

Implementing SWOT Analysis in Engineering Education in Africa

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Abstract: A research on engineering by the Royal Academy of engineering (RAE) in the year 2012 revealed that engineering has the capacity for economic and social development in various countries of the world. With the numerous opportunities and strength in engineering education comes its weaknesses and threats which necessitates a look at SWOT analysis. SWOT analysis is a tool for strategic planning and strategic management in organizations. This study analyzed implementation of SWOT analysis in engineering education in Africa and SWOT analysis as a concept was examined. Findings from the study revealed that SWOT analysis evolved in the 1960s. Though with improvement in knowledge and time, it has been superseded by other tools such as resource-based planning and competency-based planning. It is a tool for strategic planning and strategic management. There is no general convention or method for implementing SWOT analysis generally. Understanding the context and prevailing conditions is key in determining the appropriate dimension to exploring SWOT analysis in engineering education in Africa. The study therefore recommends that more effort be intensified on advancing the strengths and opportunities engineering education has while also overcoming its threats and weaknesses.

Keywords: SWOT, strengths, weakness, opportunities, threats, engineering, engineering education

I. INTRODUCTION

A research on engineering by the Royal Academy of engineering (RAE) in the year 2012 revealed that engineering has the capacity for economic and social development in various countries of the world. With engineering education, there is the impetus to contribute to the economic and social strength of any nation. With engineering as old as human existence, it has evolved as humans explored and gained mastery of their environment. With evidences from various masterpieces built which has contributed to better living standards for people in various countries of the world, engineering education is pivotal for global development. Matthews *et al* (2012) found out that engineering education is constrained by varieties of factors such as massive shortage of engineering skills, deficiency in students as they cannot transform the knowledge in them into productive outcome for societal development. This huge gap from the educational institution to the society might be a major bane to development in Sub Saharan Africa. With the numerous opportunities and strength in engineering education comes its weaknesses and threats which necessitates a look at SWOT analysis. SWOT analysis is a tool for strategic planning and strategic management in organizations. According to Thompson *et al* (2007) SWOT analysis is a simple but powerful tool which helps in sizing up an organizations resources abilities and flaws, the opportunities it has in the market and the external threats that can affect the organization in the future.

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SWOT analysis is a vital for evaluating the internal strengths and weakness and the external opportunities and threats in any context. The two dimensions of SWOT analysis focuses on the internal and the external environment. In the external analysis, the various critical threats and opportunities are considered while in internal analysis, the focus is on the strengths and weaknesses. SWOT analysis is a vital tool for situation analysis and It helps managers in evaluating various organizational and environmental factors. This also applies to engineering education as there are numerous factors that affects the discipline. Engineering education as a discipline has its strength weakness, opportunities and threats which this study seeks to unravel. The purposes of this study were to analyze, to describe SWOT and to formulate an implementation strategy for SWOT analysis in engineering education. Furthermore, this study also aims to shed light on the right implementation strategy that will confer excellence in maximizing strength, tapping into various opportunities, reducing weaknesses and overcoming threats in engineering education in Africa.

II. METHODOLOGY

This study takes a look at implementing SWOT analysis in engineering education in Africa. It is important to note that SWOT analysis is a tool for strategic planning and strategic management and it has been in existence since. Evidences from relevant literature were used to logically analyze what SWOT analysis is and its components and to understand implementation of SWOT analysis in engineering education in Africa.

Potentials of engineering education in Africa

Africa especially sub-Saharan Africa has been on the path of robust economic growth in recent years and this has made the region to attract foreign investments. This is manifested in a plethora of investments made in the region. It has been opined that to leverage fully on the vast economic potential the region possesses, there is a need to develop the human capital in the region in the areas of science, engineering and technology (The World Bank, 2014). This typifies the importance of engineering as a panacea for economic growth and development in Africa. This is a dimension by which engineering is essential for survival in Africa. It is noteworthy to bear in mind that Africa as a region has in it vast deposits of resources which is key to unlocking the potentials of the region but the presence of these huge resources has not culminated in development in the region. This has been a matter of mystery to discerning minds and how a resource rich country is characterized by widespread poverty and has become a region for global charity and aids is baffling.



