The Performance Evaluation of Medical Sciences University, and Health Care Services in Hormozgan Based on Balanced Scorecard with a Fuzzy Logic Approach

Hamidreza Hassanzadeh[1], Mohsen Dianat[2], Tayebeh Zareei Hajiabadi[3]*

[1] *Faculty Member of Tehran University, Tehran, Iran*
[2] *Faculty Member of Payam Noor University, Qeshm, Iran*
[3] *Health Information Management Research Center, Hormozgan University of Medical Sciences, Bandar Abass, Iran; MSc Student of Executive Management, Payame Noor Qeshm University, Hormozgan, Iran*

ABSTRACT: This study aimed to evaluate the performance of medical sciences university, and health care services in Hormozgan based on Balanced Scorecard model with a fuzzy logic approach. This descriptive (survey) study was done in 2013 to review the performance of the year 2012. The research population includes all managers and senior experts of staff domain involved in evaluating the performance of Hormozgan Medical Sciences University using the Balanced Scorecard (BSC) method. The research was done by a questionnaire consisting of 15 strategic objectives and 25 measures. Its validity and reliability were examined through a scientific method and it was conducted among all study members. After collecting the questionnaire, data, and documents in the University, to analyze the data, fuzzy logic was analyzed in the MATLAB environment. Finally, using gap analysis, the gap between current and desired state was determined. Wilcoxon test results on the evaluation of the University performance based on strategic goals with a fuzzy approach of P = 0.01 indicated that there is a significant difference between current and desired state of university performance. However, based on the balanced scorecard according to the amount of P = 0.06 it was observed that there is no significant difference between the current state and the desired state of the medical sciences university performance. In addition, based on cashes of scorecard in order of preference in favor of recipients of services, financial, growth, learning and internal processes it has the best performance. The performance evaluation using the balanced scorecard model in fuzzy environment can enhance the evaluation accuracy in this model. Therefore, fuzzy logic approach is an appropriate method for evaluating the organization and can increase the accuracy of assessment as well as cover the weaknesses of the scorecard model.

Key words: Performance, Balanced Scorecard (BSC), Fuzzy Logic, Medical Sciences University, Health Care Services, Hormozgan

INTRODUCTION

Performance assessment is a tool to measure the efficiency and effectiveness and the organizations need it to increase their rational decisions. In today's turbulent world, those organizations will survive who continually improve their performance. If an organization wants to achieve sustainable efficiency and development, it must consider three criteria of employees' satisfaction, employees continuing, and employees' efficiency. Therefore, considering performance management issue has a growing importance. Performance management requires decisions based on facts, so it is one of the necessary arrangements to access information. Components of performance measurement include strategic objectives, measures, units of measurement and determining the expected (predicted) state [1,2].

Many methods have been proposed to measure the performance of organizations. One of the most important methods of measuring performance that are applicable in public organizations is Balanced Scorecard (BSC). Balanced Scorecard was provided by "Kaplan and Norton". The approach advocators believe that this approach is a mechanism for translating organizational strategies and is dependent on organization strategy. Therefore, it is needed to set a clear strategy and the organizational mission and ultimately it leads to performance measurement in relation to objectives [3].

Today, health care organizations are those complex organizations that need strong protection of management in terms of performance assessment. Health care organizations have a dynamic, unexpected and uncertain environment in which quality events play a central role. Now the priority of these organizations is to determine optimally the evaluation parameters and to assign points to them accurately [4].

Efficient performance measurement system is a useful tool for administrators and is able to control the monitoring and improvement of health care processes and organizan performance. Today, health care is faced a significant strategic challenges in order to respond to customers' needs and improve the quality as well as efficiency. Health organizations need innovation and organization to improve various stakeholders effectively and to provide health care. In this regard, the organizations require information management comprehensive system, such as the Balanced Scorecard, to achieve their strategic objectives. Using the Balanced Scorecard improves the performance and sustains the competitive advantage and the results will be dramatic. The operational procedures are improved during the first year and lead to a substantial increase in revenue. Generally, Balanced Scorecard implementation for the entire health organization is to enhance its competitiveness. Performance evaluation is the more intangible requirement of assets, including patient satisfaction, ability and innovation and non-financial information, so that it is very important and can have a significant impact on organizational performance [5].

