Quality in Egyptian Higher Education Context: DEA Approach to Enhancement of Internal Quality Assurance Systems in Technical Departments[1]

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Abstract— This paper outlines the results of a study aimed to propose a new managerial instrument for performance enhancement of internal quality assurance systems and employ Data Envelopment Analysis (DEA) to estimate efficiency scores for technical departments within Mansoura University (MU). The input measures are constructed from Student Support, Teaching and Learning Methods, Facilities required for teaching and learning**,** Curriculum, Administration& Staff Development. While the output measures are based on Intended Learning Outcomes (ILOs), Quality of Learning Opportunities, and Students Achievement. Using frontier analysis we are able to separate technical departments that might qualify, as performing well from those where some improvement might be possible. A new managerial instrument treats quality enhancement as the relative comparison of a number of comparable departmental decision– making units (DMU's). The evidence suggests DEA technique can help on obtaining national optimal levels of quality dimensions that are directly linked to critical performance outcomes for technical departments. This could imply a better allocation by the university of the usually scarce public financial resources available to higher education institutions (HEI's) and enhancement of internal quality assurance systems.

Keywords— Egyptian Higher Education, Efficiency, Data Envelopment Analysis (DEA), Internal Quality Assurance Systems, Service Quality, Input/Output, Technical Education, Mansoura University.

1. INTRODUCTION

In a speech at the joint session of the people's assembly and Shoura Council 2004, President Hosni Mubarak stressed the importance of quality assurance and accreditation in education. The Ministry of Higher Education, being responsible for the overall education system in Egypt as stipulated in the constitution, took the initiative to develop an overall strategic plan for quality assurance and accreditation to assist Egyptian Higher Education Institutions (HEIs) to enhance the quality of their academic programs and that of their graduates [1] The National Quality Assurance and Accreditation Committee (NQAAC) in Collaboration with British Consultants in higher education and the Egyptian expertise developed the Quality Assurance and Accreditation Project (QAAP) which included in the 25 projects agreed upon by the National Higher Education Conference in 2000. The (QAAP) has also been chosen as one of the six Higher Education (HE) development projects implemented by the end of the year 2002.

NQAAC developed guidelines and procedures required for development internal quality assurance systems to take place in all Egyptian Higher Education Institutions. The system adopted by the institution to improve the level of the educational programmes and other elements affecting them. Such a system involves performance follow-up, suggestions for development and enhancement, programme evaluation, strategic objectives, student assessment, teaching and learning methods, facilities and teaching materials, results of course evaluation by students, course enhancement. Ministry of Higher Education and State for Scientific Research (MHESR) believes that Quality Assurance Project is not a project or a process, but it is a culture and should be the ensemble of elements of higher education enhancement. For that, MHESR developed procedures required for quality enhancement in Egyptian Higher Education through two enhancement plans [2]. The first plan called National Higher Education Reform Plan, and resulted in Strategic Reform Plan for Higher education. It included 25 Distinct Reform Projects, where implementation plan 2002- 2007. First Phase 6 major Fields covering 12 reform projects. The second plan for enhancement was 2006 Updated National Reform Plan, Strategic Planning (Master Plan) 2007-2022, Implementation

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Plan (Second Phase 2007-2012). The elements of quality assurance in the higher education enhancement plan adopting an integrated approach to quality Assurance to achieve international quality standards in higher education. It included: quality assurance systems, competitiveness in higher education, staff and leadership skills development, advanced technical education, ICT infrastructure, and international cooperation in higher education [3].

QAAP / QAAP 2 / CIQAP Projects for Quality Assurance Systems had establishment of Internal Quality Assurance System in 250 Faculty out of 320, preparation of faculties for the quality enhancement and Qualification for Accreditation, (CIQAP) in 50 faculties, and allocated budget for the preparation for Accreditation. The National Quality Assurance and Accreditation Agency (NQAAA) process places on institutions the responsibility for developing both internal and external quality assurance systems. The agency is therefore working with the supreme council of universities in Egypt to develop national reference standards for 19 sectors covering all higher education, and worked on developing quality assurance and accreditation standards for various types of education, especially technical education through Technical Education Projects. Since the 2005s, (HEIs) have been under increasing pressure to become more accountable for the services they provide. Furthermore, Technical Education has had to face increased competition for resources depending on enhancement internal quality assurance system and linkage it with the industrial community. Until the national reference standards are available, institutions should undertake to find appropriate equivalent standards [4].

I see that, although (NQAAC) in Egypt have devoted a great deal of attention to development internal quality assurance systems specially technical education, but there are still some unresolved issues that need to be addressed, and the most controversial one refers to the performance enhancement instrument.

