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THE ROLE OF NIGERIAN ENGINEERS IN SUSTAINABLE DEVELOPMENT

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ABSTRACT

Nigerian Engineers have an indispensable role to play in sustainable development of engineering projects. This sustainability is anchored on achieving a development which meets the needs of current generation without compromising the ability of future generations to meet their own needs and aspirations in the course of performing their engineering activities. The aim is the role of Nigerian engineers in sustainable development of engineering projects. The objective is to explore the various areas of engineering activities that synchronized with sustainable development in Nigeria. The methodology involve the approach and the most effective mechanism to solve engineering problems. The result reveal that the role of engineers in sustainable development include but not limited to appropriate selection of resources, accounting for sustainability, use of sustainable processed and environmental stewardship in engineering activities. The economic, social and environmental impacts of sustainability would be mitigated when Nigerian engineers play their role to engineer economic development which will improve the living standard of the people for a sustainable feature.

KEYWORDS: Engineers, Engineering, Sustainable development, sustainability; resources, processes; efficiency, economic development; impacts.

01 INTRODUCTION

Engineers deal with the creation, improvement, protection of the environment, providing facilities for living, industry and transportation, including large buildings, roads, bridges, canals, railroad lines, airports, water supply systems, dams, irrigation, harbours, docks, aqueducts, tunnels and other engineered constructions within a given region which produces high economic values. The personal involvement of each engineer is the most effective

mechanism in integrating the areas of safety and the welfare of the public, professional ethics, legal consideration, environmental responsibilities, quality, and communications. The role of Nigerian Engineers in Sustainable Development is indispensable. Rosen (2012) stated that Sustainable Development is "a constrain upon present consumption in order to ensure that future generations will inherit a resource base that is no less than the inheritance of the previous generation". Sustainability is the capacity to endure or a continuum or the ability to continue a course without termination. Sustainability is compatible with the existence of the universe, refers to quality of not being harmful to the environment or depleting natural resource while supporting a long term ecological balance and with the ability to maintain a definite stable outcome. A development is sustainable when it takes account of social, ecological, and economic factors of the living and non living resource base; long term and short term advantages and disadvantage of alternative actions.

World Conference on Environment and Development (WCED) (1987) described "Sustainable Development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs". In the light of this definition, the role of Nigerian Engineers should encompass ecological, social, economic considerations and the study of how natural systems function, remain diverse and produce everything it needs for the ecology to remain in balance i.e. living in harmony with the natural world around us, protecting it from damage and destruction in the course of performing their Engineering functions.

Engineering practice is the application of scientific and mathematical principles for practical purposes such as the design, manufacture and operations of products and process while accounting for constraints invoked by economics, the environment and other sociological factors (Rosen, 2009). Engineering activities are significant contributors to economic development, standards of living, and well-being of a society and impacts on its cultural development and environment.

The role of Nigeria Engineers in sustainable development involves the provision of engineering services in sustainable manner which in turn necessitates that engineering services be provided for all people in ways that, now and in the future are sufficient to provide basic necessities, affordable, not detrimental to the environment and acceptable to communities and people (Rosen, 2012). Engineering practice in a development setting requires technical as well as non-technical skills, and it requires an understanding of the

dynamic between society, economy and the environment. It must also consider non-traditional principles of carrying capacity, equity and gender. Engineers role viewed along five aspects in a development setting include Socio-cultural respect, community participation, political cohesion, economic sustainability, and environmental sustainability (Mc Conville and Mihelcic, 2007).

2.0 AIM AND OBJECTIVE

The aim is to examine the role of Nigerian Engineers in Sustainable development of engineering projects.

The objective is to explore the various areas of engineering activities with a view to integrating Sustainability towards the execution of engineering projects in Nigeria.

3.0 LITERATURE REVIEW

3.1 Nigerian Engineers and Sustainable Development Akingbagbohun (2018) opined that Engineers help to achieve sustainable development in:

An ever-increasing population that continues to shift to urban areas which will require widespread adoption of sustainability.

