphasized. No nation can develop without infrastructural development. Consequently, the application of the knowledge and the skills attained by well-trained Engineers is indispensable in the provision of the basic amenities required to advance national development. The provision of these basic social amenities is essential and often the right of citizens.

Unfortunately, Nigeria is lacking in infrastructural development and is still seeing as an underdeveloped nation. Today, our power system, transportation infrastructure,

and all sorts of indicators of SDGs mentioned in Table 1, are in sorry state and obviously begging for attention from the policy makers and the government.

It is clear that the design and building of all manners of infrastructures, physical or electronic, such as required in power, transportation (land, rail, water, and air), education, health care, agriculture, economy, defence, etc, fall within the purview of engineering profession. It is obvious that no nation can develop beyond the level of her engineering profession. I dare to declare that: 'show me the strength of your engineering as a nation, I will tell you the level of your development'.

Thus, the role of engineering profession in the national development is inevitable. It is on this note that I commend the recent promulgation of Executive Order Number 5, which gives preferences to indigenous firms in the award of contracts. This presidential Executive Order Number 5 has given tremendous advantage to local engineering firms, MDAs and national R & D establishment to compete favourably with any foreign engineering firms within the country. This very positive move by this very present administration actually marks the beginning of a new era in our emerging nation. The order has indeed come to promote business in science and technology. Henceforth, we discuss some specific sectors where engineering profession has direct bearing on indicators of national development:

4.1. Infrastructural development as the foundation for National development

Rabiu (2018) emphasized that infrastructural development plays dynamic role in economic growth. He stressed the fact that infrastructure such as power, transportation networks (air, rail, roads), internet connectivity, schools, clinics, telecommunications and water supply, are crucial for any sustainable development. Earlier, Juma and Yee-Cheong (2005), submitted that every level of government needs to adopt strategies to improve infrastructure in ways that promote the technological development necessary for sustainable economic growth. Rabiu (2016) observed that a situation where private sectors have to invest huge amount of capital in setting up power plants, road networks, water supply and provide security services for facilities and personnel will surely affect prices of delivery, at times drive away investors and this in turn shrink the economy. All over the world it takes indigenous technology and engineering firms to sustain infrastructural development.

4.2. Community Development and Infrastructural Maintenance

Adherence to the Engineering standard and ethics should be sustained. Supervision and monitoring of community development projects is a major role in the infrastructural development. The neighbourhood engineering professionals can monitor/supervise development of basic infrastructures that are being developed within their immediate communities. These include, the provision of borehole waters, water distribution networks, construction of drainage, rural electrification etc. Maintenance of such infrastructures can also be carried out by engineering professionals within a community. Obviously, this will extend the life span of such

infrastructure and improve the community services. It will also allay the poor maintenance culture and apathy attitude that we demonstrate to government installed projects.

4.3. Educational Development

Education is a key to the development of every nation. It is not out of place for NSE chapters to embark on guidance and sensitization tours to elementary and secondary schools to catch students young for engineering profession. Thereafter, they can be guided on the choice of subjects that will gear them towards Engineering discipline.

The theoretical knowledge impacting on the students at the tertiary institutions (Polytechnics and Universities) is vital. The rigorous practical training (SIWES, Industrial training) experience in different engineering disciplines should be sustained. Apparently, this will serve as basic entrepreneurship skills that will improve the socioeconomic development of the nation. Furthermore, it will create an avenue to be self-dependent rather than indulging in criminal activities immediately after the compulsory national (NYSC) service. Apart from these, the knowledge is passed down to generations for further improvements.

4.4. Engineering Profession and the Public Service

The engineering projects are being conceptualized, designed, supervised, evaluated, and certified by the professional engineers in the public service. These engineers are to ensure that these projects are implemented according to the specifications. They also contribute input towards the procurement of engineering related facilities in their respective MDAs. The authority of the respected agencies are expected to give the engineers the liberty to advise on the technicalities of engineering-related projects in order to have optimal performance to minimise the waste of the National resources.

4.5. Engineering Profession and the National Security

The engineering base and the mechanized division of the Nigerian Army are good examples of the engineering profession in the National Security.

4.6. Engineering Profession and Food Security

Nowadays, some countries major national economic source is agriculture. Active participation of agricultural and mechanical engineers in the design of equipment for agricultural sector is key to the national food security and production. Planting of seeds, application of fertilizer, and harvesting of the agricultural products are done through mechanization and nowadays through autonomous systems as in precision farming. Even the preservation of foods with the use of solar dryers are designed by an engineer. Provision of renewable energy to pump water for the irrigation system

is another significant contribution of the engineering profession to the national food security. The genetic modification of seed through engineering and all forms of food engineering systems are further applications of engineering towards food security.

4.7. Engineering Profession and the National Space Development

The National Space Research and Development Agency (NASRDA) was established in 1999 as a parastatal of the Federal Ministry of Science and Technology. NASRDA is an engineering-centered establishment and has made meaningful contributions to national development via her services. NASRDA has developed indigenous capabilities in space technology and its applications to advancing the course of our nation in different sectors. As at today, two observational satellites (NigerSat 2 and NigerSat X) and NigComSat 1R are orbiting in space, while Nigersat 1 and NigComSat 1 had been de-orbited.