Performance management is a process based on a series of activities that through continuous improvement of individuals and groups performance the organization will be lead to improve the strategic focus and the effectiveness of the organization. In fact, performance management can be known as a process by which a single understanding and a common language can be established "about what the organization needs to achieve" and "how to achieve" [6].

So far, a number of studies have been conducted on the performance evaluation of the organizations using the Balanced Scorecard approach.

Namdaryan and Nejad Falatury Moghadam (2011) in their paper entitled "Performance evaluation of supply chain with process and strategic vision, using fuzzy logic", used triangular fuzzy logic method. In their conclusions, they expressed that applying the fuzzy sets theory has been a strong point for the research, because fuzzy model considers the real situations related to human judgments in evaluation activities. Ajami et al. (2010), on a study entitled "Performance evaluation with a Balanced Scorecard approach" expressed that: when the objectives are integrated with process of quality system implementation through balanced evaluation model, generally the structure enhances the organizational understanding and transparency between employees and managers. Organizational understanding cause performance control to be provided, and finally the organization is better controlled. Vatankhah and Salemi (2009) in their article titled "Study of evaluation system of medical sciences university hospitals in Iran using the Balanced Scorecard", concluded that the study achieving a weak point in the overall aspect of the present evaluation system (overall property of evaluation system) is faced with an average of 66.67 percent. Therefore, in the foundation and establishment of an evaluation system, appropriate, balanced and coherent notice to the above views is extremely important so that neglecting and lack of fitness in each segment can be a major obstacle in the way of organization to achieve the mission and vision of the organization. Hung-Yi Wu et al. (2011), in an article entitled "Performance evaluation of training centers in universities based on the balanced scorecard", stated that the components of performance measurement include strategic objectives, measures, units of measurement and determining the expected (predicted) state. They concluded that learning and development are two significant influential factors and can be effective on the other three approaches. In addition, internal process, prospects and financial aspects play an important role in evaluating the performance. Asosheh et al. (2010), on a study entitled "Analysis of the Balanced Scorecard" stated that using the Balanced Scorecard in recent investigations has increased among different directors for several reasons. First, in contrast to traditional systems that only include the financial measures, Balanced Scorecard is designed in four aspects that help to improve management decision making and operations perspective. Second, as a comprehensive system of performance evaluation, the Balanced Scorecard provides causal relationships, and the connection of several classes of financial and non-financial measures. In particular, it indicates the specific improvements that lead to the desired results according to the organization's strategy. Finally, the third option of Balanced Scorecard can be used as a strategic management system. Babillo et al. (2009) on their research titled "Fuzzy expert system for fuzzy Balanced Scorecard", expressed that Balanced Scorecard is widely recognized and it is applied in business management to support decision-making. Unfortunately, the systems based on the Balanced Scorecard have drawbacks. They are not able to deal with imprecision and vagueness. To overcome these limitations, this paper proposes the fuzzy expert system that helps managers to improve and achieve the strategic objectives of the organization. In the conclusion of this paper, fuzzy expert system is proposed for the Balanced Scorecard. A fuzzy expert system improves the decision making process and involves in achieving the organization's strategic objectives. The system is used in different companies and organizations according to their needs.

Therefore, in the present research based on the conducted investigations background and according to the Balanced Scorecard, the researcher tries to identify the strategic objectives, measures, units of measure and the current state, first and then determine the performance of the organization.

MATERIAL AND METHODS

The present study is a survey research in terms of the implementation. It aims to evaluate the performance of medical sciences university, and health care services in Hormozgan province based on Balanced Scorecard model with a fuzzy logic approach. The research population includes all managers and senior experts of staff

domain involved in evaluating the performance of Hormozgan Medical Sciences University using the Balanced Scorecard (BSC) method that is as follows:

Department of Education, Department of Health, Department of Management and Resources Development, Department of Healing, Student and Cultural Affairs Department, Department of Research, Food and Drug Department.

Due to the limited number of the research population that is 30 subjects, the entire population is selected as the sample. The sampling method is census (whole enumeration).

