PRIORITIZING HIGHER EDUCATION BALANCED SCORECARD PERFORMANCE INDICATORS USING FUZZY APPROACH IN AN IRANIAN CONTEXT

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Abstract
Higher education institutes are facing new challenges in order to improve the quality of education. There is a pressure for restructuring and reforming higher education in order to provide quality education and bring up graduates who become fruitful members of their societies. In higher education as in business there are acceptable conventions of measuring excellence. As a result, the implementation of Balanced Scorecard in higher education has been a target of interest in recent years. However, rather than emphasizing on financial performance, higher education has emphasized on academic measures in its Balanced Scorecard.

This paper aims to prioritize performance indicators within the higher education balanced scorecard using fuzzy TOPSIS technique.

Because Fuzzy Theory is a better approach in comparison to Logical Theory in case of measuring linguistic terms, therefore this paper tries to apply a fuzzy approach in prioritizing the performance indicators introduced by Balanced Scorecard.

Keyword: *Balanced Scorecard, Performance Indicators, Higher Education, Fuzzy TOPSIS, Fuzzy Logic*

Introduction

Nowadays, the role of human capital in economical growth and development can not be ignored. Higher education, as the most important source of educating skilled people, is an important way of forming rich human capital through providing high quality education (Karname Hagi and Akbari, 2004). According to Iran's 20-year development plan (1404 Plan), by the year 2025, Iran is a developed country which holds number one rank in the region in the areas of economics, technology and education. Therefore, for Iran, in order to reach the planed educational position in the region, it is measure its universities' performance using performance measurement systems and make improvements. One of these performance measurement systems is balanced scorecard which has been introduced by Kaplan and Norton and widely applied by various organizations during the previous years (Kaplan and Norton, 1992, 1993, 1996a, 2000). The reason for use of the balanced scorecard is to formulate

strategy objectively in the four perspectives, considering their multidimensional effect (Epstein and Roy, 2004). Balanced scorecard (BSC) measures performance measurement within four perspectives based on several defined performance indicators. Although these indicators are inter-connected to reach to organizational vision and mission, still BSC fails to provide any relationship between the importance of each of these indicators. Therefore, this paper tries to fill this gap by studying and prioritizing the performance indicators defined in the balanced scorecard of an Iranian university.

First, this paper overviews the issues of quality in higher education. Later it reviews Balanced Scorecard and its applications in higher education. And eventually in the methodology section, it seeks to prioritize the performance indicators related to Yazd University Balanced Scorecard model.

Quality in higher education

Quality in higher education is a complex and multifaceted concept and a single appropriate definition of quality is lacking (Harvey and Green, 1993). As a consequence, consensus concerning "the best way to define and measure service quality" (Clewes, 2003, p. 71) does not as yet exist. The concerns regarding the concept of quality in higher education are clearly expressed by Barnett (1994, p. 68):
"What counts as quality is contested. The different views of quality generate different methods of assessing quality and in particular alternative sets of performance indicators (PIs). However, PIs are highly limited in their informational content, and have nothing to tell us about the quality of the educational process."

The key issue is the ability of the quality concept to facilitate the perspectives of a range of stakeholders who have differing conceptions of higher education. The concern is that there will be a direct relationship between the conception of higher education being taken, the definition of quality being used and the performance indicators chosen to measure quality. The challenge is to overcome these concerns and produce a performance evaluation framework that permits the equal expression of legitimate voices, though they may conflict or compete in some ways (Tam, 2001).

The balanced scorecard

Kaplan and Norton (1996b) developed the BSC in the early 1990s. According to them, "the BSC translates an organization's mission and strategy into a comprehensive set of performance measures and provides the framework for strategic measurement and management". Traditionally, most organizations look into their corporate performance by reviewing their financial aspects. However, financial measures alone are not a balanced view of the critical success factors of any organizations, mainly because financial measurements tend to measure the past. Therefore, what if an organization knows what has happened, if there are no explanations of "Why it has happened".

The BSC are based on four key perspectives; they are the:
(i) Financial goals - How will we look to our stake holders?
(ii) Customer perspective - How must we look to our customers?
(iii) Internal processes - What internal processes must we excel at?
(iv) Learning and growth - How can the organization learn and improve? (Sanger, 1988)

Balanced scorecard applications in higher education

The progression from monitoring to the management of quality in education requires the adoption of a system which is aimed not only at performance measurement, but also at streamlining and focusing strategy towards the objectives of the various stakeholders (Kaplan and Norton, 1996b, 2000). In order to be successful, the scorecard also needs to be rooted in the employees' internal commitment (Nørreklit, 2000) and this requires the involvement of staff (Simons, 1995) in the development of performance management decisions.

