

Developing a Research Management Strategy for the Faculty of Engineering, Ahmadu Bello University, Zaria, Nigeria

BELLO MUKHTAR

Abstract

One of the cardinal responsibilities of universities is to conduct research, which contributes to the body of knowledge and in some cases translates to process or product development. The latter enhances socio-economic and technological advancement. Over the years, the Faculty of Engineering at the Ahmadu Bello University in Nigeria has made significant contributions to manpower development and capacity building in Northern Nigeria in particular and Nigeria, in general. However, it has a low profile with regard to high-impact research output. One of the main challenges is the lack of an effective research management strategy. In this paper, a research management strategy has been developed for the Faculty in order to help increase its research output and make the research relevant in enhancing socio-economic activities within the institution's catchment areas or surrounding communities, the northern region of Nigeria and the entire country. An environmental scan was done to ascertain the Faculty's strengths (in terms of staff profile, available laboratory facilities, research experience and collaboration), weaknesses, opportunities and threats. It was found that the Faculty has a critical mass of qualified academic staff members and extensive research experience in some specializations. Therefore, five priority research areas were identified and a research management structure developed. The key objectives of the research management structure are to establish a strong research culture, promote inter-disciplinary research that impacts positively on socio-economic activities, enhance collaboration, boost research skills of staff members and, in the long term, create a remarkable research profile for the Faculty.

1 Introduction

1.1 Ahmadu Bello University

From one university in 1948, Nigeria now (in September 2018) has one hundred and sixty-five universities. Of this figure, forty-three are federally owned, forty-seven owned by state governments and seventy-five privately owned (NUC, 2018). Ahmadu Bello University (ABU) was established in October 1962 by the Government of the then Northern Region and was taken over by the Federal Government of Nigeria in

1975, thus becoming a Federal University (ABU, 2018). It is among the five first generation universities in Nigeria and the first in the Northern part of the country. It started with five Faculties (Administration, Agriculture, Arts & Social Sciences, Engineering and Sciences) and 426 students. However, within the fifty-six years of its existence, it has grown to become the largest university in Sub-Saharan Africa. It has a land area of about seven thousand hectares, two campuses, five out-stations, many affiliated colleges, several Institutes, Directorates and Specialized Centres, sixteen Faculties, two Schools (School of Postgraduate Studies and Business School) and one hundred and nine Academic Departments with over five thousand postgraduate degree programmes.

Presently, the University has a population of about forty-three thousand undergraduate and fourteen thousand postgraduate students drawn from different parts of Nigeria and other parts of the world (SPGS Annual Report, 2017). In addition, there are thousands of other students from the affiliated colleges and those pursuing degree programmes via distance learning. It has an academic staff strength of over three thousand five hundred and a non-teaching (researchers, technical, administrative and other supporting staff) staff strength of nine thousand. The vision of the University is to be 'a world-class university comparable to any other, engaged in imparting contemporary knowledge, using high quality facilities and multi-disciplinary approaches, to men and women of all races, as well as generating new ideas and intellectual practices relevant to the needs of its immediate community, Nigeria and the world at large'.

The University has excelled in the area of manpower development, capacity building and has helped to nurture several universities in the Northern part of Nigeria. It has produced over eight hundred thousand graduates at the sub-degree, first degree, postgraduate degree and honorary degree levels – most of whom have held influential administrative and political positions in both the private and public sectors. Its graduates include a former President of the Federal Republic of Nigeria, two former Vice Presidents and several captains of industry. This was well-captured by Galadanci (2012) during the University Convocation Lecture when he wrote that "when one looks at the employees of most public and private organizations, not only in the North, but in the entire country, one can say with certainty that Ahmadu Bello University has been able to adequately fulfill the dream of its founding fathers in the area of manpower development. When one compares Ahmadu Bello University with other Nigerian universities, it comes out with flying colours probably ahead of all others". In addition, the University has produced many prominent personalities at the international level such as Dr. Mansur Mukhtar – Alternate Executive Director, World Bank, Prof. James Adegoke – an award-winning climate scientist and Professor at the University of Missouri-Kansas City, United States, Dr. Mohammad Sanusi Barkindo – Secretary General, Organization of Petroleum Exporting Countries (OPEC), Prof. Elizabeth Odilile Ofili – Professor at the Washington University in St. Louis, physician, cardiology researcher and the first woman to become president of the Association of Black Cardiologists and Prof. Ibrahim Agboola Gambari (for-

mer academic staff), former Under-Secretary General and Head of the Department of Political Affairs, United Nations.