To gather research required information the following sources are used:
- Library Data:
  o Information sites of Internet World Network
  o Latin Journals
  o Persian books and articles
- The evaluation and study of the desired organization's proposed demand
- Inventory

This is done in three stages. In the first stage, the strategic objectives and measures are identified in Hormozgan University of Medical Sciences through library, document and evidence resources available in Medical Sciences University and interviews with directors and senior experts of staff domain involved in evaluating the performance. Afterwards, in the second stage, the identified objectives and measures based on fuzzy logic are set. Then, they are presented to the directors involved in this process, in the form of a questionnaire to determine the level of expected state and current state. In the third stage, the distance between the desired state and the current state is measured by the gap analysis model. Strategic objectives and measures of Medical Sciences University performance based on Balanced Scorecard are derived from documents available in Medical Sciences University and Health Care Services of Hormozgan, where the desired state is determined. The following table shows the strategic objectives and measures for each objective based on the Balanced Scorecard and the expected state of the university (desired state).

Research questionnaire consists of 25 items that are answered on a 10-point Likert scale. Since the fuzzy approach used in this study, numbers and phrases introduced by Hemmati and Abdollahzadeh (2012) are the base of the expected state and current state assessment.

Table 1. Applied fuzzy spectrum and numbers

Verbal phrases	Fuzzy numbers
Very inappropriate	(0, 0, 0.1)
Inappropriate	(0, 0.15, 0.3)
Relatively inappropriate	(0.1, 0.3, 0.5)
Median	(0.3, 0.5, 0.7)
Relatively appropriate	(0.5, 0.7, 0.9)
appropriate	(0.7, 0.9, 1)
Very appropriate	(0.9, 1, 1)

In order to assess the validity of the questionnaire from the apparent validity, using the professors and experts' opinion, the research questionnaire is revised and final set. In order to assess reliability of the questionnaire, test-retest method is used.

Therefore, the research questionnaire is first distributed among 15 directors and senior experts of staff domain involved in evaluating the performance of Hormozgan University of Medical Sciences. The questionnaire reliability is computed using Cronbach's alpha coefficient of 0.87. Then, the questionnaire is conducted among the entire population of the survey that is equal to 0.92. The reliability of each of the aspects of the Balanced Scorecard is as the table below shows.

The analysis is performed using descriptive statistics and simple frequency and relative frequency. It is conducted based on fuzzy logic and MATLAB analysis software.

RESULTS

Using fuzzy data the formation diagram of each of targets has been identified (Figure 1). Then fuzzy scores mean of each of the strategic objectives of Medical Sciences University has been determined and the gap between the fuzzy scores mean and desired state has been indicated (Table 2). Afterwards, through the Wilcoxon test, the gap between the current state and the desired performance has been tested.

According to Figure 2, the best performance is related to the purpose of increasing the attraction and retention of human resources (A9) and then the purpose of increasing health awareness level of people (A2). The worst performance is for the empowerment of employees (A8) and increasing the quality of health services (A3).

As shown in Table 2, the largest gap in the fuzzy data, respect to the three final priorities are related to empowering employees (A8), increase the quality of health services (A3), and outsourcing development (A6). The lowest gap in the fuzzy data, respect to the three first priorities are related to increasing the attraction and

retention of human resources (A9), increasing health awareness level of people (A2) and the development of private sector participation (A13). Wilcoxon test results show that due to the amount of P =0.001 there is a significant difference between current state and desired state of Hormozgan Medical Sciences University performance.

Given Table 3 and Figure 2, the maximum gap (based on priorities) between current state and desired state of Hormozgan Medical Sciences University performance based on the Balanced Scorecard is related to internal processes aspect (X2) in the first stage. Then, respectively it is related to the growth and learning aspect (X3) in the second stage, and the financial aspect (X4) in the third stage. The minimum gap in the performance of Hormozgan Medical Sciences University based on the Balanced Scorecard is related to service recipients aspect (X1).

Wilcoxon test results on the performance evaluation of Medical Sciences University based on Balanced Scorecard show that due to the amount of P =0.06 there is a significant difference between current state and desired state of Hormozgan Medical Sciences University performance.
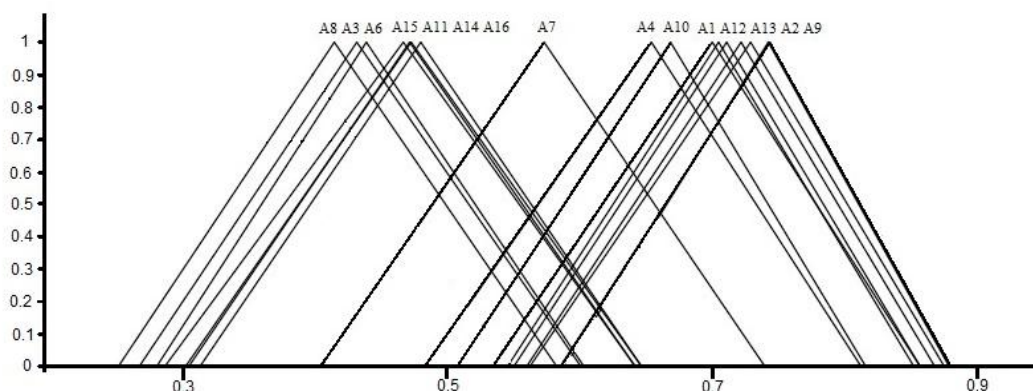

