Performance measures for academic departments

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Abstract
Measuring the performance of academic departments received little attention compared to other industries due to their complex nature and difficulty in measuring their outputs. However, measures of performance are needed to assess whether they meet their set objectives and foster an environment of continuous improvement. The objective of this paper is to develop a performance measurement system for educational institutions. It outlines the properties of adequate performance measures and the steps for developing such measures in an educational environment. Three types of performance measures are proposed. These are outcomes, inputs and process measures. Suggestions are made to select the most appropriate and relevant performance measures pertinent to academic departments' goals and objectives. Also the need, relevance and implementation issues in the context of the Saudi Arabian educational system has been discussed and highlighted in the paper.

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1. Introduction

Educational institutes play essential role in development. They support global development strategies with the necessary highly-qualified manpower and research. The success of educational institutes in achieving this role necessitates for them to have a strategic plan supported by a mechanism for monitoring, controlling and adjusting it. These institutions are comprised of academic departments (AD). The success of these institutions depends on the performance of ADs in achieving their objectives. An essential component of the mechanism is a set of performance measures that are used to assess the organization performance and its ability to achieve set targets.

ADs are building blocks of educational institutions. They can be thought of as a unit with multiple inputs and outputs. The process of converting these inputs to outputs is complex in nature and also the outputs are hard to measure. Therefore, measuring the performance of ADs is a challenging problem.

Performance measures must be based on a set of objectives that are linked to the mission of the department and its vision for the future. These define the customers and their requirements and the level that the organization needs to satisfy. It stimulates internal quality improvement and external benchmarking. It should measure things that can be changed (things that we can influence and improve). Performance measures should be based on outputs compared to inputs. Outputs of ADs include research; projects, graduates and inputs include faculty, resources, equipment, etc. It should also include measures for the ability of the process used for achieving the goals of the educational institutions such as the teaching process and the administration process. In Saudi Arabia ADs have staff from various Arabic, Islamic and Western countries. The composition of the staff brings with it a variety of cultures. In this type of environment the need for performance measures is even greater. The staff being from several countries and variety of cultures with different background and experiences needs to be focused on departmental goals and objectives. Measures of performance are expected to play a major role in this regard. The last section of this paper discusses these issues in greater detail.

Developing a set of performance measures that is strongly linked to the objectives of the organization is essential for successful implementation of the strategic plan. It helps in monitoring strategic achievements and controlling strategic activities. Al-Turki and Duffuaa (2002) discuss the link between performance measurements and strategic planning. There are few papers in the literature of developing performance measures for educational institutions. Duffuaa *et al.* (1999), introduced an integrated approach for the evaluation of engineering and technical educational institution. They used the data envelopment analysis approach for this purpose. Accreditation Board for Engineering and Technology (ABET) 2000 criteria emphasizes the integrated strategic approach for evaluating engineering schools (Accreditation Board for Engineering and Technology, 1998). ABET gives some general guidelines for preparing self-assessment reports. Al-Anzi and Alatiqi (1999) introduced an integrated framework for self-assessment at the College of Engineering and Petroleum in Kuwait

University. They suggested five categories of performance measures:
1 productivity;
2 efficiency;
3 effectiveness;
4 internal structure; and
5 growth and development.

The objective of this paper is to introduce a performance measurement system for ADs that takes into consideration the special characteristics of ADs. The next section discusses the special characteristics of ADs and their typical objectives. It also introduces their components as inputs, processes and outputs. Section 3 discusses the characteristics of effective performance measures and procedure for developing measures that are relevant to the Saudi Arabian educational system. Section 4 proposes a set of performance measures for each component. Section 5 presents a procedure for selecting relevant measures of performance from the suggested ones. Section 6 outlines implementation of the performance measurement system in the context of the Saudi Arabian educational system. Section 7 concludes the paper.

2. Nature and characteristics of ADs

ADs are service organizations and usually organized within educational institutes to provide education, conduct research and offer community services. Within the institutions, ADs have a semi-antonymous status. In higher educational institutes (universities and colleges), each department is chaired by a faculty member, who acts as a coordinator in managing the department activities. The responsibilities in ADs are highly decentralized.