With the need for wide infrastructural development in Africa to broaden the region's growth trajectory and to encourage other development such as construction of roads, bridges, buildings, airports and harbours. With a wide array of resources, there is a need to also accelerate industrial development especially in manufacturing. There is also the dire need to meet the regions need for energy to overcome the shortage of power and its attendant consequences. There is the need to focus on the natural resources in the region and all this can only be possible through engineering. This is a dimension by which engineering education is important in the African sub-region. This is in line with the findings of Matthewset al (2012) who opined that the Royal Academy of Engineering (RAE) had a research on engineering in Sub-Saharan Africa and it was argued that engineering capacity is vital for economic and social development of any nation. Matthewset al (2012) found out that Sub Saharan Africa is challenged by a massive shortage of engineering skills and the number of engineering graduates do not meet up with societal demands in Sub-Saharan Africa. A report by the Royal Academy of engineering (2012) identified engineering capacity needs in Sub-Saharan Africa and it was revealed that there is a shortage of skilled and experienced engineers in sub-Saharan Africa and this lack of capacity is inimical to achieving all the goals of development which engineering seeks to achieve. From the study also, there was notable levels of unemployed graduates among engineering graduates which was attributed to lack of necessary skills and experience that can make them employable. Some of the reasons for this include low level of investment in engineering projects, poor legislation on engineering standards for professional registration, inadequate regulatory laws to ensure that foreign companies effect knowledge transfer to local engineers, inadequate resources in the engineering institutions to support engineering activities and poor quality of education caused as a result of old archaic teaching methods and curricula.

Understanding SWOT analysis as a concept

According to Learned et al (1965) SWOT analysis evolved in the 1960s. Though with improvement in knowledge and time, it has been superseded by other tools such as resource-based planning and competency-based planning. This implies that SWOT analysis had long been in existence as a major tool for strategic planning. It is important to bear in mind that SWOT is an acronym for strength, weakness, opportunity and threat. It has various uses depending on context and some have argued for its use as a tool for strategic planning while some are of the opinion that it is a tool for evaluation. It has applicability in all areas of human endeavor as the elements within it are pivotal to overall success. Its use is varied across various disciplines and it has come in handy in analyzing various agencies, institutions, personality, events, scenarios, processes and structures. Individually, it is also applicable to humans as a tool for self-evaluation and one form of self-evaluation is through the analysis of strength, weakness, opportunity and threat which encompasses SWOT analysis. Though it is important to maintain objectivity in such evaluation. SWOT analysis can be done on individual and group level (Pandya, 2017). This implies that each individual strength, weakness, opportunity and threat can be looked at as well as group

strength, weakness, opportunity and threat. Renata et al (2018) opined that SWOT analysis can be used to analyses the problems that occur repeatedly in an agency or institution as a weakness or a threat and outcomes, achievements and success within the agency or organization can be identified as strength or opportunity. It is key to note that humans make up systems and they are the major building block of an agency or institution. With each individual and different skillset, competencies and capabilities, they exert influence on the agency or institution as a whole. Each individual also has different skills, competencies and capabilities which also influences individual outcome within the agency or organization. a critical outlook at each person's skills, competencies and capabilities is key evaluation and individual growth. These differences in people consequently influences their strength, weakness, opportunity and threat. Assessing people's competencies and capabilities is therefore a vital approach for encouraging personal growth. So also, is an evaluation of the organization. Going forward from the individual parlance, the agency or institution is also influenced by the bank of people within it and understanding their strengths, weakness, opportunity and threat will help in influencing organizational outcome. Mary and Robbins Coulter cited in Suryatama (2014) opined more on the definition of SWOT analysis. It was defined as an analysis done within the organizational unit which is used to identify strengths that are owned, weaknesses within the organization, opportunities for development and threats that may surround the operation of the organization. An organization does not exist in a vacuum, it is surrounded by various condition which seeks to influence it. By virtue of some factors like the bulk of human capital and social capital an organization has, it might confer unique strength on them. Take for instance, an organization that is keen about excellence with a caveat for recruiting people with stellar competencies and capabilities in them. Having such crop of people within the organization can propel its strength and consequentially payoff great dividend for the organization. so also, as a result of hierarchy and personal differences in an organization coupled with bureaucratic bottlenecks, it can be a weakness to the organization. By virtue of positioning as a reputable brand, tested and trusted over the years, it might confer more opportunity on the agency or organization as the go-to brand for a particular service. The prevailing external conditions in any clime influences the organization and can be seen as threats. The dynamics of the state, policies and legislation, general occurrence and global happenings all can be a threat. So, it is important to put into consideration all these factors while planning. Shahijanet al (2016) was of the opinion that SWOT analysis can be applicable as a tool to explore the strengths and weakness in an organization as well as opportunities and threats in the external environment. Before venturing into something new, SWOT analysis can prove pivotal in understanding the current status of the organization and knowing what is needed for and what decisions, resources and individuals are needed for the success of any enterprise.