II. Literature review

The issue of quality assurance (QA) in education has attracted much attention by international institutions and initiatives with increasing competition amongst higher education institutions [5]. Quality assurance refers to the procedures, processes and systems that safeguard and enhanced the quality of a HEI, its education and other activities. The concept includes both quality management and quality enhancement. In the enhancement of internal QA systems, quality refers to the appropriateness (fitness for purpose) of quality assurance methods, processes and systems in relation to stated objectives or aims. So quality is verified achievement of objectives. The UNESCO, the Council of Europe, the Socrates Programme of the European Community, the OECD as well as the International Associations of Universities have published policy statements or recommendations related to this topic [6]. In the context of the Socrates Programme, Quality Assurance Systems (QAS) in higher education consist of three levels. First, International level *(European dimension)*, it can mean promoting the development of quality assurance. Second, National level *(External quality assurance system*), it can mean an external quality review process. In the external evaluation, this appraisal is subject to peer-review. Third, Institutional level *(Internal quality assurance system)*, it can be seen as an internal quality process that evaluates and assesses an institution or its programmes in relation to its aims and objective. The internal evaluation is a critical self-evaluation of the faculties and departments with respect to what is achieved; this is carried out in the form of an appraisal that considers self-determined goals [7]. The University of Osijek developed internal quality assurance model at the university to assure standards of achievement, quality of teaching, and quality of management. This model depended on performance evaluation of internal quality assurance systems through three steps: defining quality, measuring quality, and improving quality [8].

One of the main concerns revealed with NQAAC in Egypt, is evaluation of the internal quality assurance system. The prime purpose of such a system is to maintain and improve the level of the educational programmes, the quality of the learning opportunities provided, and other elements

affecting them. This system responsible about process of continuing quality improvement [9]. According to recommendations from the guideline of NQAAC based on the ISO quality management, the NQAAC set up "6 Golden Rules" for developing plan that will lead to evaluate of internal quality assurance systems as following steps: identify the goals, obtain information about current good practice in quality management, specify of quality level and intended outcomes of educational programmes, determine the gaps between quality management system and current good practice in quality management, development a plan to close the gapes and allocate resources to perform these action, and carrying out this plan proceed to implement the identified actions.

During seminar Council of Europe CF (2008), CE put standards and guidelines for enhancement of internal quality assurance, its approval and review of programmes including internal evaluation of study programmes, review team involving staff and students, improvement measures and follow-up [10]. But The Finnish Higher Education Evaluation Council FINHEEC (2006) saw that QA can be used in two ways: it may refer to the QA system of an individual HEI or to the national system for assuring higher education quality. So Quality can be defined in many ways, for instance, quality as exception, as perfection, as fitness for purpose, and as value for money. FINHEEC concerned for Enhancement-led evaluation, it refers to evaluation geared to support HEIs in improving their education and other activities. Evaluation is systematic appraisal and highlighting of value or comparison against objectives, targets, and "measurement" of performance (assessment, as in quality assessment) against set criteria [11].

To understand quality assessment by this way, an attempt to define the evaluation standard independent of any particular service context has stimulated the setting up of several methodologies. In the last decade, the emergence of diverse instruments of measurement such as SERVQUAL [12]. It has been used for assessment of performance of service organization in quality dimension and used regression analysis to determine the relative impact of each service quality dimension on overall service quality. By this analysis, the information can be used to focus organization's efforts on improving those service quality features that have the most influence on overall service quality perception. Cronin and Taylor, (1994) Suggest survey results might be used to compare service quality performance across various units within an organization or across competitors in an industry [13]. Hemmasi, Strong and Taylor (1994) propose that "Performance-importance analysis" be used to manage service quality, it involves first measuring consumers' service quality performance perceptions and measuring consumers' perceptions of importance of each attribute. Then, each service attribute would be plotted on a matrix in terms of its performance score and its importance score to highlight where improvement efforts should be focused [14]. Brown (1997) recommends firms employ a technique which compared service quality performance scores to a set of norms, when there is a tendency for others to outperform the organization under review [15]. Barnett (in *Nielsen, 1997: p.289*) classified approaches to quality assessment: objectivist, relativist and developmental. According to the objectivist approach pass rates or learner drop-out rates are taken into account, but the relativist approach compares quality elements with those of residential universities, and the development approach is geared towards identifying problems in the programme and finding solutions for them. So the relativist approach basically focuses on improving quality by comparison with each other; it could be seen more as a means of quality assurance and accreditation than quality assessment [16].

In view of that, Firdaus (2005) proposed HEdPERF (Higher Education PERFormance– only) a new and more comprehensive performance- based measuring scale that attempts to capture the authentic determinants of service quality within higher education sector in Malaysian tertiary institutions (Non-academic aspects, Academic aspects, Reputation, Access, programme issues, understanding) [17]. But she modified five – factor structure of HEdPERF as the

most appropriate scale for higher education sector (dimension understanding dropped) [18]. Shereen (2007) tested HEdPERF scale to determine which scale had the superior measuring capability in Egyptian higher Education Institutions through terms of unidimensionality, reliability, validity and explained variance. An evidence of fair fit, it was concluded that HEdPERF model fits fairly and represents a reasonably close approximation in the population. Also the empirical analysis indicated to there was good internal consistency in all dimensions of the scale, the validity coefficients for the scale is significant at p = 0.01 level, and it has high ability in explaining the variance of service quality level. The current results also suggest that transforming it into an ideal measuring instrument of service quality for Egyptian higher education sector [19].