However, in the area of high-impact research output, the University has a low profile. Although there is a lot of research being conducted by the academic staff members, researchers in the various research institutes/centres within the University and thousands of postgraduate students, one of the main challenges is the lack of coordination due to an absence of an effective research management strategy. This hinders achievement of high-impact research output that solves socio-economic challenges and helps in the economic and technological development of its catchment area (immediate communities and the region) and Nigeria, in particular and the world, in general. Recently, the University has established the Centre for Research and Innovation with the mandate to enhance research activities and support innovation. This will hopefully help to advance solution-based research that will resolve some pressing socio-economic and technological challenges within the region and the entire country. In addition, the University research policy is being developed. Part of the policy states that “The ABU Research Policy is a university wide policy and the guidelines should be seen as a framework for sound research practice. The University shall develop portfolios of research that are of regional, national and international relevance and build on the strengths of the University and/or create strengths which the University has identified as a priority. Individual researchers form the backbone of the University’s research system. However, identification of areas of comparative advantage for ABU needs to be undertaken” (ABU, 2018).

As a policy, the University is also making effort to transit to a postgraduate university that will focus on postgraduate training and research. The policy will enable the University to devote more effort in postgraduate training of academic staff from other universities (especially the newly established universities within the region), begin to invest in research in order to achieve substantial research expertise and productivity and establish strong research culture. This will transform the University from a knowledge store to a knowledge factory where knowledge for socio-economic development is generated through intensive research and will bring regional, national and international recognition and attract research funding to the University.

1.2 Faculty of Engineering

The Faculty of Engineering was established in 1962 as one of the pioneering Faculties in the University. It started with three Departments; Civil, Electrical and Mechanical Engineering. However, over the years, it has grown to ten Departments with thirteen first degree programmes, about forty postgraduate degree programmes, over five thousand undergraduate students, about seven hundred and fifty postgraduate students, two hundred and sixty-eight academic staff members and two hundred and sixty-five non-teaching staff (technical and administrative staff). The Faculty has produced about thirty thousand graduates at the first degree and postgraduate degree level. The Faculty has a critical mass of qualified academic staff members, some of whom attended universities in Europe, North America and Russia and were among

the best during their postgraduate training. In addition, there is the Nigerian Journal of Engineering (NJE), which is a publication of the Faculty and for over forty years has been consistently publishing Engineering and Applied Science-based research findings in order to disseminate knowledge generated through research.

Despite all its potential, the Faculty has not been very prominent in terms of research output that addresses the socio-economic and technological challenges within the country. It has also made very little contribution in addressing important global issues. The main factors negatively affecting research include a weak research culture, lack of research management strategy, inadequate facilities and poor funding. Therefore, with the current plan by the Ahmadu Bello University to re-strategize and focus on research, all academic Departments and Faculties need to be on-board and develop an effective research management strategy that will strengthen their research capabilities in-line with the University's policy.

As the Faculty of Engineering is one of the key faculties that the University is looking up to for solution-based and high-impact research output, this study was undertaken in order to develop a research management strategy. The project reported here was undertaken as a Project Action Plan (PAP) for participants in the International Deans' Course (IDC) training organized by the German Academic Exchange Service (DAAD), University of Applied Sciences, Osnabruck, Germany, the Centre for Higher Education, Gutersloh, Germany and other stakeholders. The main objective of the project is to create a research coordination framework in the Faculty for better quality and goal-oriented research output. Key tasks include sensitization of stakeholders, environmental scan, and identification of research priority areas and creation of research management structure.

