Techno-Economic Study of Final Year Projects: A Case Study of Mechanical Engineering Department in one of The Top Universities in Africa

Techno-Economic Study of Final Year Projects: A Case Study of Mechanical Engineering Department in one of The Top Universities in Africa

Bolu C. A.[1], Bassey E. E.[1], Abioye A. A.[1*], Azeta J.[1]

[1]Department of Mechanical Engineering, Covenant University, Ota. Nigeria
*Corresponding author: abiodun.abioye1@covenantuniversity.edu.ng

Abstract-

The Africa Union Agenda and United Nation Sustainable Development Goals array a focal scope on various issues for the flourishing of the planet and all life therein. These aspirations and goals mirror the ambitions of Africans for flourishing and prosperity, for a continent of free nationals and extended horizons, for solidarity and integration coupled with freedom from conflict and enhanced human security. Although the timeline for achievement of these goals and aspirations grows shorter; there have been reports that the undergraduates' final year projects in most of Africa's universities are not proffering relevant solutions to different national problems. This paper studies completed final year projects of undergraduates in the Department of Mechanical Engineering in one of the top-rated universities in Africa, over the period of seven sessions. The projects over these periods were classified using some parameters such as United Nation Development Agenda, Africa Union Agenda and Scopus Classification System for projects. A database of the classified projects was designed and developed; which was subsequently analyzed utilising the Statistical Analysis Software to determine different prescribed parameters. Based on the results, the field of Corrosion in the Department had the highest number of projects during this period.

Key words: Africa Union Agenda, Scopus Classification System, Sustainable Development Goals, United Nations Development Agenda.

1. Introduction

Management acts as a linchpin in various fields endeavor aspect - engineering inclusive. Engineering projects are froth with activities requiring skilled management; this process always involves the collection of data and formulation of a database to analyse different operations in the field. Such managerial analysis harnesses the capabilities of Database-management system (DBMS) – which is a collection of interrelated data and a set of programs to access said data.

A Database System forms a vital part of virtually all accessible information ranging from websites to whole conglomerates, an illustration of the exploitation of database system is in Universities; where a Database is used in storing Student information, Matric Number, Course Registration and Grades [1].

The United Nations 2030Sustainable Development Agenda (SDG) was released by the United Nations in 2015 on her Seventieth anniversary. The agenda constitutes a total of seventeen SDGs

set aside by the United Nations and underlying member states to be realised by 2030 [2][3][4][5][6].

The African Union Agenda 2063 was adopted on January 31st 2015 by Africa Union at its 24th Ordinary Assembly. Therein, the African Union identifies Seven Aspirations for African Nations, these aspirations embody the wants of member-state denizens for flourishing and prosperity, for a continent of free nationals and extended horizons, for solidarity and integration coupled with freedom from conflict and enhanced human security [7].

At the onset of the industrial revolution in various nations across the globe man paid little to no attention to his footprint on the environment. These activities consequently led to irrevocable fallouts on the environment and thus drew our attention to the area of sustainability in our endeavors to mitigate harmful environmental footprints. In [8], a study titled, "Sustainable energy development in Nigeria: Current status and policy options", discussed the role the government has to play in achieving the use of sustainable and clean energy in the country. The study highlighted current government policies as a major contributing factor towards substantially restricted access to clean energy in Nigeria. The Nigerian Government has prioritized effective policies to boost the exploration and exploitation of Crude oil, an example of such is the privatization policy which provides private individuals the prerogative of possessing oil wells and engaging in oil exploration activities. This, coupled with the endorsement of investment tax credit – allowing investors to enjoy tax credit when procuring assets purposed for petroleum exploitation under the accounting period in which the taxable asset was first used – pose strenuous encumberments for sustainable energy technologies.

Energy plays a vital role in the development of any state; it affects the economic, social and political development of a Nation. Oyedepo cited in a paper that Nigeria is blessed with abundant energy resources which have not been utilized, the paper investigated Government over-dependency, and excessive dependence on Crude oil [9]. The study further went on to suggest that by adopting sustainable and clean energy options and diversifying away from crude oil the country can solve its energy crisis. However, important strategies will need to be put in place for the realization of this goal such as – effective renewable energy policies that will drive the transition from crude oil-based power generation to renewable energies.

Clean energy technologies face certain challenges in developing countries, ranging from poor awareness, lack of appropriate funding, etc. A research [10] highlighted the challenges that Solar thermal electricity face in Nigeria. It was construed that the absence of implementable plans towards synergizing solar thermal electricity with current capacity is not due to lack of supporting policy by the Government, but rather the paucity of strong political in endorsing the renewable energy policies. The paper also noted the staggering challenges which current fossil fuel prices and jointed subsidy lend to discourage substantial investment in the renewable sector.

