Visual Model for Managing Educational Capacity Utilization in Egyptian Universities

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ABSTRACT: *Universities throughout the world operate with large amounts of data, typically scattered across multiple, non-centralized information systems and applications. Support of administrative decision-making and knowledge discovery from such decentralized data flows requires a system designed with close eye on the specific needs of the academic and market domains. A model-based approach is needed to plan recruitment efforts and activities, optimally allocate resources, maximize enrolments and meet universities recruitment, etc. Such an approach should be based on appropriate Operations Research or modeling techniques allowing decision makers to meet institutional goals by managing the recruitment and enrolment of students at universities or any educational institution. The admissions process must admit students in such a manner as to achieve an efficient utilization of university resources. This paper introduces visual model of gap analysis and students admissions in an Egyptian universities.*

Keywords: Gap Analysis, Visual Model, Fuzzy Traffic Light Method

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1. Introduction

The efficiency of higher education have given rise to new models and systems aimed at facilitating strategic decision making, primarily concerned with resource allocation and performance analysis. International comparative studies have outlined a number of general performance descriptors (e.g. staff per student ratio, teaching load, etc.) which can parameterize such models.

The common economic principle of demand supply equilibrium builds up the core of the underlying computational model. Educational Supply (ES) describes the available teaching capacities in terms of the amount of services (i.e., courses, supervision, etc.). Educational Demand (ED) measures the consumption of those services by students according to their individual curricula.

Prior to the admission of new students, the Admission Capacity (AC) of every faculty, i.e. the upper bound on the number of beginners it can accommodate, must be announced. Accurate models and systems are necessary to avoid wasting expensive resources, long-term misbalance of the university's operation, and the failure to provide the required quality of education. AC is derived from the educational resources and is distributed among all offered study faculties according to the university's admission policy [4].

Determining the AC from the available resources is called a supply-oriented approach as educational capacity is considered to be fixed. An alternative approach, called demand-oriented, reverses the computation by allowing a priori specification of the desired admission numbers and determining the required educational supply. To keep the model manageable and intuitive and to avoid functional explosion we opted for a single bottle-neck resource of the educational capacity, which is the teaching staff. From experience, staff availability is by far the most crucial resource constraint, expensive and hardly adjustable in the short-term compared to other resources involved, such as facilities, budget, appliances, and materials.

In Egyptian universities we noted that number of students in each faculty varied from one to another depending on multi variables. No strategic planning to joined students. The decision to be made by the decision maker is how many freshman students to admit into their undergraduate students in order to meet their institutional goals. This model can be used to formulate the admissions policy for newly entering students to any educational institution making sure that the goals' priority structure is consistent with institutional enrolment priorities. Academic workload management is concerned with distributing teaching resources in order to adequately support the university's educational framework (faculties, degrees, courses, admission policies, teaching workload etc). This requires the development of a quantitative model that includes consideration of the various multidimensional and often conflicting goals of various interest groups seeking satisfaction.

This work targets to support the administrative tasks of planning the university's educational capacity in terms of the number of students in colleges can accommodate under the specified resource constraints. Higher education Decision makers able to evaluate various strategies and can generate forecasts by means of simulating with the input data.

2. Problem Methodlog

We discuss our selection of a Fuzzy Traffic Light Method, followed by a difficult task of preparing the data for analysis. Then present our model of the optimized prediction that based on hybrid principle of demand supply.

3. Model Formulation

Faculties performance can be thought of as a sort of "*black box*" for processing information, where inputs are masses of students, staff members, classes and labs data, and the output is problem discovery of balance between resources such as students, staff members, classes and labs and registered students .

The workings of the black box are extremely complicated, and to make matters worse, it is constantly being redesigned. There is a need to standardize the design of the process to make it more efficient, transparent and flexible. The first step in doing this is to find a way to describe the inner working in a simplified modular way. In practice however the quantity of raw data is usually overwhelming and the process of analysis gets broken into two parts, as shown in Figure [1].

The process of analysis has been broken into two parts; first the assimilation and interpretation of raw data to provide meaningful indicators of the quantities that the data measure, and second the comparison and integration of these indicators to understand their implications for faculties' performance. The output of this analysis provides the input to the consultative process which provides advice to management.

Estimation of number of admission students is a good example of the relationship between raw data and indicators. The raw data include many technical details, such as randomization parameters, that are relevant to the analysis but which can be set aside once the objective of the modelling, namely estimation of number of admission students, has been achieved.

The next step in understanding the system is to look inside the black box Labelled "*Comparison & Integration*" in figure [1] information flows between nodes at which information is combined, compared, and integrated. These nodes will be referred to as Characteristics in Keeping with usage in the Traffic Light Method, and (as if the figure was not already complicated enough) additional arrows from the external indicators should be included to represent the inputs.