Blose, William, and, Leisa (2005) sees that, although some techniques generated information for shaping specific strategic efforts to enhance of service quality and could be used to determine the relative impact of each service quality dimension on overall service quality, but the analysis would not specifically indicate how managerial and/or organization behavior should be strategically modified, and how are resources to be devoted entirely to improving performance on the most influential dimension, and how much adjustment in resources should be made by shifting emphasis from relatively less important dimensions. Another important problem associated with these techniques is that the basis used for judging whether a particular service effort has been adequate is the average performance of other branches or firms [20]. So during the last few years, a national quality assessment system for evaluation of the core activities of universities has been established, the experiences of the new national quality assessments have been reported by Nilsson and Swahn (2001); Sjolund (2002); and Nilsson (2002). These reports were about universities' experience from the first years of participation in assessment activity [21], [22], [23]. Swahn (2004) introduced report about international benchmarking programme managed by ESMU for driving the university's quality assurance a step further than is possible by means of national activities, this report concentrated upon role of international benchmarking in comparison with the established national quality assessment system. Although that, A number of methodological problems encountered during these activities from some difficulties in statistical comparisons which are considerably complicated by the basic concept definition [24]. On the other hand, Davis (1998) proposes that especially in the public sector, instead of benchmarking antique practices, it would be better to invent new ones [25].

III. Enhancement of Internal Quality Assurance Systems and DEA in HEI's

For last reasons, all those approaches are somewhat problematic. In addition to, it seems important to identify efficient levels of the various dimensions of service quality that directly link to measures of specific institute outputs that do, intend to maximize, specially higher education institutions which need technique used for identifying good quality practice by evaluating quality efficiency with compare the efficiency of quality among institutional units where is a relatively homogeneous set of institutional units regardless to differences in organizational structure among universities, together with the growth in student numbers. In other words, higher education institutions needed technique which could be applied to all institutions across the country, irrespective of their different natures and funding regimes. The Data Envelopment Analysis (DEA) - model is able to accommodate it for slightly incomplete data. The technique also other qualities unique to it that imply its value in numerous applications. Such are its ability to determine the following: the best practice-most productive group of DMU's; the inefficient- less productive DMU's compared to the best practice DMU's; the amount of excess resources used by each of the inefficient DMU's; the amount of excess

capacity or ability to increase outputs present in inefficient DMU's without utilizing added resources; and the best practice DMU's that most clearly indicates that excess resources are being used by the inefficient DMU [26].

The application of DEA in higher education has focused on various issues, such as the efficiency of academic department [27], [28]. Universities [29], [30], [31], [32]. Academic Research [33]. University Libraries [34]. Central Administrative Services in Universities [35]. Technical Institutions [36]. Quality Control in Distance Education [37]. Evaluation of Efficiency, Technology and Productivity among Universities [38]. And Performance of Higher Education Institutions [39].

I see that a new analytical technique, (DEA) seems appropriate for enhancement of internal quality assurance systems within HEI's (defined as being faculty or college), this is because amongst other characteristics:

1) DEA used in comparing the efficiency of units homogeneous with set of departmental units. This principle adequately adopts it as judgment not isolated but always in relation to relevant alternatives,

2) DEA can provide quantitative measurement for one unit's efficiency relative to all other units, and to other similar units; identify the sources of inefficiency; identify best–practice department; and providing performance of quality – benchmarking national indicators,

3) DEA can determine the degree of (in) efficiency of a unit by measuring its distance to the efficient frontier which made up of all identified "efficient" units. They all demand the lowest inputs for a given bundle of characteristics, at different scale levels and create a maximum performance of internal quality assurance system. These so called efficient peers represent benchmarks for all inefficient,

4) Furthermore, all units whose efficiency is estimated via the same benchmark(s) have a comparable input – output – structure; otherwise different benchmarks would be identified as reference groups,

5) DEA has the ability to handle multiple inputs and outputs simultaneously, this is important for non-profit making organization like educational departments whose operations are characterized by multiple inputs and outputs and,

6) DEA applies the same vector of parameter weights to all units exogenously would essentially apply one and the national benchmark to all units.

IV. Objective of the Study

Quality in higher education plays a vital role to gain best performance; efficiency of an institution must relate its performance related with internal quality assurance systems. As quality in higher education characterizes multiinput and output system, its measurement through the efficiency score enables to provide an aggregate of performance in terms of quality education. The relative efficiency score of departments enables to rank them and the inefficient departments can pursue continuous improvement strategies by adjusting the slack and target values. So the objectives of this study focuses on proposing Data Envelopment Analysis (DEA) approach that helps for enhancement of internal quality assurance systems in technical departments within Mansoura University, through ranking of technical departments based on their efficiency scores, and defining enhancement areas for inefficient departments.

V. Methodology

The methodology for enhancement of internal quality assurance systems in technical departments illustrated by figure 1.Fig. 1

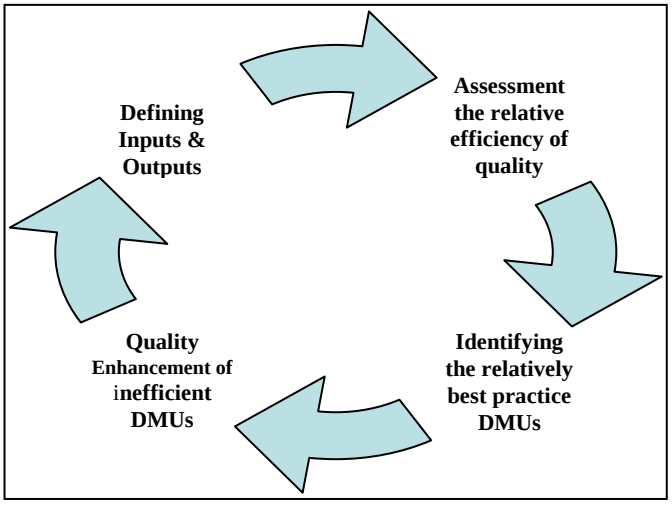

Fig. 1 The framework for enhancement of internal quality assurance systems.

