

MANAGING THE PERFORMANCE OF NIGERIAN UNIVERSITIES FOR SUSTAINABLE DEVELOPMENT USING DATA ENVIRONMENT ANALYSIS (DEA)

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Abstract

Performance management is an important strategy for universities to stay competitive and play an important role in the economic development of a nation. Performance evaluation and benchmarking can positively force an organization such as the university to constantly improve in order to survive globally in a competitive environment. The strength and weaknesses of an organization, its activities and processes can be assessed through performance management. This paper presents Data Envelopment Analysis (DEA) as a tool for assessing the performance of Universities in Nigeria. It examines the concept of performance management and sustainable development. It also takes a critical look at outputs of teaching, research and social services as measures of university performance. Information that can be generated from DEA as a measure of performance management that will help universities in contributing to sustainable economics social cultural and technological development of the country were examined. Finally, recommendations are made for the adoption of DEA as a tool for managing the performance of Nigerian Universities.

Keywords: Performance; Management; Sustainable Development; Data Environmental Analysis.

Introduction

The measurement of public sector performance especially when it involves service provision as the case universities is a complex issue. However, this is viewed in comparing public resources in terms of total amount of money expended and the structure of personnel and other resources used up by Nigerian universities and output indicators of

universities such as students' academic performance, graduation rate and research quality. Blanchard (2004) opined that good performance in higher education is expected to produce positive growth. But Nigerian universities are far behind this level when compared with other universities in Europe and America. This is why there is a need for the measurement of performance of universities to determine those institutions that produced maximum outputs from a given quantity of inputs and to suggest ways of improvement to institutions which are yet to be efficient.

Universities are established to develop the skilled manpower required by a nation in its development. The institutions are regarded as centres of excellence for technological and scientific advancement, skills development, production of quality entrepreneurial graduates, and strategic researches and development strategies.

There is no gain saying the fact that the universities are complex organizations, which are often beset with enormous challenges in their performance. To achieve their goals, their inputs, production process and performance must be critically managed for efficiency and effectiveness. There is, therefore, the dire need to ensure constant performance management in the use of the available resources to achieve the set goals of the institutions. This paper, therefore, presents Data Envelopment Analysis (DEA) as a tool for performance management in the universities. It stresses the need to adopt DEA as a tool for performance assessment of the Nigerian universities in their responses to the needs and aspirations of the society for sustainable development.

Performance Management

Performance management is an activity geared towards ensuring that organization goals are consistently achieved in an effective and efficient manner. Thus, it is a systematic process by which an organization involves its employees as members of a group in improving the activities and effectiveness of the organization. This is the concern of stakeholders in any organization, including educational institution.

Performance management is a vital and complex process that involves performance measurement, performance control, performance evaluation and performance benchmarking. Through performance management, one can reveal the strength and weaknesses of an organization operation processes and the level of preparedness to meet clientele's needs and requirements (Zhu, 2003). Lockett (1992) defined performance as a multidimensional construct and the common factors that are frequently associated

organizational performance are efficiency, quality, responsiveness, cost and overall effectiveness while Armstrong (1994) see performance management as a means of getting better results from the organization, team and individual by understanding and managing performance within an agreed framework of planned goals, objectives and standard of achievement and competence.

Managers of universities are often under constant pressure to improve their performances and invariably the performance of their institutions. Therefore performance management is very crucial in the operation of universities because it is used to identify and adopt best practices as means of improving performance and to increase productivity. Zhu (2003), elucidated that performance management is particularly valuable when no prior standard is available to define efficient and effective performance. It is noticed that benchmarking is often used in managing service operation in the service industry like the university, because performance standards are more difficult to define than performance standards in the manufacturing industries.

Benchmarks can be established but they are somewhat limited as they work with single measurement one at a time. This makes it difficult to evaluate a university's performance because such involves multiple and often complex input resources to produce the outputs (university graduates, research etc). The relationships between the inputs and outputs involve unknown Tradeoffs (Zhu, 2003).