These papers can be grouped under SDG 7 (Affordable and clean energy), as they point to the challenges faced by the Sustainable Energy Sector in Nigeria (and applicable to other Nations in the world at large), ranging from policy formation, and subsequent implementation of aforementioned policies by the Government.

Besides the complications in the energy sector, there also exists a deficit in public infrastructure on the African Continent. In line with this overarching problem, the United Nations Development Programme (UNDP) identified Industry, Innovation and Infrastructure (SDG 9) as a major challenge facing most African States. Improved infrastructures will contribute immensely to the development and prosperity of African states as it thrusts economic growth. Investigation on how the provision of infrastructure contributes to the development of African nations demonstrates how poor infrastructure (i.e. bad road networks) hamper Rural-Urban linkages, meanwhile increased linkages between rural and urban settlements can be instrumental in increasing rural productivity thereby promoting development and economic integration. Studies show that roads account for less than 7% of the land area in most African cities where these road networks have barely kept up pace with urban growth sprawls, this is in sharp contrast with the reality experienced in more developed cities [11].

Investments in infrastructure influence the economic growth and development of regions in Sub-Saharan Africa. This has been proven by a study on the contribution of infrastructure to economic growth [12]. Africa's trade is encumbered by the array of poor infrastructure, inadequate transport infrastructure, and inadequate power which reduces profit margins and further discourages foreign investment. The infrastructural needs of Africa plausibly exceed its ability to finance them. This situation presents an opportunity, for foreign private finance. However, to date, private finance has been limited in Africa. The paper suggests that this problem can be tackled through a combination of public and private initiatives which address the public and private market failures which have existed to date [13].

A plethora of research works that assess the economic markets and infrastructural status/systems of various States across the world have been conducted and published in leading Journals and repositories. These studies can be catalogued under SDG 9 (Industry, Innovation and Infrastructure) and if research results and recommendations are effectively implemented Worldwide economic growth and development can be achieved in the proposed time frame.

For sustainability efforts to be sustained the wellness and health of its drivers must be ensured therefore making good sanitation practices a paramount concern. Carriers of the Plasmodium parasite and other related disease-causing parasites are usually abundant in areas with poor sanitation and lack of access to clean water. An investigation was carried out on the failings of contemporary centralized sanitation and water systems in a bid to achieving SDG 6; identifying reliable, realistic, and economical alternatives. Novel integrated systems for rainwater harvesting, self-cleaning ponds, and waterless toilets were developed and compared to existing alternatives. These new systems were also assessed for their incorporation into daily communal life [14].

The identification of appropriate sanitation systems is far from trivial in developing urban areas where local needs are not justifiably satisfied by conventional infrastructure. In a paper “Generation of sanitation system options for urban planning considering novel technologies” developed a procedure to generate a set of sanitation system options as an input into a structured decision-making process for analyzing conventional and novel sanitation system options and future suitable incorporation of these sanitation system options in diverse urban settings. The developed procedure can be utilized for generating and exploring novel sanitation technologies as they are developed and included in the already large portfolio of options [15].

Conventional plastics take a prolonged period to degrade in the environment (hundreds, even thousands of years) and thus constitute a substantial percentage of municipal garbage. These plastics overtime break-up into tinier bits called microplastics. These plastics in municipal waste management sites and the environment at large; discharge toxic pollutants which go on to contaminate groundwater; cause changes in CO2 cycle; and release harmful neurotoxins [16], [17]. An Investigation of Biodegradation Speed and Biodegradability of Polyethylene and Manihot esculenta Starch Blends conducted by Abioye et al. (2019), developed a degradable polymer blend with Low-density Polyethylene and locally sourced starch acting as the base materials. The research results showed that the produced biopolymers were bio-degradable and environmentally friendly, and are a commendable effort in the bid to reduce waste accumulation and pollution of the environment in line with SDG 6.

These research efforts alongside the many others covering the same scope can be categorized under the UNDP Sustainable Development Goals 6 and utilized in attaining a global system in which clean water and viable sanitation systems are widely available and accessible.

This paper sought to study completed final-year projects (over a specific period) and further classify them into groups constructed in alignment with the SDGs and Agenda 2063. This grouping allowed for straightforward cataloguing and presentation of the data using the Microsoft Access database followed by consequent analyses of developed database with SAS (software).

2. Methodology

Two hundred and twenty-seven (227) completed final-year projects of undergraduates (from 2009/2010 – 2015/2016 session) in the Department of Mechanical Engineering in one of the leading Universities in Nigeria were considered for the purpose of this research.