As we see from last figure, DEA treats enhancement of internal quality assurance systems by four steps: 1) Defining Inputs &Outputs, 2) Assessment the relative efficiency of quality each department (DMUs,) 3) identifies the relatively best practice departments (DMUs) to define an efficient frontier, and 4) Measuring the degree of inefficiency of the other departments relative to this frontier to enhancement the quality of inefficient departments (DMUs).

A. Overview of the DEA approach:

DEA is a mathematical programming technique developed by Charnes, Cooper and Rhodes in 1978 to evaluate the relative efficiency of nonprofit and public service organizations to use for monitoring organizational performance. DEA compares the observed outputs and inputs for all units of an organization, identifies the relatively best practice units to define an efficient frontier, and then measures the degree of inefficiency of the other units relative to this frontier. In other words, DEA uses a linear programming approach to measure the potential for input reduction at a unit, given its output levels, or the potential for output augmentation given its input levels.

1. Charnes-Cooper-Rhodes -Model

Since the seminal paper by Charnes, Cooper and Rhodes (CCR) in 1978, there has been a large number of papers, which have applied and extended the methodology, so the basic model DEA is known as the CCR model. It was developed as an extension of what is known as Farrell's single -output/ input technical- efficiency measure, which was introduced earlier in 1957. During the last few years, a number of enhancements to the basic DEA models have been presented in the literature [40]. The DEA method determines efficiency scores by the quotient of the weighted sums of outputs and inputs. Thus efficiency scores, detailing the portion of inputs the DMU is allowed to use to create the current amount of outputs (in the input-oriented model), or vice versa (output-oriented), are conceived. The efficient DMUs, with a score of 1, and their linear combinations form an efficiency frontier, against which the inefficient DMUs are compared [41]. One key property of the DEA method is that the weights, as well as the efficiency frontier, are both endogenous to the model, defined empirically from the data set. This is one of the distinguishing qualities of the method, which has important implications, for example in the case of composite indicator 30 calculations [42]. Also the endogenous weighting removes the need of expert consultation for assigning meaningful weights to an efficiency calculation. Mathematically represented, DEA maximizes the ratio of virtual output and virtual input (or in other words, the weighted factors) by solving a linear programming problem, So, a new analytical technique, data development analysis (DEA) became a methodology widely employed in evaluating relative efficiency on an *ex post* basis. The basic multiplier form of CCR linear programming model (named by the creators Charnes, Cooper and Rhodes). The CCR-model is sometimes referred to as the CRS-model, by the fact that it builds on the assumption of constant returns to scale (CRS). Constant returns to scale means that outputs increase in direct relation to an increase in the inputs, or similarly decreases in inputs bring about relative decreases in outputs.

The function of the CCR-model, seeking to maximize outputs, is the following [43]:

$$
\begin{aligned}
&\text{maximise} && \theta = \sum_{r=1}^{s} \mu_r y_{ro} \\
&\text{subject to} && \sum_{i=1}^{m} v_i x_{io} = 1 \\
&(1) && \sum_{r=1}^{s} \mu_s y_{sj} - \sum_{i=1}^{m} v_m x_{mj} \le 0 \\
& && (j = 1, \cdots, n) \\
& && v_1, v_2, \cdots, v_m \ge 0 \\
& && \mu_1, \mu_2, \cdots, \mu_s \ge 0
\end{aligned}
$$

Where

$\theta =$ sum of virtual outputs

$x_{ij} =$ amount of input i used by DMU j

$y_{rj} =$ amount of output r produced by DMU j

$v_i =$ weight of input i

$\mu_r =$ weight of output r

$n =$ number of DMUs

Subscript o refers to the DMU whose efficiency is calculated.

The model is solved *n* times to determine the relative efficiency for each DMU. The model represented here is a most basic DEA-model. Subsequent models and elaborations have brought in additional features, such as the calculation of slacks to determine the adjustments by which an inefficient unit could achieve efficient status. Multi-stage calculation of DEA also allows the definition of peers, which 31 are a reference set of DMUs with a similar mix of inputs and outputs [44]. Maximize goal of the program is to maximize each department efficiency score, if this were the only constraint, the set of weight selected for each department would be the set that gives each department an efficiency score of one. This ratio of the weighted outputs and inputs is maximized under the restriction that no other department attains a score greater than 1 with the same weights that maximize the efficiency of service quality (ESQ) of the department that is being evaluated. Thus, all departments with a ESQ of 1 offer a maximum relative efficiency of service quality in the context of the institutions departments under investigation. Since, all departments whose efficiency is estimated via the same benchmark(s) must have a comparable input-output-structure; otherwise deferent benchmarks would be identified as reference points. So the degree of inefficiency of department is determined by measuring its distance to the origin relative to that of an efficient benchmark.