It is evident that the BSC has been widely adopted in the business sector but the education sector has not embraced the BSC concept widely as indicated by the dearth of published research on this topic (Karathanos and Karathanos, 2005). Cullen *et al.*, (2003) proposed that BSC be used in educational institutions for reinforcement of the importance of managing rather than just monitoring performance. Sutherland (2000), (cited in Umashankar and Dutta, 2007) reported that the Rossier School of Education at University of Southern California adopted the BSC to assess its academic program and planning process. Also Chang and Chow (1999) reported in a survey of 69 accounting departments' heads that they were generally supportive of the BSC applicability and benefits to accounting education programs. Umashankar and Dutta (2007) proposed a BSC model which can be applied to Indian higher education programs/institutions. Papenhausen and Einstein (2006) lay out a comprehensive and content-specific BSC for a business school as a whole. Authors propose that in an environment that demands increasing accountability from business schools, the Balanced Scorecard Approach offers a promising and valuable tool for implementing a strategic performance management system in a college of business.

Balanced scorecard in Yazd university school of humanities

Balanced scorecard has been used to measure the performance of Yazd University School of Humanities. For this purpose, strategy map pf the under study school has been drawn. Through such a strategy map, the cause-and-effect linkage can be better described, and strategy can be more clearly defined to examine the validity of examining strategy and school growth. A strategic map not only links with strategic targets, but also includes measurable indicators of different perspectives. Figure 1, shows the strategy map of Yazd University School of Humanities based on BSC approach.

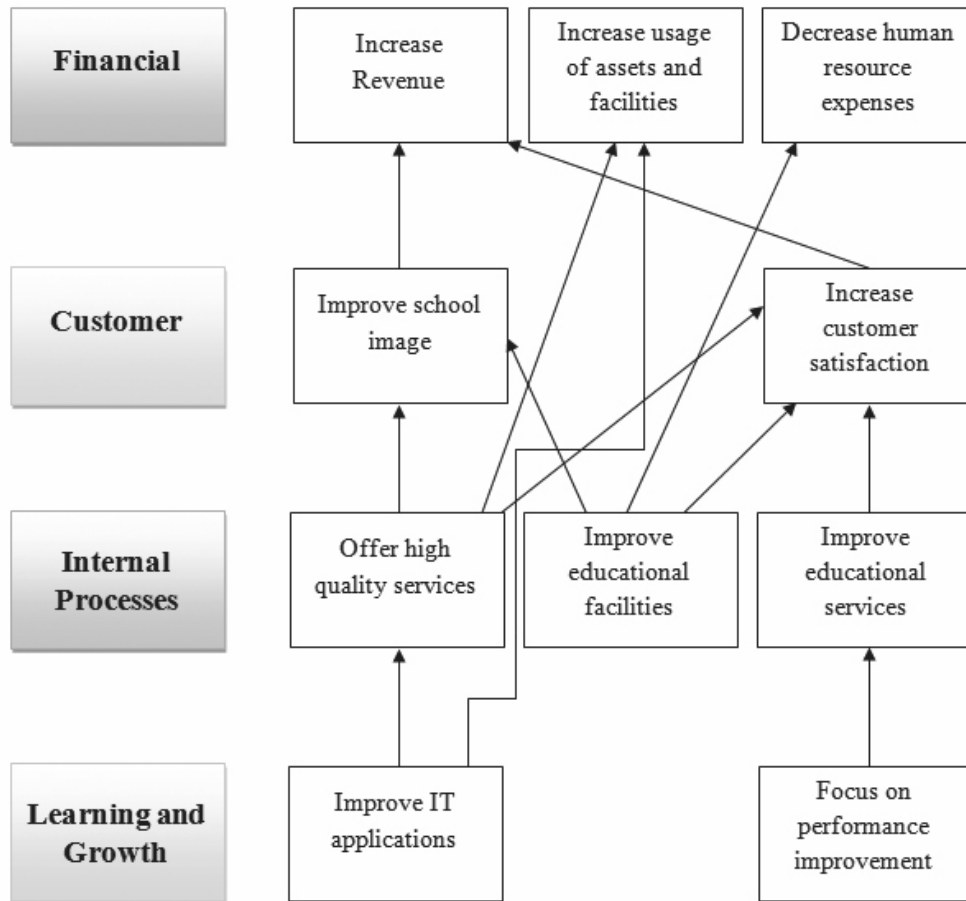**Fig. 1:** Strategy Map of Yazd University School of Humanities