Benchmarking in university performance has attracted considerable interests over the last three decades (Jouinady and Ris, 2000). This is analysis (DEA) that can be applied where price are either not available or not relevant, as the case of many non-marketed services (Coelli, Prasada and Battese, 2005). University performance cannot be directly measured but by proxies or performance measure. Performance measures are the numerical or quantitative indicators that show how well each objective is being met (Pritchard, 1990). Neely et al (2002) opined that performance measurement as the process of quantifying action where measurement is the process of quantification and action lead to performance. Performance measures must be based on a set of objectives that are linked to the mission and vision for the future. Therefore, the performance of universities can be measured by the achievement of their goals such as satisfying customers need better than their competitors. An effective performance measurement system is a set of performance measure that provides an institution with useful information that helps to manage, control plan and perform the activities undertaken in the

institutions. Therefore, performance measures must be designed to reflect the most important factors influencing the productivity of the different processes that can be found in the university. Al-Turki and Duffuaa (2003) observed that a performance measurement system should be developed for collecting, analyzing and reporting data and information related to the institutions.

Blumenthal (2003) opined that improved performance might result from improvement in one or more of the following four factors:

- i. **Organizational Stability:** This relates to whether services are consistently delivered and organization survives.
- ii. **Financial Stability:** This is based, especially on short term survival. For example, the ability to pay the institution's bills. Financial stability is often ignored as an area of importance during capacity building in an organization.
- iii. **Programme Qualities:** This is based on indicators of impact, including adequate research about effective programme and outcome management system. This aspect is often ignored in an organization.
- iv. **Organizational Growth:** This is based on attracting resources and providing more services. Adesina (1984) elucidate that growth alone is not an indicator of performance, especially in the educational system.

All these areas are addressed in Data Envelopment Analysis (DEA) as a tool for managing performance of the universities.

Concept of Sustainable Development

The term sustainable development has been tied down to economic prosperity, environment quality, social equity and cultural diversity (Mohammed, 2008). The definition of sustainable development, according to Ogunyemi (2005), has been amplified to integrate issues of economic growth, social development and environmental protection following the Rio Earth summit and the Johannesburg World Summit on Sustainable Development (JWSSD). A very crucial point of consideration when discussing sustainable development, as amplified by Lehman, Christensen and Hansen (2007), is the 1987 World Commission Report, where sustainable development is defined as the process of developing land, cities, business, communities, etc. to meet the needs of the present generation without compromising the ability of future generation to meet their own need (WCED, 1987). Lehman, et al. (2007) also submitted that global sustainable Development Strategy should have the objective of enabling all people

throughout the world to satisfy their basic needs and enjoy a better quality life, without compromising the quality of life of future generations. The World Summit Outcome Document (2005) refers to the interdependent and mutually reinforcing pillars of sustainable development as economic development, social development, and environmental protection. Furthermore, Indigenous people have argued, through various international fora such as United Nations Permanent Forum on indigenous issues and the Convention on Biological Diversity, that sustainable development also involves cultural development. In fact, the universal declaration on cultural diversity (UNESCO, 2001) further elaborates the concept by stating that cultural diversity is as necessary for mankind as biodiversity is for nature. Cultural development becomes one of the roots of development understood not simply in terms of economic growth, but also as a means to achieve a more satisfactory intellectual, emotional, moral, and spiritual existence.

Agenda 21, as enunciated in the World Summit Outcome Document (2005), clearly identified information, integration, and participation as the building blocks to help countries achieve development. It emphasized that in sustainable development, everyone is a user and provider of information. It stressed the need to change from old sector-centred ways of doing business to new approaches that involve cross processes. Hence, the need for public participation in decision making as a fundamental prerequisite for achieving sustainable development.

In the view of Hasana (2007), sustainability is a process which tells of all aspects of human life affecting sustenance. It means resolving the conflict between the various competing goals, and involves the simultaneous pursuit of economic prosperity, environmental quality and social equity famously known as three dimensions (triple bottom line), the resultant vector of which is technology. In the light of the above, for Nigeria to attain a sustainable political, economic, social, educational and technological development, universities operations must be in line with best practice such that their performance will be in agreement with national goals and aspiration and the objectives of sustainable development.