2 Brief Literature Review

Worldwide, universities are increasingly recognized to have an important role in the economic development of their societies in addition to their traditional roles in teaching and research (Smita and Kimmo, 2005). Over the years, basic and applied research activities at leading universities in the world have helped in solving numerous societal problems and to drive new product development, which in turn gives birth to new companies and thousands additional jobs. For example, in the United States, the roles of the Massachusetts Institute of Technology in growth of the industries in the greater Boston area and of Stanford University in the Silicon Valley area are enormous. In the United Kingdom, Imperial College London (ICL) has produced many spin-off companies within the last ten years. The Faculty of Engineering in the ICL has recorded considerable success commercializing the results of its academic research, which shows its commitment to drive innovation and provide sustainable solutions to global challenges (ICL, 2018). Solution-based research is also key to attracting research funding, which is increasingly becoming highly competitive. For instance, University of Victoria, Canada, has strong research capacities that enabled

it to experience a steep trajectory for research income growth from approximately \$31 million in 2000–01 to \$112 million in 2007–08, and thereafter an annual average of over \$100 million. From 2009 to 2014, funding to the University from the federal research council agencies, government agencies, non-governmental organizations and industry has also grown steadily (UV, 2015). In order to increase funding and share resources for research, collaboration is also increasingly becoming very important. For example, the University of Ibadan, Nigeria, has many research collaborations through signing of Memorandum of Understanding (MoU) with several universities in the United States, United Kingdom, Germany, China and South Africa, which have contributed to its research output success story (UI Annual Report, 2017). Thus, a world-class university should excel both in academic excellence and have a strong research base, which can enhance its bond with the society it serves through solution-based research activities.

3 Methodology

The first phase of this work involved sensitization of stakeholders on the need to have a well-coordinated research management strategy in the Faculty, in particular and the University, in general. Discussions were held with the Deputy Vice Chancellor (Academic), Dean of the Faculty of Engineering, Director, Centre for Research and Innovation, some Heads of Department and staff members. The issue was also raised at different fora within the University especially during the Faculty monthly colloquium to emphasize its importance. The second phase was an environmental scan to ascertain the staff strength, available facilities, on-going research projects and research areas that have received most attention over the years, which the Faculty had developed experience and critical mass. In addition, an analysis to identify the Faculty's strengths, weaknesses, opportunities and threats (SWOT) was carried out. This was intended to enable the Faculty understand the prevailing environment in which it operates and to specifically determine the critical issues that need to be addressed in order to make it more competitive. Therefore, several intervention activities can be initiated to address the challenges identified in the SWOT analysis. Finally, the third phase, which involved identification of priority research areas and development of a research management structure for the Faculty.

4 Findings

4.1 Sensitization of Stakeholders

From the discussions and interactions with the various stakeholders including university administration, deanery, heads of department and staff members, there is an overwhelming desire to see that the Faculty in particular and the University in general, re-strategize and focus on research activities that have the potential to solve so-

cio-economic and technological challenges within the region and the entire country. Thus, every effort towards enhancing research output and management that would benefit the immediate society and the regional and national economy would likely receive maximum support and encouragement. However, some academic staff members are reluctant to key-in to the idea of prioritizing research areas, citing concerns around funding. They argue that there should be research freedom within the Faculty because worldwide, it is recognized that academic freedom to pursue what and how research is conducted is a fundamental principle to building a strong research culture. Therefore, while a strategic research management plan will naturally allocate more resources to the research priority areas identified, it is equally important not to neglect the issue of academic freedom and broader research community. Hence, the Faculty should also plan to invest in other research and innovative areas outside the priority areas for substantial intellectual, technological, social and cultural contributions to its immediate communities, region and the entire country.

4.2 Environmental Scan

4.2.1 Staff Profile

The Faculty is endowed (qualitatively and quantitatively) with academic staff members. In addition, there is a good number of technical and other supporting staff members. However, most of the technical staff members need further training to enable them discharge their job responsibilities effectively. Table 1 gives the distribution of the number of staff members in the various Departments within the Faculty while Figure 1 shows the breakdown of the academic staff members based on their ranks; Professorial cadre (Professors and Associate Professors), Senior Lecturers and Lecturer I and below (Lecturer II and Assistant Lecturers). About 50% of the academic staff members have obtained the Doctor of Philosophy (Ph.D.) degree.