The prospect and viability of a business operation is vital before kicking off and analyzing the strengths, weakness, opportunities and threats can help in ensuring business success. The results from the SWOT analysis will provide more clarity from an organizational standpoint, it will also proffer recommendations on the right approach and strategies that can help to achieve predetermined goals. Take for instance, in designing an engineering project that will benefit all, it is important to evaluate what are the series of factors that can positively influence the project or negatively affect it. This will provide light and clarity as to the viability of the project and its overall success. Various authors have defined SWOT analysis and its applicability on individual or group level. Each definition has similarities on the purpose of SWOT analysis as it is done with the aim carrying out development through strength and opportunities individually or in the organization and minimize the vulnerabilities that will come from weakness and threats in the external environment. It is often carried out by a person or group of persons who are members of an agency or organization and they do that to have an overview of the strengths the organization or individual possesses, the weaknesses that might affect the person or the organization which must be overcome, the probable opportunities that can help in improvement, expansion or developments and threats from the external environment. Through this analysis, results will be obtained and recommendations will be made for application of appropriate strategies in realizing organizational or personal goals. SWOT analysis is a tool that can help to identify strategic direction, understand oneself and the environment (Andrade & Amboni, 2010). It is also a tool for strategic planning and strategic management in organizations. This is done by analyzing the strong and weak points of an individual, group or organization with the major aim of contributing to the goals of strategic planning (Martins et al, 2013; Paliwal, 2006). What gives more credence to SWOT analysis is the fact that when it is done aright, it reveals things that are not known before. For instance, until there's a critical evaluation of a person, group or organization, one might not fully understand the strengths and opportunities they possess and also the weakness and threats that can affect them. So, it is critical to encourage SWOT analysis on individual basis and in groups. Strategic planning is crucial to the organization and it helps in allocation of resources in order to achieve goals. There is nobody or organization with no goal or objective in mind and there is a need to consider various factors that can help in achieving or realizing that goal. There are immense potentials and possibilities in people and the organization at large and they deploy that the process guided and done in the right way which is strategy. Strategy is important in realizing organizational goals. But there is a need for coordinated effort to ensure that Strategy culminate in personal and organizational growth. It shows the plans, pathway and how to go about it in realizing a predetermined objective. Having this done before venturing into any project or business will confer maximum dividends. In SWOT analysis, various opinions come up, though often qualitative, but it reveals things that are hidden. With the knowing of such, adequate plans will be made for any project before it commences and the conduct of the project

will be guided putting into consideration the strength, weakness, opportunities and threats. Strategy cannot be undermined in any project of worth, having this understanding is important in ensuring that the project is successful. It is important to note that the delivery of a project is predicated on many factors including the environment, and these factors have the potential to influence the success of the project. The beauty of SWOT analysis is in its simplicity.

Unravelling the components of SWOT analysis

Strengths are defining abilities and properties that confer advantage on a person or organization over others. This is revealed in the analysis of the internal environment. As individuals, each person has personal differences and the differences confer advantage on them. In organizational parlance, organizational strength are the prevailing characteristics and situations in an organization that makes them more efficient and effective than other competitors. Homogeneity is not a feature with humans and this has been a defining attribute that separates individuals from others. According to Thompson and Strickland (1989), strength is that which an organization is good at or that defining characteristic that gives the organization an important capability. It might be a resource, skill, competence or other features that confer advantage on the person or organization and separates them from competitors. Strength confers comparative advantage on people or organization. They are the series of defining capabilities and competencies that helps an individual or the organization in achieving its goals. The market is dominated by lots of people and each try to outdo the other. What separates each entity in the market space is the unique strength each player possesses. Weakness is a deficiency and it is an inadequacy in competence needed to achieve something. Weakness in its simplicity is negative and unfavorable and it affects a person or the organization. Thompson and Strickland (1989) revealed that a weakness is what the organization does not have or does poorly when compared to others and it is also a condition that puts a person or organization at a disadvantage. It is a gap that limits the performance of a person or organization. It can be a limitation in skills, resources, competencies and capabilities. It is important to understand weakness and strength in the sense that no strategy can be built on weakness. Opportunities are situation or condition appropriate for an activity. It is an advantage and it helps activities to take place. It is also a favorable and desirable characteristic. Opportunities abound everywhere though it does not look like it, the ability to recognize opportunities is important to personal and organizational growth. According to Harrison and St John (2004), opportunities are conditions present in the external environment that helps the organization to take advantage of strengths, overcome their weakness and conquer their threats. It often yields positive results to people or for the organization. Threats are factors that challenge the possibility of an event being realized or achieved.