Demands for Energy, drinking water, clean air, safe waste disposal and transportation which will drive environmental protection alongside infrastructural development.

Professional Engineers are required to take responsibility for engineering projects and programs in the most far reaching sense, including understanding the requirement of clients and of society as a whole working to optimize social, environmental and economic outcomes over the lifetime of the product or program.

Understanding of social, cultural, global, and environmental responsibilities and the need to employ principles of sustainable development.

Ability to utilize a systems approach to complex problems and to design and operational performance.

Engineers design, create, explore, innovate, and receive education and training in many different fields. They also work in many different environments and make the world worthy of living.

Engineering bridges the gap between society and scientific knowledge.

The Chinese quote that, if you are thinking a year ahead, sow a seed. If you are thinking ten (10) years ahead, plant a tree. If you are thinking 100 years ahead educate people, suggest that the unique role of Engineering education with sustainable development will integrate the

concept of sustainability in process and product activity of engineering practice (Rosen, 2007).

The Role of Engineers in the Society for a Sustainable future

Most of the major issues that face the country and the world, such as climate change, water availability and energy security, need engineers to fix them. These roles cut across Technical, Social, and Economic issues which should be integrated in sustainable development to preserve our future. (Hargoves, 2007).

The economic development process entails that the legal and institutional adjustments are required to give incentives for innovation and investments in order to develop an efficient production and distribution for goods and services. Economic development is a sustainable increase in living standards which results to increased per capita income, better education, health, and environmental protection. Smith and Hargoves, (2007) considered the classification of economic activities will be considered at Primary, Secondary and Tertiary sectors.

The Primary Sector. This refers to that sector of the economy which uses natural resources to produce goods. The natural factors play an important role in the production process i.e. Agriculture and allied activities like mining, fishery, forestry, and poultry.

The Secondary Sector. These are manufacturing or industrial sector which transforms one physical good into another. e.g., manufacturing, electricity, gas, water supply e.t.c.

The Tertiary Sector. This is the service sector of the economy such as education, health, banking, insurance, trade and transport.

The role of Engineers in these economic developments will transform into:

1. Quality Education.
2. Clean and efficient energy.
3. Sophisticated infrastructure.
4. Improved Social amenities.
5. Increasing phase in Gross Domestic Product (GDP) per capita.
6. Ability of self-production.
7. Good economic stability.

The engineering profession makes important contributions to the economy from direct addition to economic output, the work they do and contribution of the sectors in which they work. Engineers make long run return to the economy of improvements in physical infrastructures, contributions to the knowledge, economy and to sustainability (Engel-Yan, Kennedy, Saiz and Pressnail, 2005).

Technology and Innovation: the role of Engineers in these areas include Education, Production, Construction, Information and Telecommunication, foreign exchange, Infrastructure, clean sustainable energy (Ravi, 2010).

1. Quality Education: with modern day's technology balance and sustain the economy with returns from institutional colleges.
2. Efficient Production: will lead to production of goods which are multiplied with less human efforts, low cost and improved qualities.
3. Information Communication and Technology: The rapid growth in ICT and Telecommunication will open doors of opportunities, and in turn boost the economy.
4. Development/Construction: Engineers deal with the creation, improvement, and protection of environment, providing facilities for living, industry and transportation, including large buildings, roads, bridges, canals, railroad lines, airports, water supply systems, dams, irrigations, harbours, docks, aqueducts, tunnels and other engineered constructions within in a given region which produces high economic values.
5. Clean, Sustainable Energy: plays a major role in any other development to a country in terms of stable and sustainable power for a stable and sustainable economy.

The Key Indicators for Sustainable Development of Engineering Activities

Paten and Hargroves (2005) opined that the engineer's role can be practiced sustainably in society under the following distinct components to achieve sustainable development.