The first stage of the design was the identification of different final year projects in the department. A database was designed using the Microsoft Access Software, the key parameters considered for the design of this database were the project title, the author, the project year, department, keywords of the project and fields of study for the project (based on Scopus classification, United Nations SDG's and African Union Agenda).

Out of the seventeen global goals set by the United Nations for developing countries; eight goals were selected for the purpose of this project. The eight goals considered were; clean water and sanitation (SDG 6), affordable and clean energy (SDG 7), industry innovation and infrastructure (SDG 9), sustainable cities and communities (SDG 11), responsible consumption and production (SDG 12), climate change (SDG 13), life below water (SDG 14) and life on land (SDG 15). Additionally, all seven aspirations of the African Union Agenda were considered in the design of the database. The aspirations considered are as follows; productivity and sustainable development in Africa (Aspiration 1), IOT/ ICT in Africa (Aspiration 2), transparency/publicity (Aspiration 3), peace engineering in Africa (Aspiration 4), social/cultural change in Africa (Aspiration 5), optimization of people in Africa (Aspiration 6), contribution/collaboration of Africa (Aspiration 7). Five hundred Scopus topics related to various engineering fields under Mechanical Engineering such as Aeronautics, Automobile, Corrosion, Energy, Engineering Management, Mechatronics, Material Science, Production, Robotics, Simulation, Thermodynamics, Software, Metallurgy were also given consideration during the design of the database. The process flowchart for the study is

as depicted in Figure 1. Upon completing the development of the database, the Microsoft Database file format (.accdb) was converted to an Excel spreadsheet format (.xlsx) which was then imported into the SAS software environment. Analysis of imported data was then carried out utilizing available tools in the software's environment. After the analysis, graphical information comparing the input parameters of the database were generated in the form of bar charts, pie charts and tables.

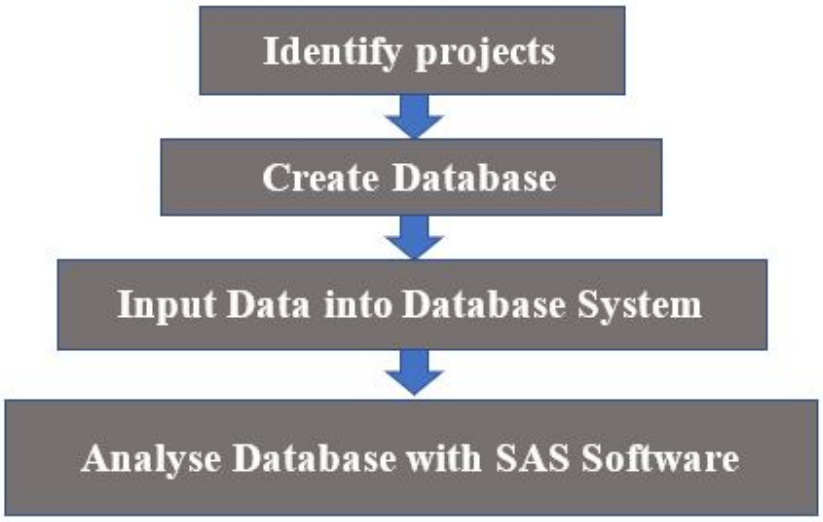

Figure 1: Process flow of the study

3. Result and Discussions

Figure 2 shows the total number of projects in the database when ran on the SAS software, from the observation a total of 227 completed project were compiled for an observed length of 2184 secs.

The CONTENTS Procedure

Data Set Name	WORK.IMPORT	Observations	227
Member Type	DATA	Variables	20
Engine	V9	Indexes	0
Created	03/16/2018 00:01:51	Observation Length	2184
Last Modified	03/16/2018 00:01:51	Deleted Observations	0
Protection		Compressed	NO
Data Set Type		Sorted	NO
Label			
Data Representation	SOLARIS_X86_64, LINUX_X86_64, ALPHA_TRU64, LINUX_IA64		
Encoding	utf-8 Unicode (UTF-8)		

Figure 2: Database details from SAS software

The analysis of the SAS software according to different fields in the Mechanical Engineering Department revealed that projects under the field of corrosion engineering had the highest percentage as shown in the chart in Figure 3, production engineering was the next field with a percentage of 24.67 % while fewer numbers of research were carried out in the field of automobile.