Data Envelopment analysis (DEA), as A Tool for performance Management

Data Envelopment analysis (DEA), introduced by Charnes, Cooper and Rhodes (1978), is a non-parametric linear programming technique for measuring relative efficiency of decision-making unit (DMU) that Performs

the same functions and has identical goals and objectives (Journady and Ris, 2000). Essentially, Charnes et. al. (1978) operationalised, and extended by means of linear programming, the production economic concepts of empirical efficiencies put forth by Farrell (1957). And since 1978, both theoretical developments and practical applications of DEA have advanced at an explosive pace.

Data Envelopment Analysis reveals what operating practices, mix of resources, scale sizes, scope of activities, and an operating unit may adopt to improve its performance in an organization. Furthermore, DEA is a scientifically based methodology that eliminates the needs for some of the assumptions and limitations of traditional efficiency measurement approaches (Bowlin, 1998). It was originally intended for use as a performance measurement tool for organizations that lack profit motivation, that is, not-for-profit maximization, for instance, governmental organizations that are social-service oriented. However, since its introduction, it has been developed and expanded for variety of uses in for-profit as well not-for-profit situations. As stated by Taluri, (2000), it is a multi-factor productivity analysis model for measuring the relative efficiency of an homogenous set of decision-making units.

Data Envelopment Analysis (DEA) is also a non-parametric method, which extends efficiency measures from a single input and single output efficiency analysis to multi-input and multi-output situations. In contrast to the parametric approach, DEA does not require any assumption about functional form. In DEA, the efficiency of a Decision-Making Unit (DMU) is measured relative to all other DMUs with simple restriction that all DMUs lie on or below efficient frontier (Seiford and Thrall, 1990).

The term decision-making (DMU) was coined by Charnes et. al (1978) in their seminar paper on DEA (Thanassoulis, 2001). Bowlin (1998) defined a DMU as an entity responsible for converting inputs into outputs. A DMU should be homogeneous entity in the sense that they use the same resources to produce the same outcomes albeit in varying amounts. For example, University Units such as Departments, Faculties, or Colleges are homogenous as they all perform the same tasks but of course differ in their levels of activities and resources usage. The characterization of a unit assessment, as "decision making" implies that it has control over the process it employs to convert its resources to outcomes. In DEA, the resources are typically referred to as "inputs" and the outcomes as "outputs".

The identification of the inputs and the outputs in assessment of DMUs is as difficult as crucial. The inputs should capture all resources,

which impact the outputs. The outputs should reflect all the useful outcomes on which we wish to assess the DMUs. Furthermore, any environmental factors, which impact the transformation of resources into outcomes, should also be reflected in the inputs or outputs depending on the direction of the impact. In general terms, the essential idea is that we wish to assess how efficiently each DMU, for instance Universities, is handling the transformation process. To do this, we must capture in outputs what the DMU achieves, take into account the resources it uses, and allow within the input-output set for any factor beyond the DMUs control, which may impact its performance. What is under DMU control will, in general, depend not only on the nature of activity in which a DMU is engaged but also on the decision making authority: it has within the broader framework of its parent organization (Thanassoulis, 2001). Different analysis options are available in DEA. Input minimization (or input orientation) instructs DEA to reduce the inputs as much as possible without dropping the output levels. Alternatively, when focus is on raising performance without increasing the resource base, output maximization (output orientation) could be specified. Under this specification, outputs are raised without increasing the inputs. The choice of the appropriate orientation is not as crucial as it is in the econometric estimation case and, in many instances; the choice of orientation will have only minor influences upon the scores obtained (Coelli and Perelman, 1990). In the education sector, the university may be given a fixed quality of resources, for instance, financial resources, facilities required, students entry qualification, and be asked to produce as much output as possible. Thus, an output orientation is more appropriate in that case. However, as pointed out by Journady and Ris (2005), in education, it is difficult to use market mechanisms such as profit to determine the performance of an institution and the economic value of many of the inputs and outputs. Furthermore, most indicators are typical of the ambiguity found in education performance measurements; for instance, high degree results may be due to high entry qualification of the students rather than effective teaching of the teachers or any other variables. In fact, it is difficult to capture the interaction among the various inputs and outputs in the educational system. In an economist's perspective, the way of conceptualizing the production process (inputs and outputs) of an educational institution concerns the additional earnings generated by expenditure on schooling. By offering the possibilities to use multiple inputs and outputs, and to leave out any functional form, DEA, therefore, appears as the most appropriate methodology for higher education evaluations (Journady and Ris, 2005). The type of information derived from

an assessment of performance, using DEA depends on the aim of the assessment and on the particular assessment methods used (Flanassoulis, 2003). It can include but may not be limited to the following:

- (i) identification of good operating practices for dissemination.
- (ii) most productive operating scale size.
- (iii) the scope for efficiency saving in resource use and/or output augmentation.
- (iv) most suitable model operating unit while an inefficient unit may emulate to improve its performance.
- (v) productivity change over time by each operating unit and by the most efficient of the operating unit at each point in time.

DEA is one of the measures which support this type of information. Since its introduction in 1978, various researchers all over the world have used DEA to estimate the performance of such complex social organizations as the universities in their respective countries. For instance, Coelli (1996), Avian (2001), Abbot and Doucouliagos (2003) in Australia, Ahn, Charnes and Cooper (1988), Salerno (2002) in the United States, Athanassopoulos and Shale (1997) in the United Kingdom, Mcmillan and Data (1998) in Cadana, Jongbloed and Coleman (1996), Jongbloed and Salerno (2003) in the Netherlands.

In all these efforts, DEA has been found to be efficacious in measuring performance, using input-output analysis.

Output Measures of Universities

The output measures that accurately reflect the role, function and performance of a university are teaching, research and community service. We need to identify output measures associated with each of these activities. In terms of teaching we may consider the following output measures as discussed by Coelli et al. (2005):

- (i) Number of Students
- (ii) Number of full-time equivalent students – this measure account for part-time and full-time students.
- (iii) Number of students in different disciplines – in social sciences, sciences, medicine and engineering.
- (iv) Number of undergraduate and postgraduate students.
- (v) Number of weighted full-time equivalent students – by discipline and level.

The teaching indicators considered by Ana and Edgar (2002) were:

- (i) Number of recipients of Bachelor, Master and Doctoral Degrees granted by the university.
- (ii) Teaching load of the department which is an index, computed by the university administration, taking into account the number of hours taught by the department on graduate and undergraduate programmes plus hours for supervising students projects.
- (iii) Undergraduate work volume (sum of number of students enrolled on all courses multiplied by the number of credit hours of the course for department).

If all the universities under consideration have a similar student-mix, then the choice of the output measure may make too much difference to the Performance measure in that region.

Research outputs of a university may be measured using different variables highlighted by Ana and Edgar (2002) as:

- (i) Number of Research Publications: Number of books, book chapters, journal articles, conference papers and other scholarly publication.
- (ii) Number of Weighted Research Publication: Each publication is weighted depending upon whether it is a book or a chapter or a journal article – it is necessary to specify some weights in constructing this measure.
- (iii) Quality of Research Publication: This aggregate is formed by weighting each publication by the quality of the medium in which it is published.
- (iv) Total Research Grant Income Received: Although, this variable is considered as research output, there should be an agreement as to whether grants are an input into research or an indicator of research output, because it could be controversial.
- (v) Total number of postgraduate students trained during a given year, since postgraduate programme is mainly research-oriented.

It is necessary to select one or two of these indicators to measure research output. We may observe here that, there may be a strong correlation between these variables, in which case choice of one variable over another may not have serious consequences.

They also itemized the indicators of community service as follows:
 • Number of social assistance registered in the academic planning unit of the university.

- Number of cultural activities registered in the academic planning unit of the university.
 - Number of scientific meetings (national or international) and conferences organized by the university.
 - Number of consultant activities delivered to the private firms
 - Number of courses delivered to the local community
 - Number of seminars, lectures and symposia delivered to the local community
 - Number of technical services delivered to the local community
 - Number of student scholarship granted to extension project developed by the university.
- These performance measures if carefully handled will greatly influenced the performance of universities which in turn will help the nation in the attainment of sustainable development.