1. Resources sustainability
2. Processes sustainability
3. Efficiency improvement
4. Environmental impact reduction
5. Fulfillment of other aspects of sustainability

Resources Sustainability are resources derived from nature like water, materials and energy. Scarcity and importance to ecosystems determines the degree to sustainable resources. These

resources consist of renewable, non renewable and input resources used by engineers to achieve sustainable development.

Processes Sustainability are engineering processes and operations used to yield product and/or services which must exhibit sustainable characteristics in terms of operations, step they involve, the energy and materials they utilize. Sustainable processes incorporates sustainable, transportation, distribution and storage systems where necessary; manufacturing and design; which utilize widely available materials while avoiding toxic or hazardous materials as much as feasible with technologies that are available where needed and operable in the setting in which they will be replaced. However engineers use these sustainable processes to achieve sustainable Development.

Efficiency improvement implies high efficiency which allows the greatest benefits, in terms of products or services to be attained from resources to aid efforts towards achieving engineering sustainability. Efficiency can be increased by;

1. resource conservation
2. improved resource management
3. resource demand management
4. resource substitution
5. better matching of energy carriers and energy demands
6. more efficient utilization of resources in term of both quantity and quality.

Environmental Impact reduction various environmental impacts associated with engineering process of concern must be addressed to attain engineering sustainability. These include impacts to the atmosphere, the lithosphere and the hydrosphere, such as global climatic change, ozone depletion, acidification, abiotic resource depletion potential, ecotoxicity and radiological impacts etc.

Fulfillment of other Aspects of Sustainability. These are sustainability related or overlap engineering process for engineering sustainability.

1. Economic affordability- implementation of mitigation in a way to save money.
2. Equity-equal access to engineering services, regardless of geographical location to achieve sustainability.

3. Meeting-increasing resource demand. This is a challenging task with increasing population to meet increasing use of material and energy resources.
4. Safety- in terms of injury health effects in short and long term.
5. Community involvement and Social acceptability - through consultation and involvement in decision making.
6. Meeting human needs - in dimensions of new technologies
7. Appropriate Land use - land for engineering related activities needs to be balanced with other needs.
8. Aesthetics - ensuring that engineering products are aesthetically appealing in engineering sustainability eg. Environmental cleanliness.
9. Life styles - change in life styles and tempering desires that are engineering driven helps in engineering sustainability.
10. Population - increasing global population which places stress on the environment and carrying capacity of the planet.
11. These are features engineers are expected to consider in order to achieve sustainable development.

4.0 Role of Engineers to Sustainable Future for Nigeria

Engineers have a unique role when compared to other occupations in industrial organization and are most affected by organizational changes. Engineers are target of change and are required to adapt to the new work environment continuously in the introduction of new products, processes and methods, new equipment and technologies. As originators of change responsible for the implementation organizational changes, they are under increasing pressure to redefine their roles and re-equip themselves with necessary skills and knowledge to meet adequately the contemporary changes. The changing roles of Engineers have considerable influence on organizational performance. Engineers are always in transition trying to re-invent itself by proposing radical changes to engineering education, carrier development, training, and management of engineering and professional formation (Weble and Fuler, 2010).

4.1 Managerial Role of an Engineer

a. Decision Making. The role of decision making for engineers are seen in almost every establishment or stakeholders organization where they belong to the management and board members of such organizations making decisions that will affect the overall

development of the country. This makes the Engineers to use their ingenuity as originators and problem solvers to make decision that will enhance the sustainable development of Nigeria.

b. Governance and Policy Formation. Engineers who find themselves in positions of authority in government should use their offices to make good policies that will promote and sustain the sustainable development in Nigeria. In political offices they are expected to work hard towards making laws that will foster safe, affordable, available and acceptable resources that will contribute to the overall sustainable development in Nigeria. These policies and laws will include, how engineers will be trained, in what areas they are to be trained, giving free hand to engineers to work in all sectors like technical sectors, granting funds to Research and development of projects being carried out by engineers.