Table 1: Distribution of staff members in the Faculty

Department	Academic Staff	Technical	Administrative
Agricultural and Bio-resources Engg.	21	54	8
Chemical Engineering	54	31	8
Civil Engineering	36	24	7
Communications Engineering	21	7	4
Computer Engineering	17	4	4
Electrical Engineering	13	16	4
Mechanical Engineering	38	23	8
Metallurgical and Materials Engineering	21	11	3

(Continuing table 1)

Department	Academic Staff	Technical	Administrative
Polymer and Textile Engineering	23	12	8
Water Resources and Environmental Engg.	24	6	11
Dean's Office	--	1	11
Total	268	189	76
Grand Total	533		

As indicated in Figure 1, the academic staff composition is different for the various Departments. For instance, Department of Metallurgical and Materials Engineering has a substantial proportion of senior academic staff members with 67% staff members on the Professorial cadre and Senior Lecturer ranks. Departments of Agricultural and Bio-resources Engineering and Polymer and Textile Engineering have 52% staff members on the Professorial cadre rank, which shows higher proportion of senior academic staff members in the two Departments. Departments of Chemical, Civil, and Water Resources and Environmental Engineering have a near-equal distribution between staff members on the Professorial cadre rank and Senior Lecturers on one hand and Lecturer I and below on the other hand. However, there is substantial number of academic staff members on the rank of Lecturer I and below (younger academic staff members) in the Departments of Communications Engineering (67%), Computer Engineering (76%), Electrical Engineering (77%) and Mechanical Engineering (71%).

Overall, there is a fair distribution of academic staff members on the ranks of Professorial cadre and Senior Lecturers (45%) and Lecturer I and below (55%) in the Faculty. Therefore, there is a good mix of the experienced and the young researchers in the Faculty that can help boost quality research output. However, certain important issues need to be considered in order to enhance the effectiveness of the staff members such as research being considered as a workload and factored into staff schedule of duties, continuous training on contemporary research issues and recruitment of academic staff members based on research specialization area and expertise (Antia, 2018).

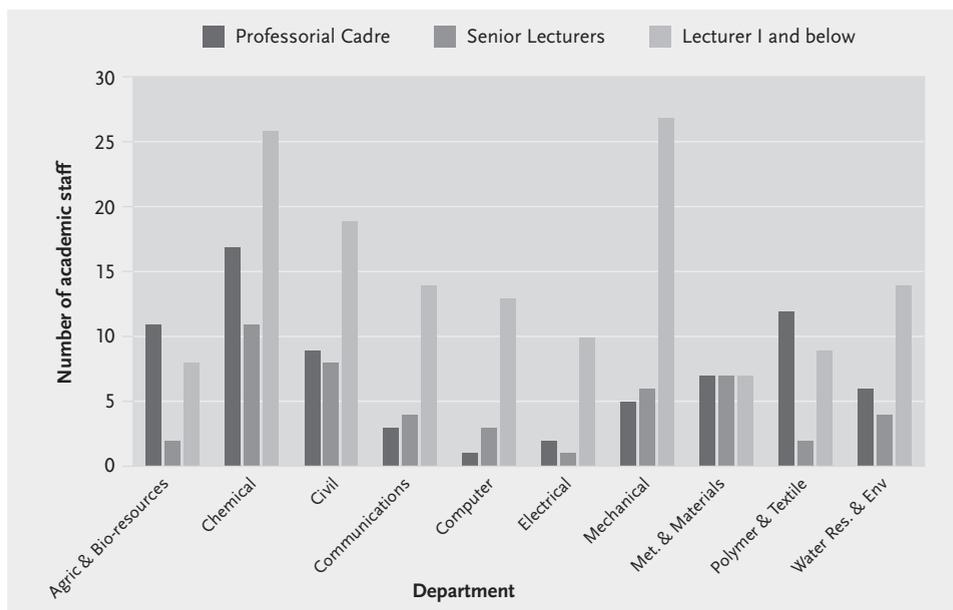


Figure 1: Breakdown of academic staff members on different ranks for the various Departments in the Faculty

4.2.2 Available Research Facilities

There is a reasonable number of simple laboratory apparatus. However, there is paucity of high-tech characterization and testing facilities in the various laboratories within the Faculty. In addition, chemical reagents needed for materials synthesis and testing are mostly unavailable and where available they are largely in insufficient quantities. Table 2 gives a sample list of available equipment in the laboratories within the Faculty.

Availability of laboratory facilities is quite important because it enhances research skills and output in terms of publications (Journal/Conference papers) and patenting of innovative ideas by the academic staff members in the Faculty. This increases the visibility of the Faculty, in particular and the University, in general. In addition, it can significantly contribute to proffer solutions to the numerous regional and national socio-economic and technological challenges.