2. Barney-Charnes-Cooper -Model

The constant return to scale assumption is of course not valid in all situations, the basic CCR-model was proposed by Banker, Charnes and Cooper in 1984. The model has been named the BCC-model after its creators (or sometimes alternatively, the variable returns to scale VRS model) and widely accepted as the basic DEA model for cases with VRS. Mathematically, the BCC linear programming model may be represented as follows [45].

$$\begin{aligned}
\text{maximize:} \quad & \sum_{r=1}^{s} u_r y_{ro} - u_o \\
\text{subject to:} \quad & \sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} - u_o \leq 0 \\
& \sum_{i=1}^{m} v_i x_{io} = 1 \\
& -u_r \leq -\varepsilon \\
& -v_i \leq -\varepsilon
\end{aligned}$$

The VRS quality of the model makes it more flexible and less strict than the previous CCR-model. As a rule CCR-efficiency scores never exceed BCC-scores, although the opposite often is true [46].

3. Recent Developments

DEA is a relatively new method of analysis, and as such it is still constantly evolving. In addition to the two basic models presented above, several other variations exist, such as the additive, slacks based measurement and hybrid models, just to name a few of the more common. There are also extensions and ways to modify the models to better adapt them to different scenarios. Although the free distribution of weights empirically is one of the main properties of DEA, the weights may also be manually constrained to prevent manifesting of false efficiency through untruthful input and output profiles**.** Also the efficiency scores themselves may be modified by extending the model to take into account what is known as super-efficiency, this is a way of determining 'the best of the best' in a group of peers [47]. These are only some examples of extensions that have been made to the DEA method recently.

B. Construction of the DEA-Model

DEA mathematically determines the best weights for each input and output for the particular DMU under analysis do as to maximize the relative efficiency ratio while satisfying certain minimal conditions specified in the model [48]**.** Here it determines the degree of (in) efficiency of service quality for a department by measuring its distance to the efficient frontier. The efficient frontier (best practice line) is made up of all identified "efficient" departments. They all demand the lowest inputs for a given bundle of characteristics, at different scale levels and create a maximum service quality. These so

called efficient peers represent benchmarks for all inefficient units. This principle adequately adopts for enhancement internal quality assurance systems in the sense that the quality efficiency of department that is judged not isolated but always in relation to relevant alternatives. The comparison against with the efficient frontier is to define the sources of its inefficiency. To make relatively inefficient departments, the proper input and output weights can be chosen in such a way that the distance between each department and efficient frontier is minimized. For a more detailed the concepts of DEA see [49], [50]**.**

Mansoura University (MU)

Technical departments of higher education institutes within Mansoura University were selected as the setting for the present study. *First*, it is necessary to define adequate levels of each of the various dimensions that constitute service quality in technical HEI'S. *Second*, NQAAA in Egypt process places on institutions the responsibility for developing internal quality assurance systems in various types of education, especially technical education through Technical Education Projects. *Third*, Mansoura University (MU) was founded in 1972, from its beginning; the University had all traditional faculties. Today MU is considered from the largest institution of higher education and research in Egypt. Nowadays, the university has 27 faculties. Its total staff amounts to more than ٥,٥٢٧ full time equivalents nearly 123,482 undergraduate students, and 6,238 postgraduate students. Mansoura University has issued the first edition of "Knowledge Development" series entitled "A guide of technical terms used in the Quality and Academic Accreditation". This edition includes a good number of technical terms and expressions commonly used in the fields of quality and accreditation to define and simplify those concepts and expressions, to eliminate ambiguity and promote the use of these concepts to the teaching staff members, the co-members, the employees, and the students. Also, some universities like **as** Kafrelsheikh University (KU) follows **t**he example of MU.

1. Identifying input-output variables

Fig. 2 illustrates the conceptual framework in which inputs and outputs variables relating to the provision of departments within HEI's are going to be investigated. The inputs and outputs listed in fig. 2 were selected from indicators of evaluation and accreditation which setting as guidelines and template for the self-study that prepared by NQAAC for higher education in Egypt.