Typical objectives of ADs include the following:
- Prepare highly qualified graduates (bachelor or diploma) in the discipline of the department.
- Prepare graduates for lifelong learning experience.
- Prepare graduates who can communicate effectively and function well within a teamwork environment.
- Prepare graduates (master and doctor of philosophy) who can conduct research at the frontier of their discipline.
- Extend the knowledge base in their disciplines to meet society needs.
- Provide continuous professional development for their graduate through continuous education, workshops and seminars.

To achieve the above objectives, ADs have several inputs and processes that need to be available, monitored and continuously improved. The major inputs to an AD include:
- Highly-qualified, motivated and committed faculty members.
- Talented students with adequate background for the field of study.
- Adequate support staff.
- Well-designed curriculum.
- Well-equipped laboratories and computing facilities for certain disciplines.
- Facilities and library resources.
- Adequate procedures and standards.

The delivery of service in an AD requires certain processes that are critical for achieving the department's objectives. These processes include:
- teaching processes;
- managerial processes;
- research supervision and support processes;
- students' support processes; and
- quality control processes.

The outputs of an AD are qualified graduates, researcher, basic and applied research and services to society such as training and workshops. Measuring the quality and quantity of these outputs are not easy.

Adequate measures of performance are required to assess whether ADs meet their set objectives in order to initiate improvements. In the past, measuring the performance of AD has received little attention compared to other industries. Possible reasons include:
- The functions of ADs within an organization, has complex relationships with other functions.
- The outputs of the ADs are hard to measure.

In the next section an attempt will be made to develop adequate measures to assess the performance of an AD.

3. Characteristics of adequate performance measures

Performance measures should be based on a clear purpose linked to the goals and objectives of the department. The purpose should be to stimulate internal quality improvement and to benchmark performance with the leading ADs. Performance measures should be clearly defined qualitatively and quantitatively and communicated to all concerned. Therefore, the characteristics of performance measures can be summarized as follows:

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- *Relevance.* Include data that are essential to provide a basis for understanding the accomplishments of goals and objectives of the organization.
- *Interpretability.* Communicate in a readily understandable manner that is concise, yet comprehensive.
- *Timeliness.* Report in a timely manner so that it will be available to users before it loses its value in making decisions.
- *Reliability.* Report consistency from period to period.
- *Validity.* The measure should measure the intended quality indicator.

It is essential to take into consideration local environment needs and conditions in order to develop and design relevant performance measures. Some of the measures are internationally common for ADs such as the ones related to basic research publications. Other measures are more geared towards serving local society (community). They must reflect local needs and priorities. The priority for local industry and the Kingdom of Saudi Arabia at large is manpower development and on-job training. This gives training-related measures high priority. Also the quality of the graduate is a very important measure for all academic institutions around the globe; however, quality should be defined differently for different societies. A quality graduate engineer is defined as the one who will be able to serve the needs of his society. The role of engineers in developing countries is different from the role of the engineer in the developed countries. Therefore, there is a need to get feed0back about the expectations and needs of local industry in order to define a quality engineer and hence quality education. In the Kingdom of Saudi Arabia, the industry is not mature enough to invest heavily in research and development. Mostly, they are joint ventures with international companies that develop the product as well as the process overseas. This limits the role of the engineer to understanding and interacting with the technology transferred.

Local industries do not hold highly-qualified engineers. The lack of qualified engineers in local industries make the opportunity of new graduates to learn and train very limited. In addition to that they are not given the chance to demonstrate their capabilities and knowledge to their employers. In most cases they move to managerial positions after a few years. Such an environment makes the role of the university different from the role of other universities in developed countries.

The environment described above has a great impact on the faculty as much as it does for university graduates. Faculty members in engineering departments have a long way to go to prove their capabilities and knowledge and gain the confidence of the local industry for conducting applied research and consultation. They need some success stories to gain the confidence of local industry but they are not given the chance to do so. Therefore it is very essential for ADs to attract highly-qualified international faculty from other parts of the world to start rolling the wheel and building success stories. A measure that is related to industrial experience is highly desirable and should be imbedded in faculty recruitment process.