4.2.3 Interventions to Support Research in the Faculty

Within the last two decades, the Faculty had received support from some public and private organizations aimed at facilitating research activities. These include endowment of two Professorial Chairs: Shell Petroleum Development Company Professorial Chair in the Department of Mechanical Engineering and Petroleum Technology Development Fund (PTDF) Professorial Chair in the Department of Chemical Engineering. The Shell Professorial Chair supports research on corrosion studies of oil and gas facilities while the PTDF Professorial Chair has a mandate to develop zeolite catalysts used for the fluid catalytic cracking (FCC) process in a petroleum refinery.

Currently, all the four petroleum refineries in Nigeria import the zeolite catalysts for the FCC process, which costs the country millions of dollars annually. However, with the endowment of the Chair, significant research success has been recorded with many publications and a patent. It is hoped that the developed catalysts will further be enhanced and commercialized, which will significantly reduce the petroleum refining cost in the country. This type of intervention with specific targeted research outcome is highly desirable because of its potential impact.

Another significant intervention is by the Nigeria Liquefied Natural Gas (NLNG) company that donated \$2 million to the Faculty as part of the company's \$12 million University Support Programme (USP) for six selected universities in the country. The USP scheme was launched in 2014 to help develop engineering education capacity in the country. The money has been used to provide a Multi-user Laboratory in the Faculty, which was commissioned in March 2016. It has six specialized research laboratories, fairly-equipped with materials testing, characterization and environmental analysis facilities. However, more of this kind of support is needed in order to boost research output and enhance its quality.

4.2.4 Faculty Research Profile

In the Faculty's fifty-six years of existence, a lot of research has been conducted by the staff members and students. However, much of this research is largely individual in nature and uncoordinated. Recently, the Faculty introduced a monthly colloquium to acquaint staff members of on-going research activities in the various Departments, to share experience and create research teams. This is aimed at having a coordinated approach towards achieving targeted research outcomes. It is impressive that some Departments within the Faculty have recorded remarkable success over the years though a lot more would have been achieved if there were planned research strategies and proper co-ordination. For example, the Department of Agricultural and Bio-resources Engineering has a mechanization programme with an aim to develop and evaluate appropriate technologies for production and post-harvest operations of the Institute for Agricultural Research (IAR) mandate crops in the North-West Agro-Ecological Zone. The programme has three main sub-programmes to achieve its broad objective, namely; Machinery/Technique Evaluation, Machinery/Technique Development and Machinery Management.

So far, it has made giant strides such as the development of a Maize dehusker sheller with a capacity of ≥ 850 kg/h and a threshing efficiency, cleaning efficiency and grain damage of 99.5%, 98% and $< 1\%$, respectively. In addition, it has developed several other agricultural equipment such as groundnut oil extractor, multi-purpose grinder, crop stalk crusher and multi-crop thresher for threshing of sorghum, millet and soybean. The Department has also been involved in the training of artisans and technicians at local and international level on prototype fabrication and on farm equipment use and maintenance. Similarly, the Department of Mechanical Engineering has developed an eco-friendly energy efficient car. All the materials and components used to manufacture the car were sourced locally (either fabricated or recycled from existing appliances). The car has participated in several exhibitions.

For example, Shell Petroleum Development Company of Nigeria Limited organized a 'Road Show' in Lagos, Nigeria, in March 2015. The car participated and passed all the technical tests including safety, ergonomics, energy efficiency, body and interior design as well as overall weight. Subsequently, the company invited the University to participate in the 'Shell Eco Marathon Competition' in the Netherlands. There is also a team in the Department of Chemical Engineering working on the development of a modular refinery for research and development activities.

In addition, staff members in several departments within the Faculty have conducted research on different aspects of renewable energy. It is clear that there is adequate expertise within the Faculty for further development and application of renewable energy technologies for use in rural and urban areas for domestic, institutional and commercial purposes such as solar crop dryer, solar cookers, solar water heaters, biogas for cooking and heating and biodiesel for use in vehicles and other machineries. If research funding is available, the Faculty can fabricate proto-types of these renewable energy devices, build bio-fuels pilot plants and micro-hydro power plants. The proto-types can then be further developed and manufactured in commercial quantities by private companies. This will significantly contribute in solving the socio-economic challenges especially of the immediate communities. However, all the outstanding research outcomes reported here were conducted by just about 25% of the academic and technical staff members in the Faculty. This means that more could be achieved if majority of the staff members are actively involved through a deliberate strategy and coordination.