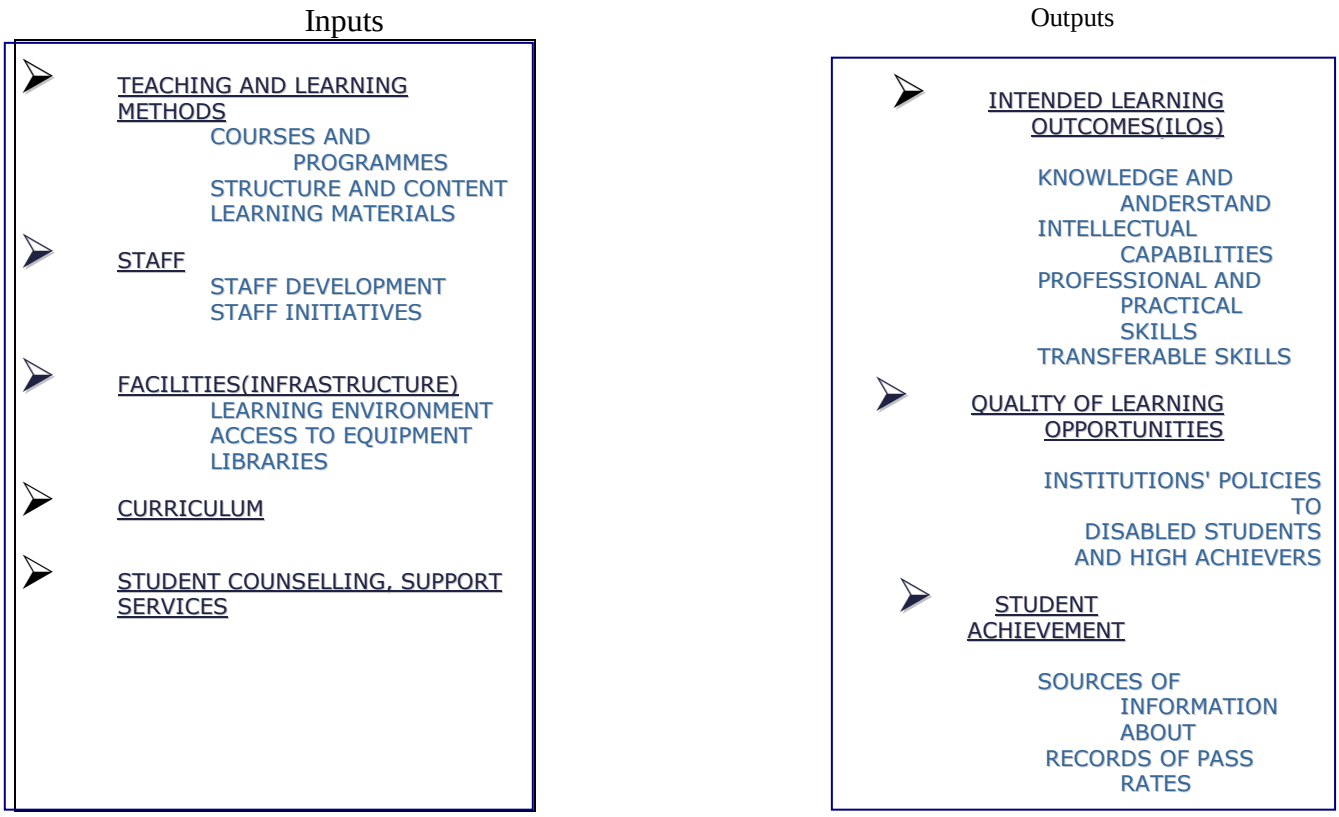

Fig. 2 the conceptual inputs and outputs framework**.**

1.1 Inputs

1.1.1 Student Support

It means both academic and non-academic servic**es** provided to student. It includes:

- Identifying the non-academic needs of student,
- The model of support adopted to meet those needs,
- Suitability of support services provision,
- The management and staffing of support services and,
- Delivering of services throughout the student's career.

1.1.2 Teaching and Learning Methods

It means the methods which are used by teacher to help students to achieve the ILOs for the course. It includes identifying the methods used in the course such as:

- Lectures,
- Discussion sessions,
- Information collection from different sources,
- Practical,
- Field visits,
- And Case studies...etc.

1.1.3 Facilities required for teaching and learning

The facilities include, appropriate teaching accommodation, including teaching aids, laboratories equipment, computers etc., facilities for field work, site visits etc., which are necessary for teaching.

- Availability and adequacy of programme handbook.
- Adequacy of library facilities.
- Adequacy of computer facilities.
- Adequacy of field/ practical training resources.
- Adequacy of any other programme needs.

1.1.4 Curriculum

The curriculum for the programme facilitates the attainment of the stated intended learning outcomes

- Curriculum design, evaluation and monitoring,
- Curriculum structure,
- Breadth, depth,
- And currency of content of curriculum

1.1.5 Governance, Administration & Staff Development

It include selection of academic leadership, effectiveness of policies, systems and practices, responsiveness to changing priorities and emerging needs, enhancement activities to the strategic objectives and plans, review of staff development.

- Mission and strategy development, planning, policy and leadership.
- Attracting and retaining staff.
- Staffs are competent to teach, facilitate learning and maintain scholarly approach.
- Training and developing staff.
- Encouraging initiative and assessing performance.
- Staff feedback and monitoring.
- Appropriate teaching accommodation.
- Developing and integrating human resource policy.

1.2 Outputs

1.2.1 Intended Learning Outcomes (ILOs)

- Knowledge and understand,
- Intellectual capabilities,
- Professional and practical skills,
- General and transferable skills.

1.2.2 Quality of learning opportunities in educational programmes

- Students' participate in all aspects of academic life,
- Students' opinions quality of teaching and learning,
- Institutions' policies for quality of learning opportunities to disabled students and high achievers.

1.2.3 Student Achievement

It means Evaluation of Student Achievement of appropriate standards.

- records of pass rates and samples of student work,
- Review students' activities with academic staff,
- Evaluation of stakeholders (Employers) to Alumni.

In this context, the input variables should capture all resources used by, and the output variables are all the outcomes related to the institute. In sum, I opted to use the inputs and outputs variable in table 1 to which I refer as my basic model.

TABLE 1: INPUT AND OUTPUT VARIABLE (BASIC MODEL)

INPUTS

Inputs:

1- Student Support.
2- Teaching and Learning Methods.
3- Facilities required for teaching and learning.
4- Curriculum.
5- Governance, Administration & Staff Development.

Outputs

Outputs:

1- Intended Learning Outcomes (ILOs)**.**
2- Quality of learning opportunities**.**
3- Student Achievement.

(Adapted from NQAAC, 2007)

2. Selection of DMUs

In order to identify DUMs, 10 technical departments within Mansoura University offering technical education in both Faculty of Engineering and Faculty of Computers and Information Sciences in undergraduate, postgraduate and research level have been considered, they are offering undergraduate degrees (Bachelor of Science), postgraduate degrees (Diploma, Master of Science, and Doctorate). The list of DUMs is shown in Table 2.