Figure 1: Fuzzy analysis showing the current state of the University performance in strategic objectives

Table 2. Fuzzy scores mean of the current state and the gap between it and the desired state

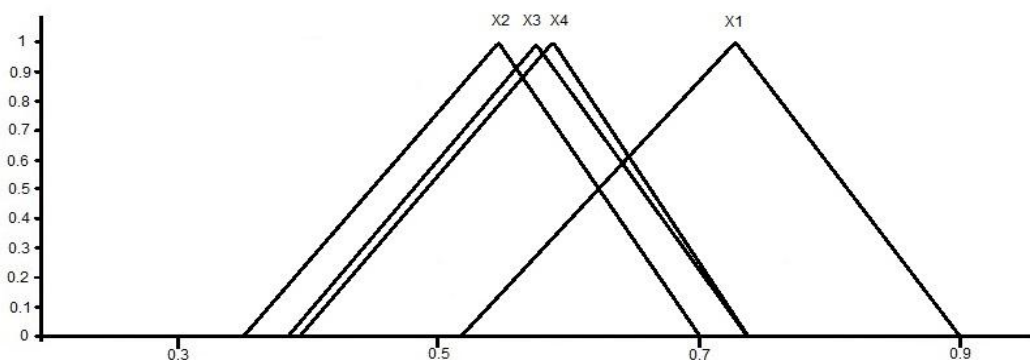| Figure	Strategic objectives	Current state mean	Desired state mean	Gap amount
A1	Increasing the satisfaction of services recipients	(0.54, 0.7, 0.87)	(0.9, 1, 1)	(0.36, 0.3, 0.13)
A2	Increasing health awareness level of people	(0.54, 0.76, 0.93)	(0.9, 1, 1)	(0.36, 0.24, 0.07)
A3	Increasing the quality of health services	(0.24, 0.48, 0.64)	(0.9, 1, 1)	(0.66, 0.52, 0.36)
A4	Improvement of staff executive process	(0.47, 0.63, 0.82)	(0.9, 1, 1)	(0.43, 0.37, 0.18)
A5	Reducing endemic diseases	(0.39, 0.58, 0.66)	(0.9, 1, 1)	(0.51, 0.42, 0.44)
A6	Outsourcing development	(0.26, 0.45, 0.62)	(0.9, 1, 1)	(0.64, 0.55, 0.38)
A7	New fields development	(0.41, 0.59, 0.78)	(0.9, 1, 1)	(0.49, 0.41, 0.22)
A8	Empowerment of employees	(0.21, 0.42, 0.62)	(0.9, 1, 1)	(0.69, 0.58, 0.38)
A9	Increasing the attraction and retention of human resources	(0.59, 0.79, 0.87)	(0.9, 1, 1)	(0.31, 0.21, 0.13)
A10	ICT development	(0.51, 0.64, 0.82)	(0.9, 1, 1)	(0.39, 0.36, 0.18)
A11	Development of banking resources usage	(0.3, 0.47, 0.63)	(0.9, 1, 1)	(0.6, 0.53, 0.37)
A12	Development of charitable resources attraction	(0.54, 0.71, 0.88)	(0.9, 1, 1)	(0.36, 0.29, 0.12)
A13	Development of private sector participation	(0.55, 0.72, 0.88)	(0.9, 1, 1)	(0.35, 0.28, 0.12)
A14	Dedicated revenues increase	(0.3, 0.47, 0.64)	(0.9, 1, 1)	(0.6, 0.53, 0.36)
A15	Reduction in insurance claims	(0.27, 0.46, 0.65)	(0.9, 1, 1)	(0.63, 0.54, 0.35)
A16	Reducing the amount of insurance deductions	(0.32, 0.46, 0.64)	(0.9, 1, 1)	(0.58, 0.54, 0.36)