4.2.5 Summary of the SWOT Analysis

4.2.5.1 Strengths

The Faculty has qualified academic staff members. They are mostly young with opportunities to grow and can help energize the research agenda of the Faculty while the highly experienced professors provide the leadership. The Faculty also has many academic staff members with several years of research experience in some specializations. With minimal support to this category of staff, in terms of training for grants proposal writing and collaboration, they can attract research funding. In addition, the number of students being admitted for the various postgraduate degree programmes in the Faculty has recently increased sharply due to the large number of applicants. The postgraduate students can significantly help to boost the Faculty's research output. The Faculty has also produced thousands of graduates, which has placed it at the top not only within the region but in the entire country. This gives the Faculty an advantage to attract support from both public and private organizations.

4.2.5.2 Weaknesses

The Faculty's biggest weakness is lack of a strong research culture. Research activities are mostly individual in nature or being conducted by small research groups at the Departmental level and mostly targeted at publication for promotion. There is no deliberate attempt to emphasize to the staff members that research is part of academic life and in the Engineering discipline it is not only for academic publications

but also a means of solving contemporary socio-economic and technological challenges that brings immediate benefits to the society. There is also the lack of established agenda for mentorship. For instance, in some departments, the young academic staff members are not being properly mentored by the senior and experienced professors on research and ethics; instead they are left to use their own initiatives. This is a threat to transfer of knowledge, sharing of experience and sustainability of high-quality research output. It will also deter development of the next generation of globally recognized professors and researchers. In addition, the new generation of technical staff members that are supposed to manage the laboratories are not adequately trained. This poses a problem of inability of the technical staff members to appropriately operate and maintain the laboratory equipment and assist postgraduate students in conducting laboratory experiments accurately, which compromise the integrity of the data generated and can lead to misleading results. In some cases, there is also politicization of recruitment of both the academic and technical staff members, which threatens the quality of staff members for effective service delivery.

There is also paucity of state-of-the-art laboratory facilities. This affects the quantity and quality of research output and restricts the kind of research that can be undertaken. In addition, the Faculty has a very low research grants profile. Much of the research is conducted through the efforts of the staff members and the students without any research grant. In fact, even the University itself has not been providing research funds and there is no indication that this will change in the near future. Finally, there is the non-existence of an established reward system. Staff members that excelled in their area of specializations through their outstanding research output are hardly officially recognized. This tends to give a wrong signal to the majority of the staff members that they do not have to work extra-ordinary.

4.2.5.3 Opportunities

The Faculty has a vast alumni network, which it has not properly utilized for its benefits. However, with a well-planned strategy and good coordination, it can still reach out to its alumni for support. For instance, the Faculty is organizing a Scientific Conference and home-coming for its alumni (supposed to be in November, 2018 but has been postponed to a later date in 2019 yet to be announced due to a strike action by the academic staff members). This will avail the Faculty an opportunity to showcase its successes over the years and pressing challenges (such as inadequate laboratory and learning facilities) with the hope of seeking the support of the alumni to overcome the challenges. The Faculty can also use its 'goodwill' to seek collaboration with some national and international institutions in order to share resources and experience. This can provide both the staff members and the postgraduate students an opportunity to share experience and use research facilities (that may not be available within the Faculty) in the other institutions. There are also many national and international research grants awarding organizations that support excellent research proposals. Therefore, the Faculty can provide adequate training for its staff members on research grants proposal writing and grants management in order to compete for the scarce resources globally. This will enhance research skills and boost research output.