TABLE 2

TECHNICAL DEPARTMENTS IN MANSOURA UNIVERSITY (DUMs)

Symbol	*Institute*	*Name of the Departments (DUMs)*
DMU1	Faculty of CIS	Computer Science
DMU2	Faculty of Eng.	Electronics& Communications Eng.
DMU3	Faculty of CIS	Information Systems
DMU4	Faculty of Eng.	Architectural Eng.
DMU5	Faculty of Eng.	Structure Eng.
DMU6	Faculty of Eng.	Textile Eng.
DMU7	Faculty of Eng.	Production Eng.& Mechanical Design
DMU8	Faculty of Eng.	Power& Electric Machines Eng.
DMU9	Faculty of Eng.	Computer Eng.& Systems
DMU10	Faculty of Eng.	Mechanical Eng.

C. Questionnaire survey

A sample of technical departments within Mansoura University was surveyed over a three– month period during the academic year 2008/2009. The data I have used were made available to me by final questionnaire, adding to Quality Assurance Units (QAUs), annual overview reports on quality of educational activities, and records of pass rates...etc,. In brief, the method of preparing of final questionnaire was according to Casu and Shaw, (2005***)*** [51]**,** and assessment follows:

- Following the receipt of primary questionnaire, each participating units submits a general contextual self-description together with a report on each of the inputs and outputs area,
- The primary questionnaire and all reports are discussed at a joint seminar for two participating units,
- At this seminar, units representatives also make short presentation of various activities within the assessment areas, the topics of these presentations are depended on the basis of departmental reports,
- After this seminar, the questionnaire is completed with two participating units in the different areas.

The areas of assessment list above are divided into sub- areas such as inputs and outputs. I formulate a number of detailed questions, illustrating central aspects of the sub-area. Many of the detailed questions are inspired by the methods and questions prepared by NQAAA [9]. The questions are answered in questionnaire, the departments' reports are used to formulate a comprehensive statement of collected excess data about departments' practices within assessment area, and the questions are answered by responsible persons. Every department's own report and analysis as an answer to questionnaire from a solid basis for validity. The responses of students for their perceptions and expectations under each item are collected through a structured questionnaire survey. Each respondent is asked to rate his/her opinion in a Likert type scale 1 to 5 (1 being strongly disagree and 5 being strongly agree) a large number of items offer tended to displace the average score on that sub- area towards the middle of the 1 to 5 scale. The survey is administered to the respondents via personal contacts. Further, additional data are collected from experts such as head of institutions, head of departments through personal contacts. Finally 513 responses are taken into consideration for further analysis after screening the responses and rationality in judgmental scores.

VI. DEA application

A. Model Assumptions

Two assumptions must be made to use the basic data envelopment analysis model in the form presented previously. These are outlined by Nunamaker (1983) as follows: First, the DEA approach assumes constant returns to scale for each DMU evaluated. Second, it is assumed the constructed efficient production frontier is piece– wise linear and continuous. Importantly, this second assumption implies all points along the efficient surface are practically attainable production possibilities [52]. The objective function for DEA has been fixed as the ratio of weighted sum of perceptions to the weighted sum of expectations assuming that perception of a student seldom touches the expectation. Hence, a DMU becomes a benchmark unit when the objective function becomes unity. In other words, perceptions equals to expectations. If either of these assumptions cannot comfortably be made, there are other modified versions that should be applied instead. The general output oriented maximization CCR- DEA model is used to obtain efficiency score. Data Envelopment Analysis Programme (DEAP version 2.1) has been used to solve the model.

B. DEA relative efficiency scores

To illustrate the use of DEA, the inputs were calculated by first averaging the responses for each item across all the survey obtained for a particular department. For example, Table 3 lists the average values of the data analysis for each item for department 1. Then, to create five dimensions – level scores for each department, these item level averages ware averaged within their corresponding dimension. The last column of Table 3 shows these values for department 1.

TABLE 3

QUALITY ITEM LEVEL SUMMARY FOR DEPARTMENT 1

(SURVEY ITEM NUMBER)

	Item	Item	Item	Item	Item	Item	Item	Item	Row average
1	5.46	5.48	5.59	5.02	5.10				5.33
2	5.53	5.46	5.16	5.31					5.37
3	5.10	5.10	5.24	5.14	5.32	5.23	4.66	4.92	5.09
4	5.50	5.34	5.45	4.31	4.20	4.00	5.23		4.86
5	5.57	5.54	4.96	5.43	5.47	5.37	5.00		5.33

Keys:

1 = Student Support.

2 =Teaching and Learning Methods.

3 = Facilities required for teaching and learning.

4 = Curriculum.

5 = Governance, Administration & Staff Development.