The hierarchal structure of a university shown in fig [2] is defined as follows: basic division units are the *faculties*, each responsible for one scientific discipline.

Faculties dispose of the teaching resources classified into *position groups*, such as professor, associate professor, research

assistant, etc. Each position group has a *teaching load* assigned to it, which is the number of academic hours per week invested in curricular activities, denoted Hours per Week.

The total of the teaching loads of a faculty adjusted appropriately in case of teaching load and multiplied with the number of staff. And each level has number of Theoretical Hours per week denoted theoretical hours per week.

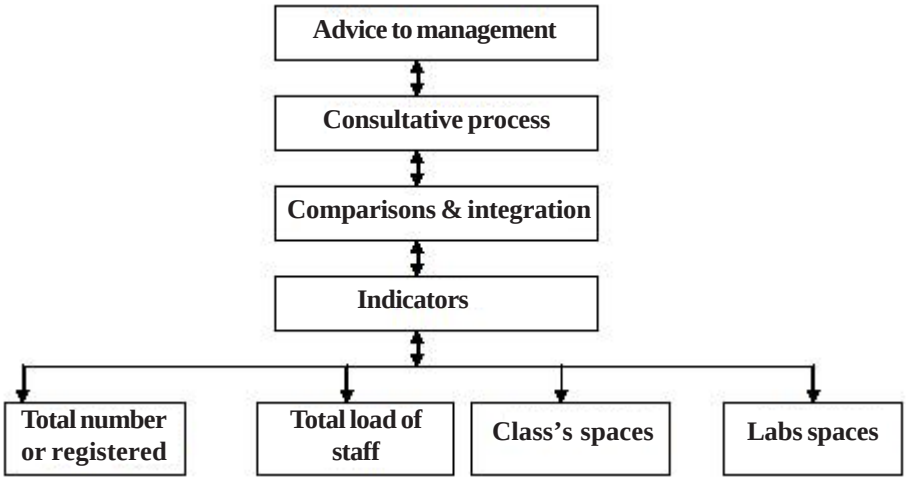


Figure 1. Gap analysis

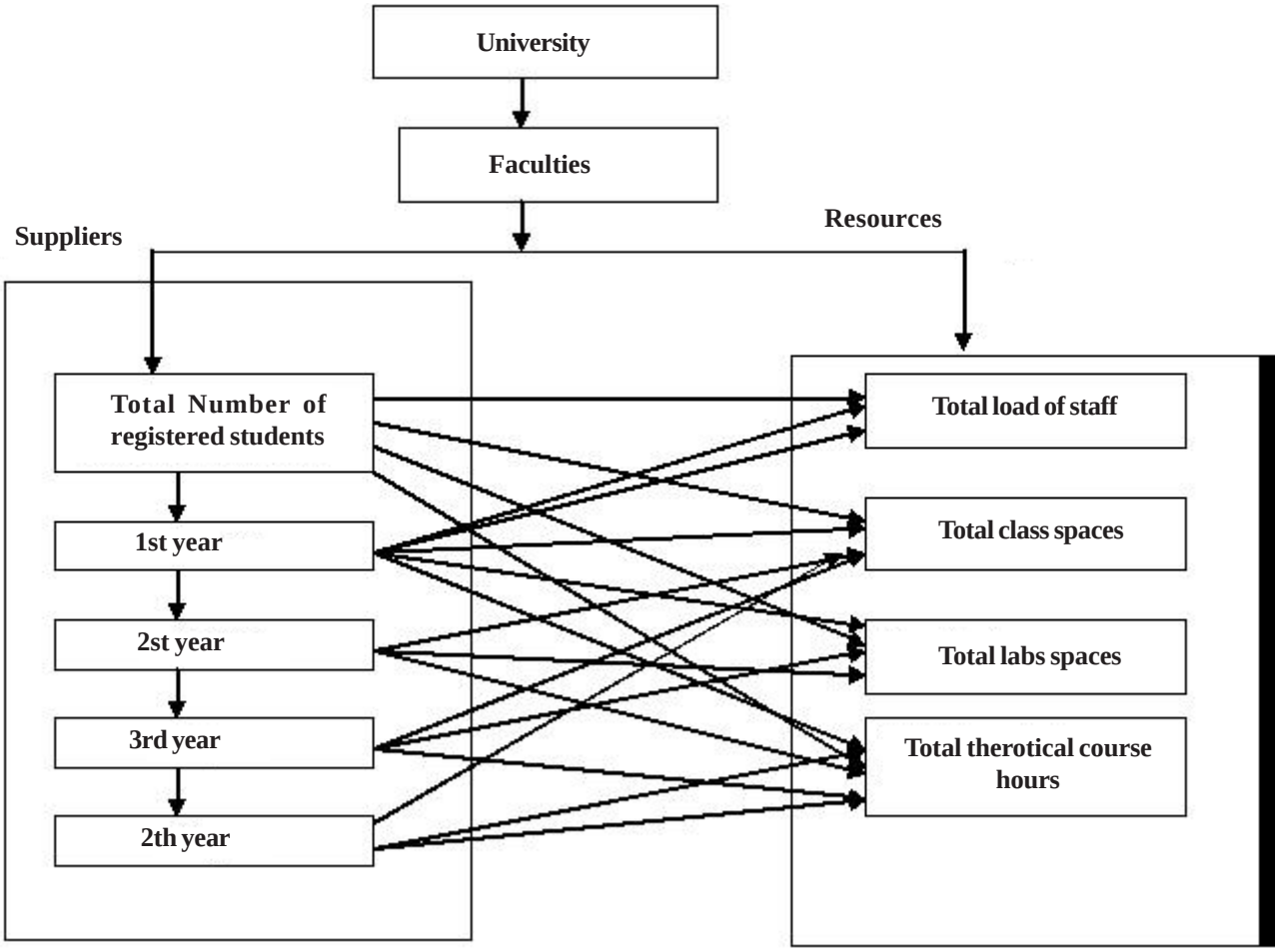


Figure 2. Hierarchical System Students to Faculty

Education is organized into *courses.* Each faculty is said to "*own*" the courses offering its discipline and to supervise the students registered therein.

Abstracting from different admission approaches (e.g., each term or once per year) we speak of the *annual* admission capacity. To determine the admission numbers for the faculty's from its Education Supply *ES total*, it is necessary to specify the admission scenario, i.e., the portion of each supervised program, called its *partition*, in the total number of the faculty's beginners.

3. Modelling Approach

Egypt Universities has devoted additional resources to recruitment efforts to address declines in applications and yield. However, to best utilize these resources, a visualized model-based approach is needed to allow decision makers to meet institutional goals by managing the recruitment and enrolment of students at any educational institution. Visual model contains two components which are:

A) Gap analysis model

B) Prediction optimization model.

3.1 Gap Analysis Model