4.2.5.4 Threats

There is persistent problem of inadequate funding from the federal government. This demoralizes staff members and enormously affects the quality of the research output. The new Faculties of Engineering within the Universities in the region and the country as a whole are becoming very dynamic and, in some cases, have surpassed the old Faculties of Engineering like that of Ahmadu Bello University in terms of available facilities and quality of service delivery. For instance, there are three other universities within the North-western region of Nigeria that have Faculty of Engineering. Among them, the Faculty of Engineering in Bayero University Kano is the most established. It has won the Science and Technology award for the nationwide Universities Research and Development Fair (NURESDEF) in 2010 and the Research and Development award in the Techno Expo organized by the Raw Materials Research and Development Council (RMRDC) Abuja, Nigeria in 2011 (BUK, 2018). There is the tendency that the Faculty can attract more students especially the post-graduate students that tremendously assist in research than the Faculty of Engineering in Ahmadu Bello University. Therefore, the Faculty of Engineering in Ahmadu Bello University needs to be proactive and reinvigorate itself in order to maintain its competitiveness.

5 Identification of Priority Research Areas and Creation of a Research Management Structure

5.1 Identified Priority Research Areas

Based on the extensive research conducted and experienced acquired by the staff members and postgraduate students of the Faculty over the years, the following key research priority areas have been proposed:

1. Design and Fabrication of Agricultural Equipment and Machineries
2. Development of Renewable Energy Resources and Technologies
3. Process Analysis, Modelling, Simulation and Optimization
4. Development of Composite Materials for Institutional and Industrial Applications
5. Environmental Degradation Mitigation and Management

Each of the identified research priority areas is multi-disciplinary in nature. For example, design and fabrication of agricultural equipment and machineries can be a collaborative undertaking by some staff members in the Departments of Agricultural and Bio-resources Engineering, Mechanical Engineering, Metallurgical and Materials Engineering and Electrical Engineering. Every discipline has a key role to play and bringing specialists in specific areas together would lead to quality research output. The key research areas are targeted at impacting positively on the socio-economic activities of the immediate communities, the region and the entire country. Excellent research coordination in these areas would enhance food and energy security in a sustainable environment. In addition, it would boost research skills and spur

innovation. Therefore, the identified priority areas have the potential to strengthen the Faculty's research capabilities and hopefully lead to high-impact research output.

However, it is important that even though the Faculty should focus on the identified research priority areas for enhanced research strengths, it should also support other areas of research because not everyone is expected to fit within the priority areas. Moreover, research by its very nature is constantly evolving; what is cutting edge and very important today may be obsolete and irrelevant in the near future. Hence, while the research management plan encourages allocation of more time and resources on the identified priority areas, it is important not to neglect the broader research community.

5.2 Research Management Structure

It is extremely important to have a well-defined research management structure in order to coordinate research activities in the Faculty for enhanced research output and profile. Therefore, it is suggested that a Faculty Research Committee should be formed, which shall be chaired by the Faculty Representative to the University Board of Research. The Committee's responsibilities are to oversee the activities of the research groups for the identified priority areas, serve as a conduit for communication from the research groups to the deanery, initiate and promote collaboration with other institutions and private organizations, develop strategies for the marketing of the research outcomes and monitor the Faculty's research performance. Figure 2 shows the block diagram for the proposed research management structure in the Faculty.

It is equally important that support services are provided to the research groups by the Faculty. These include preparing applications for research grants proposals, identification of potential research funding agencies and collaborators (both public and private organizations), preparation of the research contract agreements and administration of projects after research grants awards have been secured and support in procurement of laboratory facilities. Institutional support and commercialization of research outcomes are among the key enablers for a successful research management (Ziegele, 2018). Overall, the key objectives of the developed research management structure are to:

- a) establish a strong research culture that promotes dedication to research excellence, innovation and entrepreneurial activities;
- b) encourage inter-disciplinary research and collaboration among staff members in the Faculty and between the Faculty and relevant regional, national and international partners;
- c) promote specific research areas with potential to significantly impact positively on the socio-economic activities in the region, in particular and the country, in general;
- d) enhance research skills of staff members in the Faculty for high quality research output;
- e) create an impressive research profile for the Faculty.