Conclusion and Recommendations

As stated earlier, the first issue to be to be considered in measuring the performance of the university is the choice of an appropriate measure of performance. In the private sector, a variety of measures are used to access performance. These include: profit, rate of return on assets, unit cost, and other simple partial productivity measures (Coelli, 1992). It has been argued by researchers for instance, Bowlin, (1998), Jouinady and Ris, (2000), Lopes and Lanzer, (2002), Zhu, (2003), Coelli, Prasada and Battesse, (2005) that these are not perfect measures of public sector performance, especially in assessing university performance. The profit and return on asset measure may not be a suitable measure of university performance because (i) output prices of research papers and degree courses are not available and (ii) if output prices are available, profit maximization is not one of the stated aims of the university (Coelli, 1992). The unit cost and other partial productivity measures are not suitable in this context, because universities are multi-input and multi-output organizations, and these measures deal with a single input and a single output. For instance, student-teacher ration can be a very misleading measure of performance because it does not account for research output and also does not account for non-staff input such as material and financial resources.

In Nigeria, the performance of universities is evaluated by a group of external referees in the same area of knowledge in the form of accreditation

panel. This procedure has some merits and demerits for instance, it allows for cross fertilization of ideas while it could be considered to be time consuming and expensive. Frederic (1993) in his study concluded that very few results were obtained after five years of a programme based on external assessments of the quality of Dutch Universities, in spite of the significant resources allocated to that process. In view of this, a relatively fast and less expensive, but still reliable approach to measure the performance of the universities need to be adopted.

A recent attempt to estimate the performance of Nigeria Universities was the study carried out by the National Universities Commission in 2002. The study was coordinated by the 2002 University System Annual Review Meeting (USARM) to assess the performance of Federal Universities with special reference to teaching, research and service to the community. Ten universities were selected for the study, and the performance assessment was based on the stability of academic calendar, quality of teaching, research, funding, physical development, quality assurances, internal efficiency, staff and student union activities and elimination of vices. However, the could be criticized because each Vice-Chancellor was allowed to rate his/her university.

This, therefore, calls for a radical departure from the traditional performance management practices adopted by the National Universities Commission (NUC) to a contemporary university performance-management strategies being adopted in various parts of the world. This is to aid sustainable economic development in the country – a function which universities are founded to achieve. DEA is applicable in this context as a widely used tool for universities performance management. This is because the information generated by the application of DEA in performance assessment of universities will help the under performing universities to improve their performance.

For the Nigerian universities to help in the achievement of the objectives of sustainable development, the resultant effect of which will help in achieving the Millennium Development Goals (MDG) in Nigeria, the inputs and outputs of the institutions must be clearly specified to conform with international standard. Furthermore, quality associated with different output indicators must be carefully selected and taken into consideration. This is because output quality is the basis upon which university performance is measured. Thus, the performance measurement of the institutions, as service organizations is of considerable interest in this context. In carrying out this, application of Data Envelopment Analysis (DEA) must be seen as

an alternative to the erstwhile traditional performance management strategies for improvement.