The four major steps necessary to develop and evaluate a performance measurement can be outlined as follows (McNamara, 2000):

1 *Choosing areas to measure.* The choice of the areas for assessment is based on three criteria: the importance of the area; the potential for quality improvement; and the degree to which the measure can be controlled for improvement. Other measurement criteria must also be considered, such as the availability, accuracy, and completeness of data. There is no point of measuring performance in areas that are not significant to the quality of the output or the quality of the process or to measure areas where there is no potential for improvement. Also measuring things that cannot be controlled does not serve the strategies of the organization.
2 *Selecting performance indicators.* An indicator is a statement about the process or an outcome that is based on guidelines issued by specialty societies, government agencies or others. Class size and student GPA are two performance indicators related to the education process and education output, respectively.
3 *Designing specification for a measure.* The standard approach is to state the indicator as a proportion, that is to define a numerator and a denominator. The target population for the measure should be defined clearly as well as the source of data. Measures for qualitative indicators such as satisfaction assessment, should be developed.
4 *Testing the scientific strength of the measure.* The scientific strength of a measure is determined by testing for reliability, validity and interpretability. A measure is reliable if, when repeatedly applied to the same population, the same result is obtained in a high proportion of time. Reliability is important for insuring

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comparability of results among plans and over time within the same plan. Validity is the extent to which the measure accurately represents the quality being assessed. Interpretability refers to the ease with which the intended audience can understand and use the information generated by the measure.

4. Performance measures for ADs

A performance measurement system should be developed for collecting, analyzing and reporting data and information related to the performance of the AD. We propose a hierarchical system of performance measures so that at the top we have few measures that give a global indication of the department's performance. This is directly linked to the mission of the department and used by the university higher administration for assessing departments and colleges and allocating resources. The second level of the performance measurement system includes three major indicators for the three components, inputs, processes and outcomes. This level of the measurement system can be used by the college administration to assess departments within the college and allocate resources. The third level of the system includes all the detailed measures related to basic activities of the department. The three levels of the performance measurement system are shown in Figure 1.

In this section we will give a set of detailed performance measures (third level) that can be utilized to assess whether the AD is accomplishing its mission and educational objectives. The performance measures cover outputs, processes and inputs. On this basis the performance measures are divided into three categories:

1 Outcomes performance measures.
2 Processes performance measures.
3 Input performance measures.

These performance measures are quantified by performance indices as shown in Figure 1.

4.1 Outcome performance measures

Any AD has three major outputs (outcomes). These are: graduates, research and scholarship and services to the community in terms of training, projects and consultation. The outcome measures must reflect the quality of the output.

4.1.1 Quality of graduates

The performance measures for the quality of graduates assess the ability of the graduates to perform the educational objectives and outcomes set in the program. The measures in this sub-category are obtained through well-designed employers and alumni surveys. The indices used to quantify the ability of students to perform program's objectives and outcomes are:

- Percentage of employers surveyed who agree or strongly agree that the graduates perform objective i very well ($i = 1, \ldots, M$), where M is the number of objectives. An overall measure can be obtained by aggregating the individual objective indices.
- Percentage of alumni surveyed who agree or strongly agree that graduates perform objective i very well ($i = 1, \ldots, M$), where, M is the number of objectives. An overall measure can be obtained by aggregating the individual objective indices.
- Median/average (maximum, minimum) major grade point average for graduating students in the last three years.
- Median/average (maximum, minimum) yearly score in professional exams.

4.1.2 Quality of research and scholarship

The performance measures for research and scholarship assess the quality of research and master and PhD students that are graduated from the department. The research consists of publications in refereed journals, referred conferences and research grants/projects. The indices that quantify these measures are:

- Journal publication index (JPI) is the number of refereed papers per faculty per year. This index can further be refined to reflect the quality of the journals.
- Conference publication index (CPI) is the number of refereed conference papers per faculty per year. This index can further be refined to reflect the quality of the conference.
- Research grant and project index (RGPI) is the number of research grants and projects per faculty per year and total Saudi Riyals per faculty per year.
- Graduate students supervision index (GSSI) is the number of graduate students supervised per faculty per year.
- Master thesis publication index (MTPI) is the average number of papers published in refereed journal per thesis.
- PhD thesis publication index (PTPI) is the average number of paper published in refereed journal per thesis.