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They are unfavorable and disadvantageous to people and the organization. For this reason, it is a negative feature that must be avoided like plague. Threats are conditions that makes it impossible for a person or group to achieve its goals. It is present in the external environment and it challenges a person or the organization. According to Ulgen and Mirze (2010) threats are factors that occur as a result of changes in the external environment and it prevents the organization from maintaining a superior stance in competition which in the long run will be unfavorable to the organization.

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There is no general convention or method for implementing SWOT analysis generally. Understanding the context and prevailing conditions is key in determining the appropriate dimension to exploring SWOT analysis in engineering education in Africa. In implementing SWOT analysis for engineering education in Africa, it is important to conceptualize the strengths, weakness, opportunities and threats of engineering and make recommendations on how the analysis can be carried out. From various evidences, it has been revealed that engineering education has its strength, weakness, opportunity and threats. Understanding the various strength, weakness, opportunity and threats is therefore crucial to this study. Though there are no general convention on what constitutes these elements of SWOT analysis, it will be conceptualized with evidences to support it. The elements of SWOT analysis have been defined above and those elements will be considered viz-a-viz engineering education in Africa. SWOT analysis is a tool for evaluation, and this study will seek to understand the past of engineering education and possible solution to existing problems. The implementation of SWOT analysis in engineering education in Africa will be conceptualized with respect to prevailing conditions. From the definition of engineering by the Royal Academy of engineering (2016), it captures the strength of engineering education. Engineering was defined by the Royal Society of Engineers as the creative application of scientific principles to invent, design, build, maintain and improve structures, machines, devices, systems, materials and processes. This definition of engineering is complex as it has in it the multi-faceted application and strength of engineering. Engineers are individuals that are creative and innovative and they deploy their creativity to proffer solution to various problems of the world and help build the future. Creativity and innovation have been a defining characteristic for engineering education as the discipline encourages the provision of solution to various challenges that exists in a system, process, structures etc. In engendering creativity, creative thinking is deployed and this ensures that a new perspective culminate in the provision of a solution to a problem. Creativity also involves putting concepts, methods, devices, processes together in a new way. It also has in it divergent thought and it is predicated on various amalgamation of knowledge which is driven by collaboration. Engineering education is also a discipline that depicts itself as a problem solver. Generally engineering sciences are typified as troubleshooter and the discipline tend to proffer solution to various complex problems. As times are developing, there are more

challenges to grapple with now and this requires an upgrade to the problem-solving approach that were obtainable in previous epochs. There are many opportunities for engineering education now as we are in a period of massive technological outbreak referred to as the fourth industrial revolution. The opportunities this time portend for engineering education is numerous and it will confer more opportunities on the discipline. The fourth industrial revolution is a period where there is fusion of physical, cyber and biological systems with various attendant technologies impacting all disciplines, economies and industries (Schwab, 2017). Many of the technologies that will prove pivotal as an opportunity for engineering include robotics and automation, big data, industrial internet, virtual reality etc which will affect the conduct and practice of the discipline. One thing is certain that these technologies are viable for opportunities for engineering education and they must be leverage on to derive maximum benefits. We are at a critical period in time where the world is grappling with various challenges such as global economic crunch, environmental issues, economic instability and the global pandemic. This are challenges that are peculiar to various countries of the world and it provides a veritable avenue for solutions to spring up. The harnessing of engineering education can as well be an opportunity in this time as multi-disciplinary solutions are required for various problems of the world. Weakness of engineering are numerous and in Africa, the curriculum is not responsive economically, culturally, pedagogically, and disciplinary. The discipline has not been able to meet up to those following dimensions of responsiveness. The threats of engineering education are the external conditions that might affect the discipline. With the dawn of the fourth industrial revolution, there are some threats that will affect engineering education. The economic condition prevalent in Africa has always been a threat to engineering education. There has been inadequate investment in education that is necessary to facilitate development in Africa as a region. Much more than this, there are also cultural and political dimension to engineering education which can be a threat to the conduct and practice of the discipline. As revealed by the World Economic Forum (2016), there will be an overhaul and transformation in the pattern of work done across various discipline and this will culminate in job creation, job displacement, skills gap. As a result of new jobs created, there will be the need to skill up to meet with the demands of this new job, while those who cannot skill up will be displaced and hence, unemployment increases. The technologies that will emerge as time progresses such as robotics and automation are threats to engineering discipline as some of its processes will be replaced by machines and robots. Implementing SWOT analysis is vital in engineering education as it helps the discipline to adopt its strategies to meet the changing demands and needs of people. It is a major tool that helps in assessing current situations both internally and externally and to implement new strategies that might influence the discipline positively.



