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Managing the Performance of Nigerian Universities for Sustainable Development using Data Envelopment Analysis

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Abstract

This paper examines Data Envelopment Analysis (DEA) as a tool for managing performance of Nigerian universities. It posits that performance assessment of the universities through periodic accreditation exercise is proving inadequate to meet developmental challenges at national and global levels .The universities could be able to play their roles effectively if they identify and strive towards improving socio-economic and political needs of the country. University education should also prepare its recipients for present and future needs. These aspirations could be actualized through the use of DEA which is capable of measuring and controlling performance of members of an organization. It is also capable of monitoring inputs, processes and outputs in such university programmes as teaching, research and community services. Its use is therefore recommended for Nigerian universities in order to be able to attain sustainable development.

Keywords: Performance Management, Performance Control, Data Envelopment Analysis, Sustainable Development, Nigerian Universities.

Introduction

Measurement of public sector performance, especially in provision of services in organizations such as universities, is a complex issue. It involves comparing public resources in terms of total amount of money expended, the personnel and other resources, with outputs such as students' academic performance, graduation rate and quality of research. Blanchard (2004) opined that good performance in higher education is expected to bring positive growth. In particular, universities are established to produce skilled manpower required for national development. They are centers of excellence for technological and scientific advancement, skill development, production of quality entrepreneurial graduates, and strategic researches for development.

However, Nigerian universities are far behind this level when compared with many universities in Europe and America. They are often beset with enormous challenges at national and global levels. To achieve their goals, their inputs and production process must be properly managed for efficiency and effectiveness. This paper, therefore, examines the

management of job performance in Nigerian universities. It also stresses the need to adopt Data Envelopment Analysis (DEA) as a tool for evaluating the universities in their responses to the needs and aspirations of the society for sustainable development.

Concept of Sustainable Development

The term sustainable development has been tied down to economic prosperity, environmental quality, social equity and cultural diversity (Ogunyemi, 2005). A very crucial point of consideration when discussing sustainable development is the 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 (World Commission on Environment and Development, I987). In the same vein, Lehman, Christensen and Hansen (2007), stated that global sustainable development strategy should focus on satisfaction of people's basic needs without compromising the quality of life of future generations. The World Health Organization (2005) refers to the interdependent and mutually reinforcing pillars of sustainable development as socio-economic and cultural development, and environmental protection. Furthermore, the World Health Organization (2005), identified information, integration, and participation as the building blocks for countries to achieve development.

Thus, sustainable development would involve all citizens of the nation whose knowledge and skills are essential for solving today's problems and preparing for future challenges. Education is expected to play a central role in the production of these human resources. Particularly, university education is to intensify and diversify 'its programmes for development of high level manpower within the context of the needs of the nation' (Federal Republic of Nigeria, 2004, p.38). In the light of this, for Nigeria to attain a sustainable political, economic, social educational and technological development, universities' operations must be in line with national goals and aspiration. Moreover, performance of units and departments should be properly managed in order to ensure efficiency and effectiveness.

Data Envelopment Analysis (Dea), As A Tool for Performance Management

Data Envelopment Analysis (DEA), which was introduced by Charnes, Cooper and Rhodes (1978), is non-parametric linear programming technique for measuring relative efficiency of organizations which perform the same functions and has identical goals and objectives. 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 method that eliminates 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 as not-for-profit situations. As stated by Talluri, (2000), it is a multi-factor productivity analysis model for measuring the relative efficiency of a 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 DEA, the efficiency of a Decision-Making Unit (DMU) is measured relative to all other DMUs with simple restriction that all DMUs are laying on or below efficient frontier (Seiford & Thrall, 1990).

The term decision-making unit (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 a 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 resource 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".

Identification of the inputs and the outputs in assessment of DMUs is very 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 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 applied. 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 & Perelman, 1990).

In the education sector, the university may be given a fixed quality of resources, for instance, financial resources, facilities, 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 educational 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 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 & 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 (Thanassoulis, 2001). 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, researchers such as Coelli (1996), Abbot and Doucouliagos (2003) in Australia; Ahn, Charnes and Cooper (1988), have used it to estimate the performance of such complex social organizations as universities in their respective countries. In all these efforts, DEA has been found to be efficacious in measuring performance, using input-output analysis.

Dea As A Tool for Measuring Performance of Nigerian Universities

As earlier on stated in this paper, the first issue to be to be considered for determining a level of performance in the university is the choice of an appropriate measure of performance. In the private sector, a variety of indices are used to assess 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); Jouimady and Ris, (2000); Coelli, Prasada and Battesse, (2005) that these are not perfect measures of public sector 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 output and a single input. For instance, student-teacher ratio 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 (accreditation panel) in the same area of knowledge. 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. In view of this, a relatively fast, reliable and less expensive approach to measure the performance of the universities need to be adopted.

An attempt to estimate the performance of Nigerian universities was the study carried out by the National Universities Commission (2002). The study was coordinated by the 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, they 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 of the country – an objective 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 universities to improve their performance.

Output Measures of Universities

The output measures that accurately reflect the role, function and performance of a university are teaching, research and community service. In terms of teaching we may consider the following output measures as discussed by Coelli, Prasada and Battesse (2000):

(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 a course multiplied by the number of credit hours of the course for all courses of all undergraduate programmes taught by the department).

If all the universities under consideration have a similar student-mix, 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 student 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.

Ana and Edgar also itemize the indicators of community service as follows:

(i) Number of social assistance registered in the academic planning unit of the university.
(ii) Number of cultural activities registered in the academic planning unit of the university.
(iii) Number of scientific meetings (national or international) and conferences organized by the university.
(iv) Number of consultant activities delivered to the private firms
(v) Number of courses delivered to the local community
(vi) Number of seminars, lectures and symposia delivered to the local community
(vii) Number of technical services delivered to the local community
(viii) Number of student scholarship granted to extension project developed by the university.
(ix) Number of courses delivered to the local community
(x) Number of seminars, lectures and symposia delivered to the local community
(xi) Number of technical services delivered to the local community
(xii) 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

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 to 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. Therefore, application of Data Envelopment Analysis (DEA) would serve as an alternative to the erstwhile traditional performance management strategies for improvement.

Recommendations

In order to effectively manage the performance of Nigerian universities, the following recommendations were made. Inputs into the universities should be carefully controlled to ensure its quality. This is because inputs quality determines output quality. The production process in the university system must be properly monitored in order to determine the quality of the outputs. For universities to achieve the objectives for which they were established, frequent performance assessment need should be carried out regularly. The National Universities Commission should adopt the use of DEA as one of the tools for measuring university performance in Nigeria.

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