4.1.3 Quality of services to community

The performance measures for the quality of services assess the ability of the department to deliver quality services to the community. The quality of service is measured by the following indices:

- Number of short courses per faculty per year.

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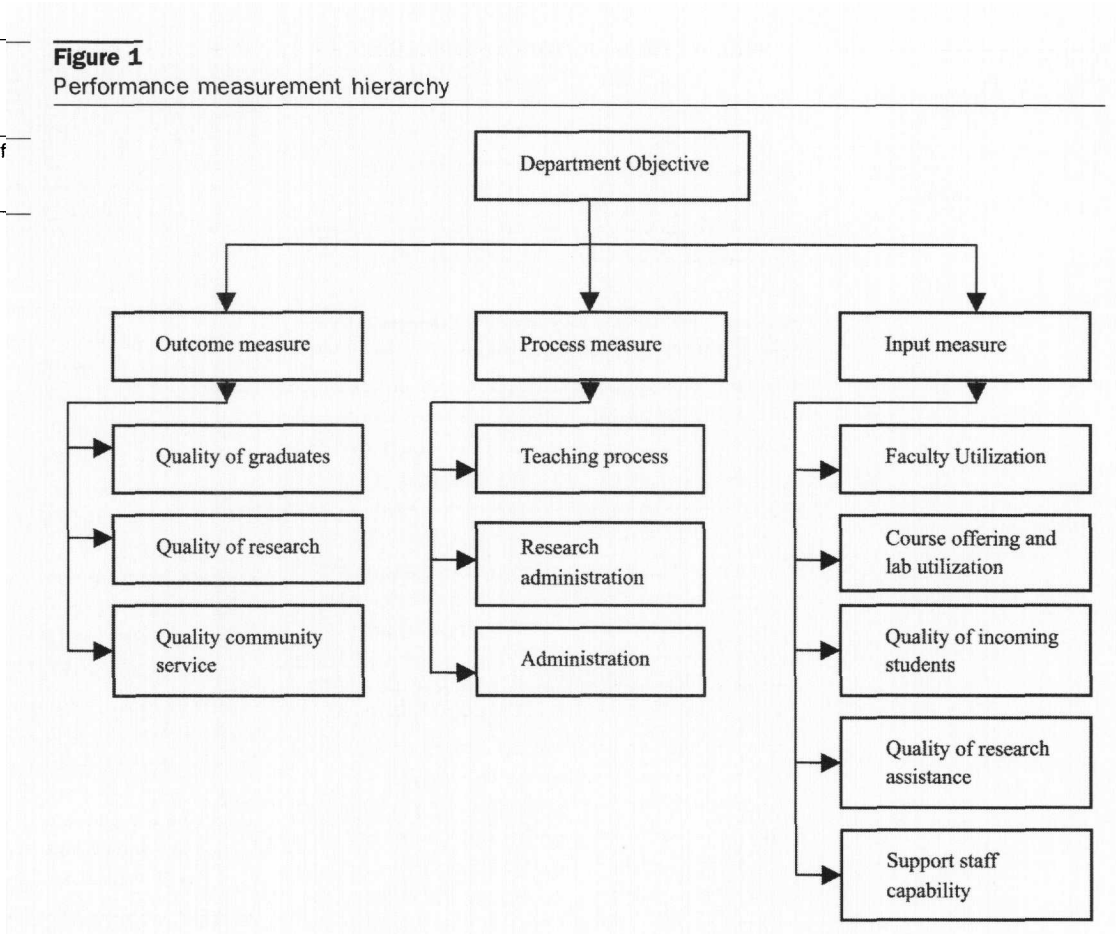
Figure 1
Performance measurement hierarchy



- Percentage faculty members participating in short courses per year.
- Median/average short courses evaluation.
- Number of industrial-sponsored projects per faculty per year.
- Number of consultancy jobs per faculty per year.
- Percentage faculty members engaging in industrial consultancy.