Implementing SWOT analysis in engineering education must be done with predetermined objectives in mind. SWOT analysis as opined in the study is a tool for strategic planning and strategic management and it gives perspectives going forward into the future in any endeavor, discipline or individual. Clarifying the objective of the SWOT analysis is vital as a primary step in SWOT analysis in engineering education. Information is also vital in implementing SWOT analysis in engineering education and this can be done using various means such as interviews, group discussion etc. Understanding the organization, business, industry and market is also key in implementing SWOT analysis in engineering education in Africa. no analysis is done in the vacuum, and it takes a crucial knowledge of the particular discipline to unravel its strengths, weakness, opportunities and threats. After the knowledge of the discipline is gained, it will be easy to identify its strength, weakness, opportunities and threats. Going forward from the strengths, weakness, opportunities and threats identified, it is important to use such as a tool for strategic planning and management. In this stage, strategic plans are made on how to maximize strengths and opportunities in the discipline and minimize threats and weakness and a framework is developed.

III. FINDINGS AND DISCUSSION

Findings from this study revealed that Africa as a region has in it vast deposits of resources which is key to unlocking the potentials of the region but the presence of these huge resources has not culminated in development in the region. This has been a matter of mystery to discerning minds and how a resource rich country is characterized by widespread poverty and has become a region for global charity and aids is baffling. To leverage on the vast presence of natural resources in the region, there is a need to intensify effort on engineering education in the region. Findings from the study also revealed that from the definition of engineering by the Royal Academy of Engineering, the profession has in it numerous benefits and advantage for human survival and wellbeing. Some of the numerous benefits it has include its impetus to contribute to the economic and social strength of any nation. Most of these numerous opportunities and strength in engineering education comes its weaknesses and threats which necessitates a look at SWOT analysis. It was also found out that SWOT analysis is a tool for strategic planning and management. It is applicable on organizational level and on individual level. SWOT analysis is a simple but powerful tool which helps in sizing up an organizations resources abilities and flaws, the opportunities it has in the market and the external threats that can affect the organization in the future. It can also be extended to disciplines to understand the strength, weaknesses, opportunities and threats in the discipline. SWOT analysis has many benefits and some of them as revealed in the study include exploring the strengths and weakness in an organization as well as opportunities and threats in the external environment, it can help to identify strategic direction, understand oneself and the environment (Andrade & Amboni, 2010), and it is a vital tool for strategic planning which is crucial to the organization and it helps in allocation

of resources in order to achieve goals. It has been opined that engineering education has its strength, weakness, opportunity and threats. Understanding the various strength, weakness, opportunity and threats is therefore crucial to this study and this study conceptualized and explored the various strength, weakness, opportunity and threats in engineering education.

IV. CONCLUSION AND RECOMMENDATION

This study concludes that engineering education as a discipline has numerous benefits such as contribution to the economic and social strength of any nation. With the numerous opportunities and benefits it has, it also has with it various threats and weakness and understanding the strengths, weakness, opportunities and threats in engineering education will prove pivotal in shaping the conduct of the discipline for better performance and output. The study analyzed what SWOT is and its component while also considering the strengths, weaknesses, opportunities and threats. The study therefore recommends that more effort be intensified on advancing the strengths and opportunities engineering education has while also overcoming its threats and weaknesses.

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