Table 1, shows the performance indicators which have been defined for the school performance assessment:

Table 1: Yazd University School of Humanities Performance Indicators in BSC Approach

Perspective	Performance Indicator
Financial	Annual revenue from tuition in comparison to annual devoted budget
	Value of contracts with industry per year in Rials in comparison to annual devoted budget
	Total fund raised in Rials
	Value of raised services and aids from outside university sources in Rials
	Average life cycle of facilities and equipments
	Average usage of library services (book per student per month)
	Average cost of educational staff (in million Rials)
	Average cost of administrative staff (in million Rials)
Customer	Students' satisfaction grade (1 to 10 scale)
	Academic staff's satisfaction grade (1 to 10 scale)
	Number of complaints made per month
	Increase in students' tendency to enter school
	University's position in national and international rankings
Internal Process	Students' satisfaction level from school's administrative staff performance (1 to 10 scale)
	Students' satisfaction level from school's internal processes (1 to 10 scale)
	Ratio of students to academic staff in bachelor degree programs
	Ratio of students to academic staff in master and PhD degree programs
	Average cycle for renewing educational facilities and equipments
	Time cycle for up-to-dating the computer and IT equipments of the school
	No. of International students enrolled in comparison to total no. students at school
	Students' satisfaction from education
	Average no. of papers by academic staff published in conferences per year
	Average no. of papers by academic staff published in ISI journals per year
	Average no. of papers by academic staff published in refereed research journals per year
Learning and Growth	Ratio of using office automation in processes
	No. of online programs offered by school
	Ratio of using computer in processing and keeping documents
	Amount of performance-based culture availability

The objective of this paper is to rank BSC performance indicators in Yazd University School of Humanities. The following section describes the methodology and its findings.

Methodology

There are various models for prioritizing factors in research. The most important models are Multiple Criteria Decision Making (MCDM) models such as AHP[1], TOPSIS[2], etc. In this paper, we try to apply Fuzzy TOPSIS model, introduced by Chen (1997) for prioritizing performance indicators within the higher education balanced scorecard using fuzzy TOPSIS technique. Study sample society was randomly selected from the university professors of Yazd University, school of humanities. Totally, 90 questionnaires were distributed among which 78 questionnaires were returned (return rate of 86.7%). Table 2 shows the characteristics of the sample society.

Table 2: Sample Characteristics

Factor		Frequency	Percentage
Position	Lecturer	3	4%
	Assistant Professor	58	74%
	Associate Professor	15	19%
	Professor	2	3%
Gender	Male	73	94%
	Female	5	6%

Questionnaire development, validity and reliability

In order to prioritize the performance indicators within the higher education balanced scorecard in an Iranian context, the performance indicators were driven from Balanced Scorecard model. The required data was gathered in the form of a questionnaire asking the respondents to choose the importance of the mentioned indicators based on a Likert scale, with a ranking of: 1 very low; 2 low; 3 relatively low; 4 fair; 5 relatively high; 6 high; and 7 very high. Prioritizing the factors was done using the Fuzzy TOPSIS.
The numerical value of each linguistic term used in the questionnaire, was determined based on the table 3 (Ching *et al.*, 2005).

Table 3: Fuzzy range and numbers

Linguistic term	Fuzzy Number
1	(0, 0.05, 0.15)
2	(0.1, 0.2, 0.3)
3	(0.2, 0.35, 0.5)
4	(0.3, 0.5, 0.7)
5	(0.5, 0.65, 0.8)
6	(0.7, 0.8, 0.9)
7	(0.85, 0.95, 1)

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[1] Analytic Hierarchy Process
[2] Technique for Order Preference by Similarity to Ideal Solution

Because the questionnaire used in this research is a simple questionnaire for measuring the importance of several items and similar questionnaires have already been used in previous studies, its validity is confirmed. In order to test the reliability of the questionnaire, Cronbach's Alpha was found to be 0.813, which indicated that the questionnaire has high internal reliability.