4.2 Processes performance measures

There are key processes in the ADs by which key activities are delivered. There are three key processes that need to be evaluated periodically and measure their performances:

1 teaching and learning process;
3 research administration process; and
4 administration process.

Several indices are proposed to measure the performances of these processes.

4.2.1 Teaching and learning process

The performance measures for the teaching and learning process is based on student input, peer review and curriculum development and can be measured with the following indices:

- Median/average student evaluation for all courses.
- Percentage faculty members awarded excellence in teaching.
- Number of new course proposals per faculty per year.
- Number of new book proposals per faculty per year.

4.2.2 Research administration process

The performance measures for research administration assess the ability of this process to foster a conducive environment for research. This is measured by the following indices:

- Median/average time to approve a research proposal in months.
- Median/average time to approve a conference application.
- Median/average time to process a promotion case.

4.2.3 Administration process

The performance measures for the administration process assess the ability of the department to deliver goals set and respond to higher administration solicited input. The performance is evaluated through the following indices:

- Percentage yearly goals achieved within planning horizon.
- Percentage requests for input responded to by deadline.

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- Faculty level of satisfaction measured by the percentage of faculty members satisfied (obtained from faculty survey).

4.3 Input measures

The input performance measures deal with the efficiency and utilization of the department resources in addition to the quality of incoming students, research assistants and support staff. The measures are divided into five groups, according to the type of resource. The groups are:

1 faculty utilization;
2 course offering and laboratory utilization;
3 quality of incoming students;
4 quality of research assistants; and
5 support staff capabilities.

Several indices are developed for each group and given below.

4.3.1 Faculty utilization

The performance measures in this group deals with utilization of faculty members. The following indices are used to measure faculty utilization:

- faculty student ratio;
- average (maximum, minimum) student credit hour per faculty per year;
- number of graduate students under supervision per faculty per year; and
- number of committees per faculty per year.

4.3.2 Course offering and laboratory utilization

The performance measures for course offerings and laboratory utilization are quantified using the following indices:

- Course offering index (COI) that is percent course offered from planned course offering.
- Laboratory utilization index (LUI) that is percent total student laboratory hours taught to total ideally available laboratory hours.

4.3.3 Quality of incoming students

The performance measures of incoming students are very essential. The following indices reflect the quality of students joining the department:

- Median/average (maximum, minimum) percentage in Saudi certificate examination for students joining the department.
- Median/average (maximum, minimum) yearly scores in university entrance exam for students joining the department.
- Median/average (maximum, minimum) yearly grade point average in preparatory year for students joining the department.
- Median/average (maximum, minimum) time to complete BSc degree.
- Yearly success rate (percent students obtaining more than 2.0 every semester). It can be broken into several indices based on major grade point average (GPA; for example percent of students with GPA ≥ 3.0 percent of students with GPA between two and three.
- Attrition rate percent of students leaving the department due to failure or other reasons.

4.3.4 Quality of graduate students and research assistance

The performance measures of incoming graduate students are very essential for a successful graduate program that is expected achieve its objectives. The following indices reflect the quality of graduate students and research assistants (RA) joining the department:

- Median/average (highest, lowest) graduate record examination (GRE) scores for graduate students and Research assistants (RA) joining the department.
- Median/average GPA for graduate students and RAs joining MS and PhD programs.
- Median/average undergraduate GPA for graduate students and RAs joining MS and PhD programs.
- Median/average time to complete MS and PhD programs.

4.3.5 Support staff capabilities

The performance measures for the support staff reflect the capability and quality of service the support staff is providing. The performance measures are quantified using the following indices:

- Number of support staff (secretaries) per faculty.
- Support staff (technicians) per lab.
- Support staff satisfaction index obtained from faculty survey, computed as the percentage of satisfied faculty from the support provided by the support staff.