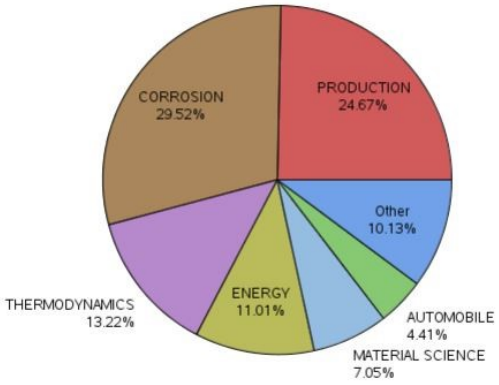

Figure 3: Distribution of engineering projects according to field of specialisation

Analyzing the database by the SAS, based on SDG parameters for the classification, it was discovered that SDG 9 (Industry innovation and infrastructure) has the highest number of projects compared to others in the department as shown in Fig. 4.

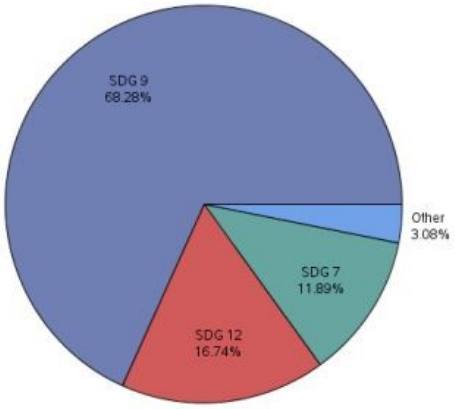

Figure 4: Distribution of projects according to the SDGs

The database was analyzed according to the African Development Agenda, most of the projects done in the department were categorized under aspiration 1 which stands for a prosperous Africa based on inclusive growth and sustainable development. The aspiration 1 has 92.96 % while other aspirations have only 7.05 % of the total projects as shown in Fig. 5.

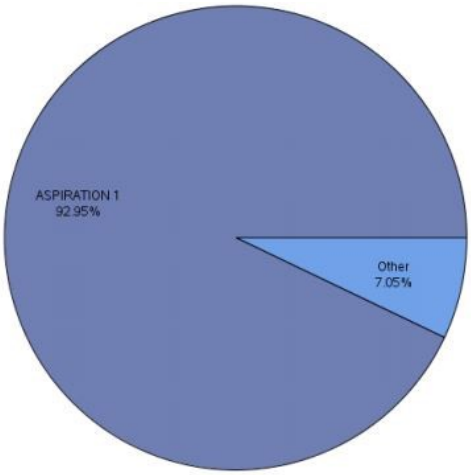

Figure 5: Distribution of projects according to the African Development Agenda

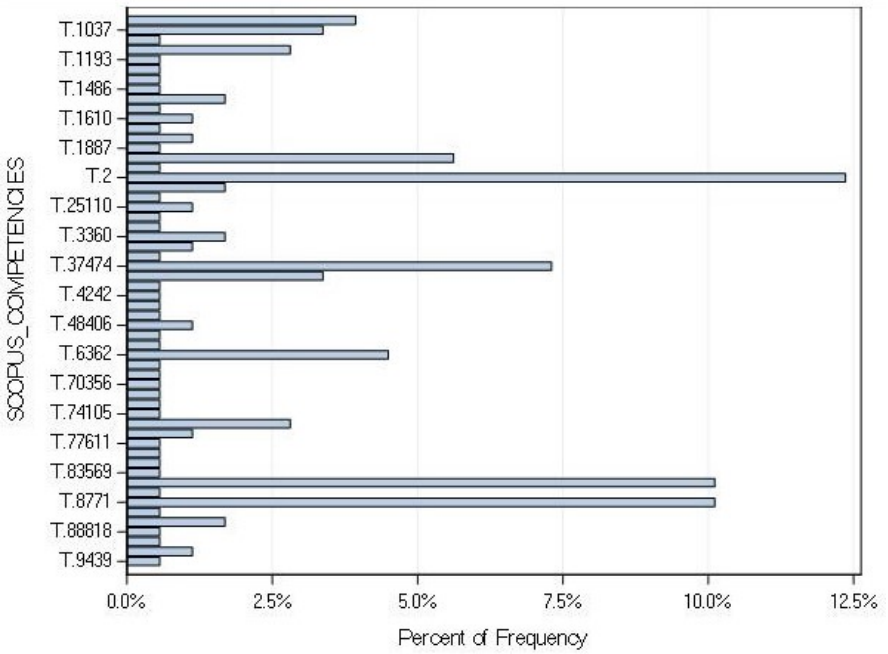

Figure 6: *Scopus distribution of projects as illustrated on a bar chart*

4. Conclusion

To achieve SDG's and AU aspirations the university must play an important role as projects need to reflect the vision of the set agendas of each goal and aspiration, a projects relevance to society will be based on the number of issues it solves. Since the SDG AND AU aspiration mirror the issues and challenges confronting the world at present, it can also be said that a project relevance can be measured by the number solutions it provides to the issues highlighted by the SDG and AU aspirations, therefore it is important that a well-defined evaluation process for selection of project should be embarked on before the commencement of such project, this evaluation can be done by a group or an individual who can use appropriate means or resources to pre-determine the impact the project will have on society.