Gap Analysis module use traffic Light Method that to show performance status and gap between the number of students and the education resources for each faculty. The Traffic Light Method is an elegant way of presenting complex data in a graphical and easily understood form, but by requiring that all indicators be represented by one of only three discrete "*lights*" it suffers from a significant loss of potential information. It is not clear whether a yellow light is "*almost green*" or "*almost red* " see appendix A.

The three fuzzy sets in the Fuzzy Traffic Light Method FTLM are represented by three colors of lamps, and can be described verbally as:

• The set of unsatisfactory indicator values (red),

• The set of marginal indicator values (yellow), and

• The set of satisfactory indicator values (green).

Thus instead of just using a single light that is either red, yellow or green to indicate whether the indicator status is unsatisfactory, marginal or satisfactory, we need to show partial memberships in the three sets.

3.2 Prediction optimization

The second component is goal programming shown in appendix A. The admissions goal planning model developed in this research is a powerful decision-making tool to optimize university admissions planning and to set a rational basis for the admissions policy based on institutional enrolment goals.

It is used to plan admissions for the coming year with the intent to increase the electiveness of recruitment efforts. The model is integer goal programming model that Manages student flows.

The decision variables are the number of freshman students admitted for each faculty and the goals are those contained in the University Strategic Plan. At the beginning of each academic year admissions can program their recruitment efforts based on the admissions policy for the coming year. The model developed provides the best solution possible subject to the constraints, goals and priority structure established. The solution satisfies the university strategic plan goals to the best possible extent. The admissions policy is not sensitive to changes in the priority structure.