References

- Abbot, M. and Doucouliagos, C. (2003). "The Efficiency of Australian Universities: A Data Envelopment Analysis". *Economies of Education Review*. 23: 8-97.
- Adesina, S. (1984). *Growth without Development*. (An Inaugural Lecture Series. Ilorin: University of Ilorin).
- Ahn, T., Charnes, A., and Cooper, W.W. (1988). "Some Statistical and DEA Evaluations of Relative Efficiencies of Public and Private Institutions of Higher Learning". *Socio-Economic Planning Sciences*. 22 (6): 295 - 269. Al-Turki, U. and Duffuaa, S. (2003). "Performance Measures for Academic Departments". *The International Journal of Educational Management*. 17(7):330-338.
- Ana, L.M. and Edgar, A.L. (2003). "Data Envelopment Analysis (DEA) and Fuzzyset to Access the Performance of Academic Department: A Case Study of Federal University of Santa Catarina". *Pesquisa Operacional* 22(2):217-230.
- Armstrong, M. (1994). *Improving Organisational Effectiveness*. London: Kogan Page Limited.
- Blanchard, O. (2004). *Economic Future of Europe. NBER Working Paper* 103(10)
- Blumenthal, B.N. (2003). Field Guide to Consulting and Organizational Development. Online at www.authenticityconsulting.com.
- Bowlin, W.F. (1998). "Measuring Performance: An Introduction to Data Envelopment Analysis (DEA)". *Journal of Cost Analysis*. 8: 3 - 27.
- Charnes, A., Cooper, W.W., & Rhodes, E. (1978). "Measuring the Efficiency of Decision Making Units". *European Journal of Operational Research*, 26: 29 - 44.
- Coelli, T. (1996). Assessing the Performance of Australian Universities using Data Envelopment Analysis. Internal Report, Center for Efficiency and Productivity Analysis, University of New England.
- Coelli, T. & Perelman, S. (1999). "A comparison of Parametric and Non-Parametric distant functions with application to European Railways". *European Journal of Operational Research*, 117: 326 - 339.
- Coelli, T., Prasada, R.T.D. & Battese, G.E. (2005). *An Introduction to efficiency and productivity analysis*. USA: Springer International Series.
- Farrell, M.J., (1957). "The Measurement of Productive Efficiency". *Journal of Royal Statistic Society, Series, A3* (120): 253 - 281.
- Frederic, V.A. (1993). "Public Accountability or Fiscal Control: Benchmark of Performance in Dutch University". *Australian Journal of Education*, 40 (1):104-123.
- Hasna, A.M. (2007). Dimensions of Sustainability. *Journal of Engineering for Sustainable Development: Energy, Environment and Health*, 2.
- Jouinady, O. & Ris, C. (2000). *Performance in European Higher Education: A Non-Parametric Production Frontier Approach*, University of New Caledonia, Mimeo.
- Lehman, M., Christensen, P. & Hansen, J.A. (2007). Public -Private partnership and the roles of universities in sustainable development. Mimeo: Department of Business Studies, Aalborg University, Denmark.
- Lockett, J. (1992). *Effective Performance Management: A Strategic Guide to Getting the Best from People*. London: Cogan Page Limited
- Lopes, A.M. & Lanzer, E.A. (2000). "Dea and Fuzzy sets to assess the performance of Academic Department: A case of Federal University of Santa Catarina". *Pesquisa Operacional*. 22: 217 - 230.
- National Universities Commission, (2002). *Report on the Performance of Federal University System*. Abuja: NUC.
- Neely, A., Adams, C and & Kennedy, M (2002). The Performance Prism: The Scorecard for Measuring and Managing Business Success. London Pearson Education Limited.
- Ogunyemi, B. (2005). "Mainstreaming Sustainable Development into Africa School Curriculum: Issue for Nigeria". *Journal of Current Issue in www.tc.columbia.edu/cice/archieve/7.2/72 ogunyemi.Pdf*
- Pitchard, R.D., Roth, P.L., Jones, S.D. and Roth, P.G. (1990). "Implementing Feedback System to Enhanced Productivity: A Practical Guide". *National Productivity Review* 10(1):56-57.
- Seiford, L.M. & Thrall, R.M. (1990). "Recent Development in DEA: The Mathematical Programming Approach to Frontier Analysis". *Journal of econometrics* (46):11-2.
- Talluri, S. (2002). Data Envelopment Analysis Model and Extensions. 31:8 www.decisionscience.org/decisionline/vol13/1/133pom.Pdf.
- Thanassoulis, E. (2003). Introduction to the Theory and Application of Data Envelopment Analysis. Norwell, Massachusetts: Kluwer Academic Publisher.

- Horin Journal of Sociology 3(1): 37-50 Abdulkareem, A.Y. & Oyeniran, S.
World Commission on Environment and Development (1987). Report of The
World Commission on Environment and Development. General
Assembly Resolution 42/187, 11 December 1989.
World Health Organization (2005). World Summit Document September
2005.
Zhu, J. (2003). Quantitative Models for Performance Evaluation and
Benchmarking. USA: Springer's International Series.