Table 4 shows resulting dimension – level summary measures for all of the departments included this study. Table 5 listed the resulting efficiency scores for each department from resulting DEA score for each DMU

TABLE 4

DIMENTION- LEVEL INPUTDATA& OUTPUT DATA

FOR ALL DEPARTMENTS

Departments	1	2	3	4	5	OSQ	QLO	ILOs	SA
DUM1	5.33	5.37	5.09	4.86	5.33	2.86	3.01	10.89	2.26
DUM2	3.70	4.54	4.23	4.86	4.84	3.88	2.66	10.98	3.84
DUM3	5.92	5.47	5.61	5.42	5.11	2.62	2.49	5.93	3.03
DUM4	5.84	5.91	5.63	5.63	5.30	2.58	2.89	5.87	2.82
DUM 5	5.03	5.22	5.05	5.00	5.10	2.99	3.18	10.96	2.36
DUM 6	**5.51**	**5.99**	**5.87**	**5.32**	**5.52**	**2.11**	**2.07**	**2.16**	**2.17**
DUM 7	**5.96**	**5.98**	**5.83**	**5.98**	**5.52**	**2.10**	**2.08**	**3.27**	**2.18**
DUM 8	5.76	5.62	5.21	5.33	5.50	2.63	2.96	7.88	2.67
DUM 9	5.53	5.76	5.32	5.13	5.43	2.62	2.84	5.87	2.68
DUM 10	5.11	5.15	5.72	5.22	5.40	2.51	2.89	5.87	2.53

Keys:

OSQ = Overall service quality (dependent variable of regression)

QLO = Quality of learning opportunities

ILOs = Intended Learning Outcomes (ILOs).

SA = Student Achievement.

TABEL 5

DEA RELATIVE EFFICIENCY SCORES

DEPARTMENTS	*Efficiency score*
DMU2	1.000
DMU5	1.000
DMU1	1.000
DMU8	0.995
DMU10	0.990
DMU9	0.977
DMU3	0.933
DMU4	0.923
DMU6	0.921
DMU7	0.911

As the Table 5, indicates the efficiency score for departments, ranges from 0.911 to 1.000. Three departments were assigned an efficiency score of 1.00. In the context of this article, these units would be said to be obtaining relatively, the best quality of learning opportunities, Intended Learning Outcomes (ILOs), and Student Achievement, given each DMU's level on five dimensions of service quality performance. But those initiates operating less than perfectly efficiently, they have to enhance. So; they might look to the results of the dual problem from the DEA for guidance as to how they might enhance the efficiency.

TABLE 6

DEA EFFICIENT REFERENCE SET WEIGHTS

DMUs	Weights to apply to the DMUs in the efficient reference sets		
	DMU2	DMU5	DMU1
DMU1			1.0000
DMU2	1.0000		
DMU3		.5123	.4536
DMU4	.3427	.6234	
DMU5		1.0000	
DMU6		.6088	.3256
DMU7	.3452	.3425	
DMU8		.4356	.6834
DMU9		.3452	.5437
DMU10		.6321	.3245

From Table5 and Table 6, DMU7 should examine it operating procedures in these identified service quality performance dimensional areas comparing with DMU2 to identify possible sources of inefficiency and enhance them.

C. Defining enhancement Areas for Inefficient Departments

The guidance described earlier in the form a hypothetical, relatively perfectly efficient DMU whose input levels can be used existing inputs or outputs that would help the DMU move towards the efficiency current input and output levels and the enhancement that analysis identified for DMU7.

TABLE 7
CURRENT AND PRESCRIBED INPUT & OUTPUT LEVEL FOR DMU10

DMU	1*	2*	3*	4*	5*	QLO	ILOs	SA
DMU7	5..96	5..98	5..83	5..98	5..52	2..08	3..27	2.18
Target level (DMU2)	3.70	4..54	4..23	4.86	4.84	2.66	10.98	3.84
Enhancement level	-2.26	-1.44	-1.60	-1.12	-0.68	0..58	7.71	1.66

*(1= Student Support, 2=Teaching and Learning Methods, 3= Facilities required for teaching and learning, 4= Curriculum, 5= Administration & Staff Development).

From Table 6, DMU7 should examine it operating procedures in these identified service quality performance dimensional areas to identify possible sources of inefficiency. The analysis suggests that, the greatest efficiency for DMU7 gains are possible in the area of Student Support, Facilities required for teaching and learning, Teaching and Learning Methods, and Curriculum dimensions of its service quality performance offering.

VII. Conclusions

The purpose of this study is to propose a new managerial instrument for performance enhancement of internal quality assurance systems, and employ DEA approach to estimate efficiency scores for technical departments within Mansoura University (MU). The evidence suggests that frontier analysis able to separate departments that might qualify, as performing well from those where some enhancement might be possible, and a new managerial instrument (DEA) encouraged institutions to compare their departments' quality performance with equivalent standards, and could treat quality as the relative comparison of a number of comparable departmental decision– making units (DMU's). The basic contribution of this instrument, DEA technique can help institutions on obtaining optimal levels of quality dimensions that are directly linked to critical performance outcomes. This could imply a better allocation by the departments of the usually scarce public financial resources available to higher education institutions and performance enhancement of internal quality assurance systems.

VIII. Limitations and suggestions for future research

The current study allows us to understand how DEA instrument measures internal quality insurance systems compare to others. However, this work poses more questions than it provides answers. The present findings suggest that DEA instrument is appropriate in higher education service setting. Given that the current study is limited to one service industry, this assertion would need to be validated by further research. Future studies should apply the measurement instrument to help the Egyptian National Quality Assurance and Accreditation Agency (NQAAA) attains national academic reference standards directly linked to critical performance outcomes for Egyptian HEI's through measuring performance of quality for an institute relative to all other similar institutions and identifying best practice to compare academic standards of an institute with equivalent standards nationally, then identifying sources of quality inefficiency. In other words DEA technique can provide NQAAA with national quality benchmarking indicators

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