Figure 2: Fuzzy analysis showing the current state of the University performance in strategic objectives based on the Balanced Scorecard
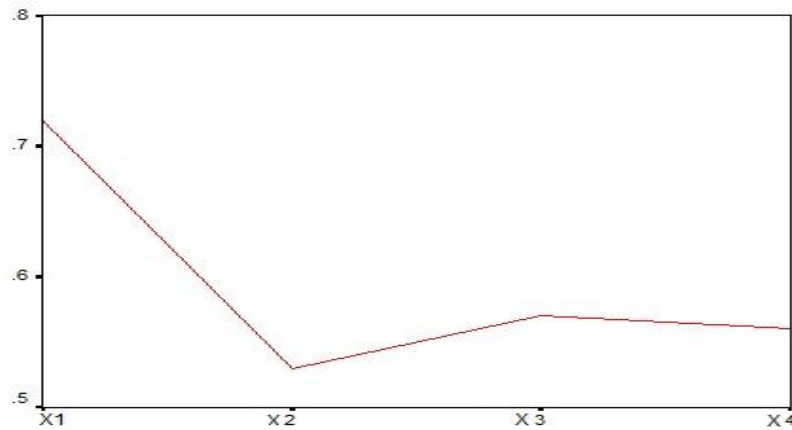
Figure 3: The state of Hormozgan University performance in strategic objectives based on the Balanced Scorecard

Table 3. Fuzzy scores mean of the current state and the gap between it and the desired state based on the Balanced Scorecard

Figure	Strategic objectives	Current state mean	Desired state mean	Gap amount
X1	Service recipients aspect	(0.54, 0.73, 0.9)	(0.9, 1, 1)	(0.36, 0.27, 0.1)
X2	Internal processes aspect	(0.35, 0.54, 0.7)	(0.9, 1, 1)	(0.55, 0.46, 0.3)
X3	Growth and learning aspect	(0.39, 0.56, 0.73)	(0.9, 1, 1)	(0.51, 0.44, 0.27)
X4	Financial aspect	(0.4, 0.58, 0.73)	(0.9, 1, 1)	(0.5, 0.42, 0.27)

DISCUSSION AND CONCLUSION

This study aimed to evaluate the performance Hormozgan Medical Sciences University in 2013. While most healthcare organizations spend considerable energy in evaluating performance, the effectiveness of the applied measures is changing significantly. In total, there is a significant difference between expectations and perceptions of the current state and the desired state of the management. Therefore, evaluating the performance of these organizations is necessary to improve their excellence. It should be always considered that the philosophy and purpose of performance evaluation is to understand and measure the differences in the current state performance compared to the desired performance. On the other hand, the present study is an applied research in terms of the objectives so that it can be used as a model for evaluating the performance of universities.

The results of the study questions investigation indicate that in the study of the performance state of Hormozgan University of Medical Sciences based on strategic objectives the best performance is related to "increasing the attraction and retention of human resources" and the worst performance is related to the empowerment of employees. Wilcoxon test results between the current and desired state of performance of Hormozgan Medical Sciences University show the value Z (-3.517) at (0.001) confidence level.

What are concluded in this fuzzy model are some results that are not much close to reality (optimal performance). The description is that, there is a significant difference between the current state and the desired state of Hormozgan Medical Sciences University performance. However, in some performance components of the strategic objectives the university acted relatively well. These include increasing the attraction and retention of human resources, increasing health awareness level of people, development of private sector participation, development of charitable resources attraction, reducing endemic diseases, increasing the satisfaction of service recipients.

Strategies for the empowerment of employees can be the following cases:
✓ Development of new fields based on regional needs
✓ Development of collaborative educational and research studies with other universities
✓ Enhancement of scientific and technical skills of human capital and the ability to use the information by the staff
✓ Involving employees in decision-making

Being relatively inappropriate of increasing health services quality can be for the following reasons:
- Lack of adequate medical facilities, such as medical and pharmaceutical devices
- Lack of specialists doctors in the subordinate of the province
- Shortage of healthcare personnel in subordinate units, especially outside the center of the province
- Lack of adequate health care centers in deprived and faraway areas
- Shortage of nurse staffing
- Strategies to enhance the quality of health services

- Supplying the requirements of health sector
- More supervision over the observance of infection control
- development of employees training courses
- Clinical audit and clinical effectiveness as well as teaching assistants and doctors

- In management and education pivot, engagement in the implementation of strategic objectives, operational plans, and the innovative measures in the hospital
- Creating awareness in the staff about the goals and objectives related to the organization (hospital)
- Evaluating the forces and applying corrective actions in satisfaction surveys
- Supervision of safety management focused on increasing safety culture
-

Strengths of increasing the attraction and retention of human resources in the service recipients aspect can be enumerated as creating the essential infrastructures for the reduction of tariffs, funding, connecting to health related sectors, the foundation of the health system, and honoring the client.