Measurement with fuzzy set

The subject of service quality is burdened by fuzzy terms or buzzwords (e.g. attitude, taste, atmosphere), and respondents may fill out the questionnaire subjectively based on their unique experience or personal characteristics. This subjective assessment is intrinsically imprecise and ambiguous (Williams and Zigli, 1987). To reflect the subjectivity and imprecision in the survey, the assessment made by the respondents can be represented as fuzzy sets (Yeh and Kuo, 2003). Fuzzy set theory, initially introduced by Zadeh (1965), is used to manage the vagueness of human thought, since it can represent vague expressions such as "usually," "fair" and "satisfied," which are regarded as the natural representation of respondents' preference and judgment. The theory also enables the application of the fuzzy domain in mathematics and programming. A fuzzy set is a class of objects with a continuum of membership degrees, characterized by a membership function which assigns a membership grade ranging between zero and one to each object (Kahraman *et al.*, 2000).

In classical set theory, an object is either a member of a set or excluded from it. Thus, in conventional dual logic, a statement can only be either true or false. In reality, however, human cognition, perception and judgment involve approximate and vague reasoning, and cannot be modelled adequately by classical set theory. Fuzzy sets were introduced by Zadeh (1965) as a method of handling vagueness or uncertainty, particularly linguistic variables. Fuzzy sets consider the gray area of data, rather than considering membership of a set to be simply true or false. In other words, fuzzy sets allow partial membership of a set.
The following seven steps, based on the technique introduced by Chen (1997), are used for this research purpose in ranking airlines service quality factors:

Step one:
Consider Fuzzy Decision Matrix of respondents' idea as if follows, where i stands for the number of factors (performance indicators) and j stands for the number of respondents. Also, $\tilde{X}_{ij}$ stands for the score assigned by respondent number i for factor j. On the other hand, $\tilde{W}_{ij}$ is the importance (weight) of each respondent's ideas. It must be added that, because all the respondents are considered to have the same weight, $\tilde{W}_{ij}$ will be defined as $\tilde{W}_j = (1,1,1) \forall j \in n$.

$$\tilde{D} = \begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} & ... & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & ... & \tilde{x}_{2n} \\ . & . & & . \\ . & . & ... & . \\ . & . & & . \\ \tilde{x}_{m1} & \tilde{x}_{m2} & ... & \tilde{x}_{mn} \end{bmatrix}$$

$$\tilde{X} = (a_{ij}, b_{ij}, c_{ij})$$

$$\tilde{W} = [\tilde{w}_1, \tilde{w}_2, ..., \tilde{w}_n]$$

Step two:

This step includes neutralizing the weight of decision matrix and generating fuzzy un-weighted matrix ($\tilde{R}$). To generate $\tilde{R}$, either of the following relations can be applied:

Relation 1:

$$\tilde{R} = \left[\tilde{r}_{ij}\right]_{m \times n} \qquad \tilde{r}_{ij} = (\frac{a_{ij}}{c_j^*}, \frac{b_{ij}}{c_j^*}, \frac{c_{ij}}{c_j^*})$$

, where:

$$c_j^* = \max_i c_{ij}$$

Relation 2:

$$\tilde{r}_{ij} = (\frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{ca_j^-}{c_{ij}})$$

, where

$$a_j^- = \min_i a_{ij}$$

Step three:

This step includes generating fuzzy un-weighted matrix ($\tilde{V}$), while having $\tilde{W}_{ij}$ as an input for the algorithm.

$$\tilde{V} = \left[\tilde{v}_{ij}\right]_{m \times n} \qquad i = 1, 2, ..., m, \quad j = 1, 2, ..., n,$$

$$\tilde{v}_{ij} = \tilde{r}_{ij} . \tilde{w}_j$$

Step four:

Determine positive ideal ($(FPIS, A^+)$) and negative ideal ($(FNIS, A^-)$) for the factors:

$$A^+ = (\tilde{v}_1^*, \tilde{v}_2^*, ..., \tilde{v}_n^*)$$

$$A^- = (\tilde{v}_1^-, \tilde{v}_2^-, ..., \tilde{v}_n^-)$$

In this research, the positive and negative ideas introduced by Chen (1997) are used. Therefore,

$$\tilde{v}_j^* = (1,1,1)$$

$$\tilde{v}_j^- = (0,0,0)$$

Step five:
In this step, we calculate the sum of distances from positive and negative ideas for each factor:

For fuzzy numbers such as A and B, the difference between A and B shown as $D(A,B)$, is determined using the following formula:

$$\tilde{A} = (a_1, b_1, c_1) \qquad \tilde{B} = (a_2, b_2, c_2)$$

$$D(A,B) = \sqrt{\frac{1}{3}\left[(a_2 - a_1)^2 + (b_2 - b_1)^2 + (c_2 - c_1)^2\right]}$$