Furthermore, Africa as a developing continent possess enormous potential and also faces underdevelopment in some sectors, some issues are peculiar to certain areas, it is paramount that university projects from such areas focus on those problems using the SDG and AU aspiration as guidelines in the research work and also for implementation as such work should reflect on the guidelines set by the UN and AU.

An all-inclusive African starts from an strong link between governments and institutions of African Nations this will help speed up connectivity and co-operation between African universities thereby driving a strong sense of pan-Africanism, these process will lead to sharing of ideas between institutions that will enable students thrive better also students will need to be oriented as regards to the SDG and AU aspiration so they can implement it into every invention or innovative idea.

The start points of actualizing these goals is now by imbibing a strong spirit to solve problems facing the society through impactful projects and new ideas to leave a better future for the next generation.

Reference

[1] H. F. Korth and A. Silberschatz, "Database research faces the information explosion," *Commun. ACM*, vol. 40, no. 2, pp. 139–142, Feb. 1997.

[2] UN News Centre, "UN adopts new Global Goals, charting sustainable development for people and planet by 2030," *United Nations Dep. Econ. Soc. Aff.*, 2015.

[3] Q. Wang and Z. Yang, "Industrial water pollution, water environment treatment, and health risks in China," *Environ. Pollut.*, vol. 218, pp. 358–365, Nov. 2016.

[4] U. B. Akuru, I. E. Onukwube, O. I. Okoro, and E. S. Obe, "Towards 100% renewable energy in Nigeria," *Renew. Sustain. Energy Rev.*, vol. 71, pp. 943–953, May 2017.

[5] H. Jouhara *et al.*, "Municipal waste management systems for domestic use," *Energy*, vol. 139, pp. 485–506, Nov. 2017.

[6] A. A. Adenle *et al.*, "Managing Climate Change Risks in Africa - A Global Perspective," *Ecol. Econ.*, vol. 141, pp. 190–201, Nov. 2017.

[7] African Union Commission, "The Africa We Want," Addis Ababa, 2015.

[8] N. V. Emodi and K. J. Boo, "Sustainable energy development in Nigeria: Current status and policy options," *Renew. Sustain. Energy Rev.*, vol. 51, pp. 356–381, 2015.

[9] S. O. Oyedepo, "Towards achieving energy for sustainable development in Nigeria," *Renew. Sustain. Energy Rev.*, vol. 34, pp. 255–272, 2014.

[10] O. Ogunmodimu and E. C. Okoroigwe, "Solar thermal electricity in Nigeria: Prospects and challenges," *Energy Policy*, vol. 128, no. September 2015, pp. 440–448, 2019.

[11] B. Arimah, "Infrastructure as a Catalyst for the Prosperity of African Cities," *Procedia Eng.*, vol. 198, no. September 2016, pp. 245–266, 2017.

[12] O. Kodongo and K. Ojah, "Does infrastructure really explain economic growth in Sub-Saharan Africa?," *Rev. Dev. Financ.*, vol. 6, no. 2, pp. 105–125, Dec. 2016.

[13] P. Collier, "Attracting international private finance for African infrastructure," *J. African Trade*, vol. 1, no. 1, pp. 37–44, 2014.

[14] M. Han, S. Hashemi, S. H. Joo, and T. Kim, "Novel integrated systems for controlling and prevention of mosquito-borne diseases caused by poor sanitation and improper water management," *J. Environ. Chem. Eng.*, vol. 4, no. 4, pp. 3718–3723, 2016.

[15] D. Spuhler, A. Scheidegger, and M. Maurer, "Generation of sanitation system options for urban planning considering novel technologies," *Water Res.*, vol. 145, pp. 259–278, 2018.

[16] A. A. Abioye *et al.*, "Investigation of Biodegradation Speed and Biodegradability of Polyethylene and Manihot Esculenta Starch Blends," vol. 20, no. 2, pp. 65–72, 2019.

[17] S. M. Mintenig, M. G. J. Löder, S. Primpke, and G. Gerdts, "Low numbers of microplastics detected in drinking water from ground water sources," *Sci. Total Environ.*, vol. 648, pp. 631–635, 2019.