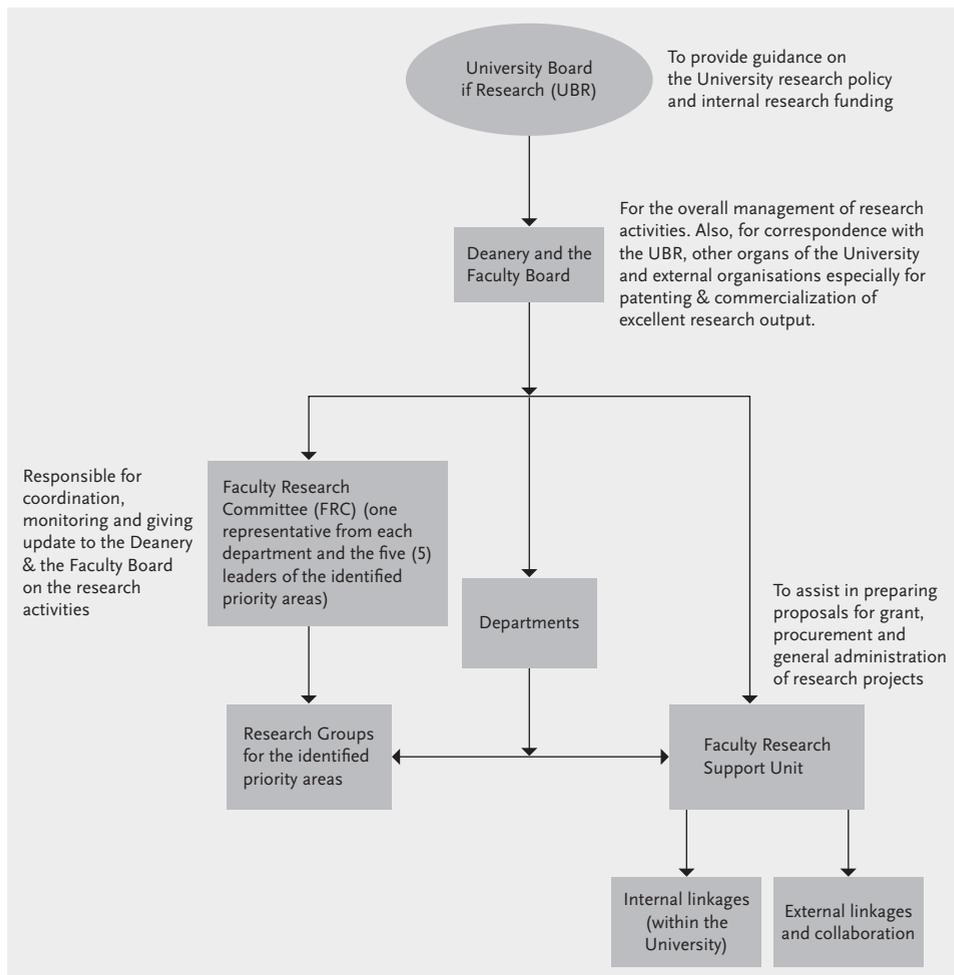


Figure 2: Block diagram for the proposed research management structure in the Faculty

Dissemination of knowledge generated through research is not restricted to the traditional academic publications and conference presentations but also includes innovations and partnerships that impact on economic activities and commercialization of research outputs. In fact, recently many universities are expanding their entrepreneurial activities through development of products and provision of specialized services in order to raise their profile and augment funding. Therefore, promising research output can be patented, licensed and spin-off companies established or private companies can be encouraged to set-up factories for large scale commercial activities.

However, effective implementation of the research management plan is required in order to achieve the targeted benefits. In the short term, success will be measured by an increase in collaboration, research funding and publications. While

in the long term, success will be measured through acquisition of state-of-the-art laboratory facilities for enhanced research capabilities of staff members and commercialization of research products with significant socio-economic benefits. Though, it is pertinent to mention that the identified priority research areas and the developed research management structure be frequently reviewed and updated in order to make it responsive and relevant at all time.

6 Conclusion

Research is one of the main functions of universities, which are increasingly being recognized to have an important role in the socio-economic development of their societies. Based on the findings in this study, it is clear that the Faculty of Engineering in Ahmadu Bello University has adequate and qualified academic staff members that can boost research output. In addition, over the years, a lot of research has been conducted by the staff members and postgraduate students in the Faculty and some have recorded significant success. The SWOT analysis indicated that while there are very important challenges that need to be addressed, the Faculty can still use its potentials in order to improve the quantum and quality of its research output. However, with better coordination in terms of streamlining to focus on priority research areas and having a well-defined research management structure, the Faculty can excel in research by creating a strong research culture that would lead to an outstanding research profile.

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