Therefore, the difference of each factor from positive and negative ideals is calculated:

$$d_i^* = \frac{\sum_{j=1}^{n} d(\tilde{v}_{ij} - \tilde{v}_j^*)}{n} \qquad i = 1,2,...,m$$

$$d_i^- = \frac{\sum_{j=1}^{n} d(\tilde{v}_{ij} - \tilde{v}_j^-)}{n} \qquad i = 1,2,...,m$$

Step six:
The adjacency of each factor to positive ideal is calculated as the following:

$$CC_i = \frac{d_i^-}{d_i^* + d_i^-} \qquad i = 1,2,...,m$$

Step seven:
This is the final step where we rank factors in a descending order of CC_i. Therefore the higher CC_i go to top.

Findings

The findings of this research shows that "students' satisfaction from education", "academic staff's satisfaction grade", "ratio of students to academic staff in master and PhD degree programs", "students' satisfaction grade", "increase in students' tendency to enter school" and "level of performance-based culture availability" are considered as the most important performance indicators of educational balanced scorecard in the perspective of Iranians. Interestingly, "students' satisfaction level from school's internal processes", "value of raised services and aids from outside university sources in Rials" and "students' satisfaction level from school's administrative staff performance" have been selected as the least important performance indicator by respondents. Table 4 shows the rankings of the performance indicators.

Table 4: Ranking performance indicators of educational balanced scorecard

Rank	Factor	d_i^*	d_i^-	Ci
1	Students' satisfaction from education	0.102	0.927	0.901
2	Academic staff's satisfaction grade	0.111	0.916	0.892
3	Ratio of students to academic staff in master and PhD degree programs	0.129	0.897	0.874
4	Students' satisfaction grade	0.131	0.894	0.872
5	Increase in students' tendency to enter school	0.161	0.862	0.843
6	Level of performance-based culture availability	0.223	0.803	0.783
7	Ratio of students to academic staff in bachelor degree programs	0.198	0.598	0.752
8	University's position in national and international rankings	0.206	0.589	0.741
9	Average no. of papers by academic staff published in ISI journals per year	0.208	0.585	0.738
10	Average cycle for renewing educational facilities and equipments	0.208	0.583	0.737
11	Time cycle for up-to-dating the computer and IT equipments of the school	0.214	0.579	0.730
12	Average no. of papers by academic staff published in refereed research journals per year	0.216	0.578	0.728
13	Number of complaints made per month	0.220	0.574	0.723
14	Average usage of library services	0.234	0.558	0.704
15	Ratio of using office automation in processes	0.237	0.556	0.701
16	Average no. of papers by academic staff published in conferences per year	0.247	0.556	0.692
17	No. of International students enrolled in comparison to total no. students at school	0.247	0.547	0.689
18	No. of online programs offered by school	0.247	0.543	0.687
19	Ratio of using computer in processing and keeping documents	0.252	0.540	0.682
20	Value of contracts with industry per year in Rials	0.255	0.539	0.679

21	Average life cycle of facilities and equipments	0.269	0.521	0.659
22	Annual revenue from tuition	0.271	0.520	0.658
23	Total fund raised in Rials	0.272	0.521	0.657
24	Average cost of educational staff	0.273	0.522	0.656
25	Average cost of administrative staff	0.273	0.519	0.655
26	Students' satisfaction level from school's internal processes	0.278	0.519	0.651
27	Value of raised services and aids from outside university sources in Rials	0.278	0.515	0.650
28	Students' satisfaction level from school's administrative staff performance	0.312	0.481	0.606

Conclusion

Universities world-over are facing the challenge of being centers of excellence for teaching as well as research. On one hand universities are increasingly being required to teach ever increasing number of students in increasing numbers of specializations and disciplines, and on the other they are being asked to pay more attention to quality of teaching and educational programs (Smeby, 2003). This again indicates at the requirement to re-look at the ways institutions of higher learning are to be managed.

One of the most successful performance measurement which has been widely implemented by various organizations during the previous years is Balanced Scorecard. It measures organization's performance within four perspectives based on several defined performance indicators. Although these indicators are inter-connected to reach to organizational vision and mission, still BSC fails to provide any relationship between the importance of each of these indicators. Therefore, this paper tried to fill this gap by studying and prioritizing the performance indicators of balanced scorecard model implemented in an Iranian university.

This explorative study gives a valuable first insight into the importance of each performance indicator according to Iranian university professors and reveals the rank of each single performance indicator in comparison to others.

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