Table 4. Priority of the best and the worst performance of Hormozgan University of Medical Sciences and Health Care Services, based on the Balanced Scorecard

Figure	Strategic objectives	Current state mean	Desired state mean
A1	Service recipients aspect	Relatively good	First
A4	Financial aspect	Average	Second
A3	Growth and learning aspect	Average	Third
A2	Internal processes aspect	Average	Fourth

Performance Evaluations of Medical Sciences University and Health Care Services based on the Balanced Scorecard indicate that in the aspect of the service recipients with relatively good performance is the best performance based on Balanced Scorecard. After that the financial aspect, growth and learning aspect, and internal processes aspect are in average verbal level.

REFERENCES

1. Seyedhosseini SM, Taleghani AE, Bakhsha A, Partovi S. 2011. Extracting leanness criteria by employing the concept of Balanced Scorecard. Expert Systems with Applications. 38(8):10454-61. ScienceDirect (Elsevier).
2. Wu H-Y, Lin Y-K, Chang C-H. 2011. Performance evaluation of extension education centers in universities based on the balanced scorecard. Evaluation and Program Planning. 34(1):37-50. ISI Database : ScienceDirect (Elsevier).
3. Nørreklit H. 2003. The balanced scorecard: what is the score? A rhetorical analysis of the balanced scorecard. Accounting, organizations and society; 28(6): 591-619.
4. Barati A. R. & Maleki M. R. & Golestani M. & Imani A. 2006. Evaluation of the performance management system of staffs in Amiralmomenin hospital in Semnan using Balanced Scorecard. Journal of Management and Medical Information collage, University of Medical Sciences, Iran 34 (1).
5. Lin Q-L, Liu L, Liu H-C, Wang D-J. 2012. Integrating hierarchical balanced scorecard with fuzzy linguistic for evaluating operating room performance in hospitals. Expert Systems with Applications.
6. Iranzadeh S. Barghi A. 2009. Evaluating the organization performance with Balanced Scorecard method (BSC), case study, Journal of Industrial Management, Faculty of Humanities, Islamic Azad University of Sanandaj, No. 8.
7. Sakaran U. 2005. Research methods in management," translated by Saebi M. & Shirazi M. Tehran, Institute of Management Studies and Planning.
8. Shekari M. & Emami H. & Raufi A. 2011. Strategic plan of Hormozgan University of Medical Sciences and Health Care Services, Daroltafsir publicashion.
9. Ajami S., Tofighi Sh. & Tavakkoli V. & Ebad Sabchani A. 2010. Performance evaluation of hospital medical documents with a Balanced Scorecard approach. Health Information Management 7 (1)
10. Namdaran L. & Nejad Falatury Moghaddam T. 2011. Performance evaluation of supply chain with process and strategic vision, using fuzzy logic. Industrial Management (6) 3.
11. Vatankhah S. & Salemi A. 2009. Study of evaluation of medical sciences university hospitals in Iran using the Balanced Scorecard: (12) 38.
12. Hemmati M. & Abdollahzadeh R. 2010. Applying fuzzy theory in the balanced scorecard (BSC) to evaluate the organization's current strategy, Islamic Azad University, Semnan
13. Asosheh A, Nalchigar S, Jamporazmey M. 2010. Information technology project evaluation: An integrated data envelopment analysis and balanced scorecard approach. Expert Systems with Applications. 37(8):5931-8.
14. Benchina J. 2011. Fuzzy Decision Trees as Decision-Making Frame Work In The Public Sector Yugoslav Journal of Operations Research. Nub2:205-224.
15. Babillo F, Delgado M, Go´mez-Romero J, Lo´pez E. 2009. A semantic fuzzy expert system for a fuzzy balanced scorecard. Expert Systems with Applications. (36): 423-433. ScienceDirect (Elsevier).