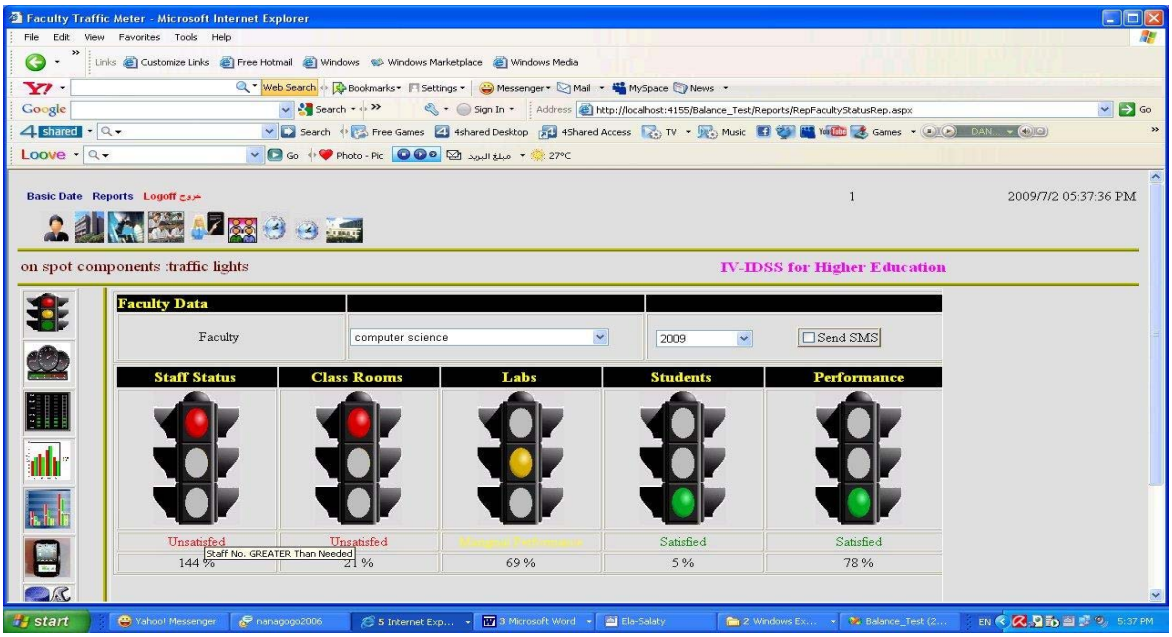
The proposed modeling approach is to use Goal Programming, a powerful and appropriate technique for optimizing university admissions planning. The proposed model is integer goal programming model that manages student flows. The decision variables are the number of freshman students admitted (admittance levels) for each student faculty and the goals are those contained in university strategic plan.

The use of this goal programming model assumes that the decision maker will be able to define order and quantify the objectives of the recruitment program. Management needs to establish goal priorities, sub-goals' weights and goal achievements.

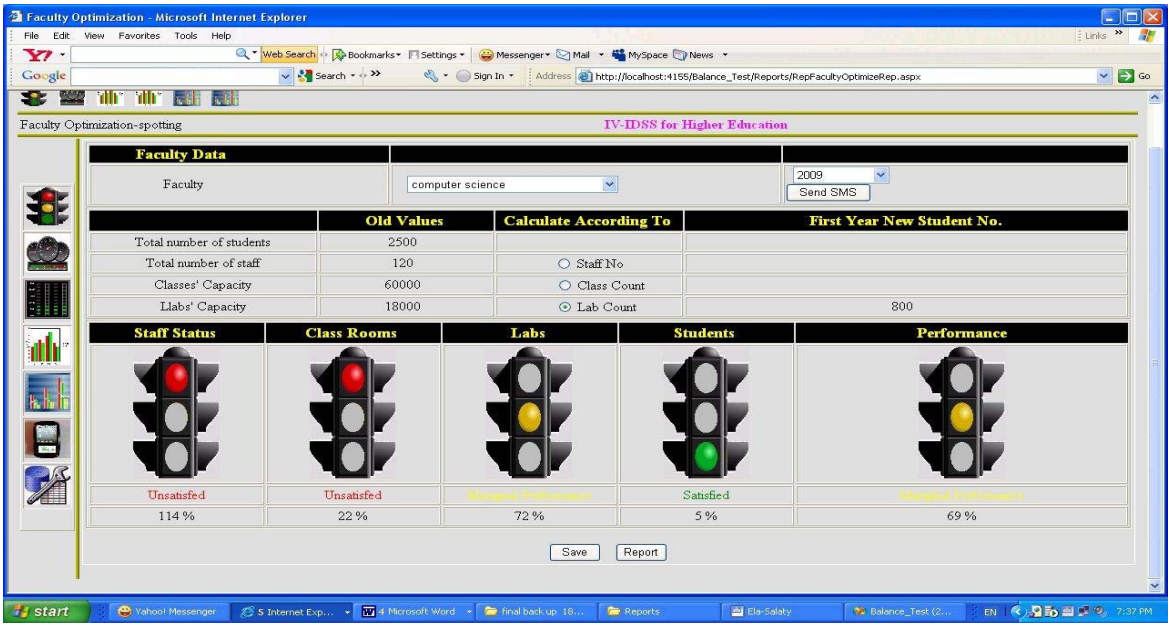
4. Conclusion and Future Work

The number of students in an Egyptian universities and capacity admission policy is very critical factor for higher education quality, this paper introduces a visual model for gap analysis and optimize the number of students for each faculty depending on the hybrid demand and supply resources but there is another important decisional variable is the market needs from graduates, in future we will improve this model to work with market needs from graduates.

Appendix A: Screen shots of visual model implementation



Screenshot of gap analysis using FTLM



Screen shot of number of students and gap analysis

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