4.8. Engineering Support at the Centre for Atmospheric Research 'CAR'

The Centre for Atmospheric Research 'CAR' is one of the seven autonomous specialized R & D centres of National Space Research and Development Agency 'NASRDA' - a parastatal of the Federal Ministry of Science and Technology. CAR was established in January 2013 with a compelling mission to improve our understanding of the behaviour of the entire spectrum of the Earth's atmosphere; promote capacity development in relevant atmospheric sciences as a way of facilitating international competitiveness in research being conducted by atmospheric scientists; and disseminate atmospheric data/products to users towards socio-economic development of the Nation.

Our extant core research focus includes: space weather, tropospheric studies, atmospheric research software and instrumentation development, microgravity and human space technology, atmospheric chemistry and environmental research. We are summarily involved in research activities that cover a wide range of ecosphere from the bottom of the ocean via the atmosphere to the centre of the Sun

Our atmospheric and space weather monitoring facilities are running perfectly. As at today, CAR runs weather stations under the TRODAN project in 20 locations, 3 GPS stations for Space Weather monitoring, 1 lightning monitor facility, 1 all-sky Optical Imager, 3 magnetometers, 1 scintillation monitor, 1 Fabry Perot Interferometer, 1 SOFIE, and 1 Ozone monitor. With observational facilities littered over our beautiful National landscape and international collaborative research; it is no gainsaying that within our five years of existence, we have attained the status of a world-class R & D CoE in atmospheric research.

Our present research activities border on quality of the air around us, the annexation of solar energy, strengthening the accuracy of prediction of atmospheric and allied

parameters for socio-economic purpose, safety of space environment over us and the improvement of the earth-satellite radio-communication systems which include telecommunication and all manners of ICT-dependent systems. Precisely, on 6th January 2018, we started the first daily nowcasting of the space weather condition in Sub-Saharan Africa. We continue to maintain our ways by engaging in field observations, promoting research and capacity building. Our activities are documented in our annual report series freely available in the public domain at our webpage - www.carnasrda.com.

In addition, over the years we have also established the following network of observatories: National Air Quality Research Laboratory, University of Ilorin (2014); Space Environment Research Laboratory SERL, NASRDA, Abuja (June 2015); Space-Earth environment Research Laboratory SEERL, University of Benin (September, 2016); the Atmospheric and Space Weather Research Laboratory ASWeR Lab, Osun State University, Osogbo (February 2017); and the Space Weather and Atmospheric Physics Laboratory SWAP Lab, Bayero University Kano (April 2017).

It is necessary to mention here that our team of engineers at CAR had successfully worked with our local collaborators to develop an hybrid of weather stations and air quality monitors, as well as magnetometers. Also, our team of engineers had produced an unmanned aerial vehicle UAV with sensors capable of monitoring the altitudinal profile of atmospheric parameters including some GHGs from the ground level to pre-defined altitude of about 300 metres. These facilities operate with telemetry component, thus send data to dedicated server in our Laboratory and compare well with imported products. From our experience, engineers get things done when equipped and challenged. Therefore, indigenous development of atmospheric facilities at CAR is already yielding results. Such innovation will play a technical supporting role in the development and industrialization that will promote our National Development.

5.0. Recommendations

NSE/COREN should take up advisory and regulatory roles in the FG proposed Nigeria Air project to ensure sustainability of the project.

Review of educational curriculum at tertiary educational levels to include entrepreneurial components

FGN should embark on novel strategies to engage indigenous technology and patronise national/local engineering firms to sustain infrastructural development.

There should be a re-orientation of development policies to encourage patronage of indigenous technology and local engineering firms.

The local content law should be enforced in all engineering projects in the country. This should not just be limited to award of contracts, rather it should be made to reflect in even ownership of any engineering based company operating within the shores of our great country. By this, I mean certain percentage of ownership of every engineering firm operating in the country should be Nigerian. In clear terms, foreign companies operating in Nigeria should have certain percentage of ownership even at top echelon reserved for indigenous Nigerian registered engineers.

NSE/COREN should assume oversight function over every engineering projects being embarked on by the government at all levels. This will complement the government effort and ensure that standards are maintained in execution of such projects.

Promotion of business activities in S & T: As mentioned in Rabiou (2016, 2018), government procurement act will need to be revisited to promote technological innovation and patronage of indigenous products by local engineering firms. This in turn saves capital flight and fast track sustainable development. In order to drive economic and industrial growth, Scholtes and Wall (2014) noted that certain developing economies are dedicating considerable efforts to identifying new forms of partnerships with domestic and foreign companies to enhance technology transfer and linkages. As at today, we have a lot of items that are made in countries outside Nigeria for Nigerian companies to market. With a population of about 180 million, a quarter of African population, we constitute a great market anywhere in the world. Local production of items such as match stick and tooth pick can save a lot of capital flight and develop our economy. Any nation that is a great consumer of imported technological products will end up being an industrial dumpsite for the technology produced nations. On this note, India recently rejected a proposal to exempt Apple from local sourcing rule. Quoting Roy and Purnell (2016): 'We want local sourcing for job creation. You can't have a situation where people view India only as a market. Let them start doing some manufacturing here'. Executive Order Number 5 has actually come to take care of this.