5. Measures selection

The measures suggested in this paper are too many and departments may be faced with the problem of selecting the most appropriate ones for its situation. The association matrix shown in Figure 2 is proposed to aid in selecting adequate measures of performance that are relevant and directly linked to the goals and objectives of the department. The objectives are written on the top row of the matrix and the performance measures on the left column of the matrix. The degree of association is placed in the cell that corresponds to the intersection of the performance measure with a particular objective. The circle with a plus indicates that the performance measure is strongly associated with the objective and has

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Figure 2
Association matrix: relationships between performance measures and objectives

	Objective: To prepare students to						
	Formulate problems and apply problem solving skills to obtain realistic valid solutions	Skills critical thinking and problem solving	Improve planning and utilization of resources and help organizations to make optimal decisions	Conduct experiments, collect data, and perform analysis and interpretation to draw valid conclusions	Identify, examine, stabilize, control and design organizations	Communicate Effectively (Oral and written)	Life long learning, professional growth in the field and professional and ethical responsibility
Average GPA of SE graduates	■		○	○	△		
Average score in IE professional exam	■		○	△	△		■
Median senior project/coop grade	■	○	○	■	△	■	
% Employers agree that SE graduates are of high quality	△	■	○	○	○	■	△
Faculty student ratio	○	■		○		■	

■ Strongly indicative ○ Moderate indicative △ Weekly indicative

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a high probability of revealing the objective level of achievement. The circle is an indication of a moderate association and the triangle indicates a weaker association. The measure of performance that is strongly associated with many objectives is more adequate and should be given a higher priority in the selection process. The judgment whether a performance measure is strongly, moderately or weakly associated with an objective can be determined through surveys or brainstorming sessions.

The matrix shown in Figure 2 shows seven educational objectives and five measures of performance. It can be seen that the measure of performance "percentage of employers that believe systems engineering graduates are of high quality" has the highest over all association level and must be considered in evaluating the level of achieving program objectives. Also the measure of performance "the average grade in senior projects and co-op" is a good measure of performance provided the examination in these courses is designed to address the program objectives. An example of the affinity matrix applied in the education institution is given in Figure 2.

6. Implementation of performance measures in the context of the Saudi Arabian higher education system

The Saudi Arabian higher educational system, especially universities, have special structure and characteristics that call for effective performance measuring and evaluation. The characteristics include the following:

- The composition of the staff (faculty members) in ADs in universities is a mixture of several nationalities. They come from Arabic, Islamic and sometimes Western countries. As an example, Table I shows the composition of the staff at the Systems Engineering Department, King Fahd University of Petroleum and Minerals. Table I also shows the number of the faculty members from each nationality and countries where their doctoral of philosophy degree (PhD) has been obtained.
- Each faculty member comes from a different background, culture and trained in a different educational system. This blend of cultures enriches the AD; however, it introduces a high variance in expectations and impacts major departmental functions. Measures of performance are used to minimize variance and focus staff members on common objectives. The process of developing measures of performance served in the systems engineering department is a forum for communication and exchange of ideas that lead to better control of the department processes and functions. It also helped in the management of change and played a role in facilitating the transformation from previous experiences and cultures to the department new culture.
- The administrative positions in ADs in Saudi Arabia are usually held by Saudi nationals. Many of the Saudi nationals as soon as they acquire experience move to industry for better paying jobs. This led to high turnover in these positions. Procedures and established measures of performance are expected to mitigate the impact of high turnover by defining the key processes and functions to be measured and evaluated.

To implement and use measures of performance effectively, an academic information system is needed. The system must have the capabilities to store, retrieve and process real data into measures of performances. This system must be

Table I
Faculty composition at the systems engineering department

Nationality	Number of the staff with PhD	Countries granting PhD degree
Saudi Arabian	9	Eight USA and one Saudi Arabia
Turkish	4	USA
Egyptian	2	USA
Tunisian	2	USA and Canada
Jordanian	2	USA
Pakistani	1	Japan
Singalese	1	France
Algerian	1	UK
Sudanese	1	USA
Yemeni	1	UK
Lebanese	1	Canada

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designed to facilitate the process of entering data by the staff in order to obtain reliable and meaningful performance measures.

7. Conclusion

In this paper performance measures for ADs are proposed. A criteria for selecting appropriate measures is suggested. The implementation and use of performance measures are discussed in the context of the Saudi Arabian educational system. Further work is needed to test these measures in different environments and assess their impact. Also, further work is needed to design information systems that will facilitate the use of performance measures in ADs.

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