4.2 Technical Role of an Engineer

a. Planning The first and paramount role engineers need to play is ensuring sustainable development is always to have a workable plan because integrated planning approach is an essential way of achieving security of resources supply on a sustainable basis in order to capture numerous factors that shape sustainable development. There is need for all stakeholders in the engineering sectors to involve engineers in the planning stage of every project. Engineer should make themselves available to be used and should also make meaningful contributions when they are called upon to do so. There should be concrete plan on how to replace existing technologies for new ones such as renewable energy technologies, secure and reliable sources for sustainable development of Engineering Projects.

b. Enlightenment (Energy Efficiency and Conservation). The adoption of energy efficiency and conservation will significantly mitigate the supply challenge. Introduction of energy efficient technologies with modification of some parts, existing power plant can be more efficient. There should be improvement of the already existing design and new design for buildings and other energy sources.

c. Sustainability. Sustainable sources of energy and allied services would be researched to ascertain how best to reduce the global warming caused by burning of fossil fuels and associated problems can be mitigated in a sustainable manner.

d. Professionalism in Project Execution. The bane of infrastructural development, looking at the rate of failed contracts in Engineering sector which most of the time are executed by unqualified engineers make it difficult to achieve sustainable development. Engineers

should rise up to this challenge and live up to the expectations of the society by playing a leading role in sustainable development of engineering projects.

e. Monitoring and Maintenance of Energy Facilities. Proper monitoring to make sure that there is no deviation from designed mode of operation of the system will make any system to be sustained. This is a cardinal role for any given project that is technology driven. Proper monitoring to ensure effective and efficient use of facilities will surely enhance sustainable development.

4.3 Challenges to sustainable development on Role of an Engineer in the country are; Weak technological base, Poor infrastructural facilities, Financial obstacles, Energy policy issues, inadequate reliable data, poor utilization of resources and inertia towards change are some of the challenges affecting sustainable development (Sambo, 2009).

4.4 The Way forward on Role of an Engineer will include: Good maintenance culture, Public Private partnership, Implementation of National Sustainable development policy, Adherence to the ethics of Engineering profession and Sensitizing the public on importance of using improved and new technologies to ensure efficient sustainable development.

5.0 CONCLUSION

Engineering is the bedrock for sustainable development of any serious Nation. Every section of economic activity has the roles of engineering and technology whether it is raw materials, manufacturing, or distribution.

The challenges facing the country in Energy, Infrastructures and environment with their associated sustainable development are engineering challenges.

There is need for Engineers to play a much stronger role in the public policy process to provide the right incentives for industry and others to move on sustainable path so that engineers can be encouraged and supported to design sustainable technology for the purpose of economic development that benefits society in a holistic way now and in the future.

6.0 Recommendations

1. Engineers must be involved in politics to give them the opportunity to be at policy/decision making bodies. This will afford them to use their professional knowledge to attract and defend important engineering infrastructural development projects.

Similarly, they will contribute to the enhancement of other engineers' welfare by motivating them to higher productivity for national economic development.

2. Engineers must lead the new industrial economic revolution as championed by some professional organizations such as the Institution of Electrical and Electronic Engineers (IEEE) World Engineering Partnership for Sustainable Development (WEPSD), World Federation of Engineering Organization (WFEO), Nigerian Society of Engineers (NSE), American Society of Civil Engineers (ASCE), and World Business Council for Sustainable Development (WBCSD), among others to make sustainable economic development a high priority in engineering and business both in practice and in the education of future engineers.
3. The role of Nigerian Engineers of the future must be much of interdisciplinary. The lines between the traditional engineering disciples must transcend to interdisciplinary co-operation by joining forces with biologist, chemist, meteorologist, economics, planners, political scientists, ethicists, religionists, and Community leaders in unprecedented ways to lead the society an a sustainable economic path.

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