Supervisory/advisory roles for NSE/COREN in MDAS: The decision about the National Development is taken at the highest level of Government. I recommend that NSE/COREN should constitute advisory committees to work hand in hand with the heads of all engineering based MDAs in the country. In addition, NSE/COREN should ensure that competent engineers head any engineering based MDA. For instance, the Ministries of Power and Transport should be supervised by professional engineers as in the case of the Ministry of Health and Justice that are being overseen by professionals in the field. This will encourage the engineering family and enhance the national development.

I strongly recommend that NSE/COREN should set up appropriate committee to sensitize and mobilize indigenous engineering practitioners and local engineering

firms to take advantage of the recently promulgated Executive Order Number 5. The 'Society' must take advantage of the moment.

Engineering is a dynamic profession and so there is need for continuous training and re-training of professional in order to keep abreast of new developments in their respective fields. NSE/COREN should sustain their training programmes for registered members.

6. Conclusion.

Engineering profession is indispensable in National development. No nation can rise above the level of his infrastructure and Engineers are the builders of all forms of infrastructures. Engineering has made the world a better place to live. Today, we can turn on a tap water, switch on an electric bulb, travel by road, rail, or by air, watch live matches, transact financial business at any time and within the comfort of our rooms and do much more. I challenge every engineer here to magnify his/her office henceforth.

The recently promulgated Executive Order Number 5 should be sustained and NSE should ensure members take advantage of this new development that is capable of turning our nation around for good.

In summary, I found the words of Bordoff et al., (2006) for the United States very aptly. 'To remain at the technological frontier, **a country** must make more workers literate in science and **engineering**; embrace a redesigned system of national investments in—along with a stronger commitment to— scientific research; and adopt more effective incentives for private sector firms to undertake R&D. This is the way to *develop our nation*.' [Emphasis mine]

Thank you and wishing you all of God's blessings.

References

Bordoff, J. E, Deich, M., Kahane, R., Orszag, P. R., 2006. Promoting Opportunity and Growth through Science, Technology, and Innovation. The Brookings Institution, Washington DC, 20 pp

Cerin, P. (2006). Bringing economic opportunity into line with environmental influence: A Discussion on the Coase theorem and the Porter and van der Linde hypothesis. *Ecological Economics*, 209-225.

COREN, 2004 COREN Act, "The Council for the Regulation of Engineering in Nigeria."

Dernbach, J. C. (1998). Sustainable development as a framework for national governance. *Case Western Reserve Law Review*, 1-103.

Dernbach, J. C. (2003). Achieving sustainable development: The Centrality and multiple facets of integrated decision making. *Indiana Journal of Global Legal Studies*, 247-285.

Federal Republic of Nigeria, 2018. Presidential Executive Order number 5 (For planning and execution of projects, promotion of Nigerian content in contracts, science, engineering and technology) of 2018. Government Notice No. 53, Official Gazette, No 25, Vol 105, Lagos - 5th February 2018. A69-78

Juma, C and Yee-Cheong, L., 2005. Innovation: Applying knowledge in development, UN Millennium Project. Task Force on science Technology and Innovation, EarthSCAN, London, 220pp

Rabiu, A. B. 2016. Science and Technology for Economic Survival. Programme and book of abstracts of the 5th National Conference, The Polytechnic, Ibadan, Nigeria. 19-29.

Rabiu, A. B. 2018. Potency of science and technology in sustainable national development. 4th University Distinguished Lecture, Mountain Top University, MFM Prayer City, Nigeria, 32pp

Roy, R. and Purnell, N., 2016. India rejects rule waiver for Apple. *The Wall Street Journal*, 27 May 2016, pB3.

Sachs, J. D., 2012. From Millennium Development Goals to Sustainable Development Goals. *Lancet* 2012; 379: 2206–2211

Scholtes, P., and Wall, T., 2014. Engaging with the private sector in the post – 2015 development agenda. *Making IT Industry for development*, 16, 22-27

Theodore, J. H. and John, C. L. F., 1950. *The Engineering Profession*, Stanford University Press, 486 pp

Trading economics, 2018. <https://tradingeconomics.com/nigeria/gdp-growth-annual>. accessed 24th June 2018

United Nations General Assembly, 1987. Report of the world commission on environment and development: Our common future. Oslo, Norway, 300pp

United Nations General Assembly, 2015. Draft outcome document of the United Nations summit for the adoption of the post-2015 development agenda". Sixty-ninth session. Agenda items 13a and 115. A/69/L.85

United Nations, 2015. The Millennium Development Goals Report, 2015, New York, 75pp