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Research Article

Determining Importance Degrees of Strategic Plan Goals with Integrated Fuzzy AHP and Fuzzy TOPSIS Methods

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Abstract

Effectiveness of strategic planning activities prevents to loss of time, money and reputation of organizations. Universities as educational institutions are continuing these studies to provide better quality and more innovative education services. The strategic plan is to ensure the continual improvement of the universities, to be a partner of other national and international universities, to give good education services to students and to be preferred by students. In this study, 2013-2017 strategic plan prepared by Hacettepe University is examined and the long-term objectives of the plan are ranked according to their importance. The aim of ranking the goals that highly contribute to the strategic plan is to use the resources and energy of the institution more accurately in the direction of achieving these goals and to reach its strategies more determinedly. Fuzzy AHP (Analytical Hierarchy Process) and Fuzzy TOPSIS (Technique for Order Preference by Similarity to Ideal Solutions) methods, which are multi-criteria decision-making methods, are used in order to the ranking of strategic goals. The criteria of the SMART (Specific-Measurable-Accessible-Realistic-Time Limited) method is also used for evaluating of the goals. The Fuzzy AHP method is used to determine the weights of these criteria and the Fuzzy TOPSIS method is used to obtain the significance of the goals. The importance degrees of long-term goals have been normalized, and then goals providing high added value to the strategic plan have been determined by using Pareto analysis with 80-20 rule. In this way, strategies that provide high added value to the strategic plan are also determined. With the developed integrated decision-making approach, it is envisaged that more effective strategic planning process will exist as a result of the determination of high value-added goals.

Keywords: Strategic planning; SMART approach; fuzzy multi-criteria decision making methods; pareto analysis.

Bütünleşik Bulanık AHP ve Bulanık TOPSIS Yöntemleri ile Stratejik Plan Hedeflerinin Önem Derecelerinin Belirlenmesi

Öz

Stratejik planlama çalışmaları etkili yürütüldüğü takdirde kuruluşların zaman, para ve itibar kaybının önüne geçmektedir. Üniversiteler bir eğitim kurumu olarak daha kaliteli ve daha yenilikçi bir eğitim hizmeti vermek amacıyla bu çalışmaları sürdürmektedir. Stratejik planın üniversiteler için önemi sürekli gelişmeyi sağlamak, diğer ulusal ve uluslararası üniversitelerle olan rekabete ortak olmak, iyi eğitim hizmetini öğrencilere verebilmek ve üniversiteye girecek öğrenciler tarafından tercih edilmeyi sağlamaktır. Bu çalışmada, Hacettepe Üniversitesi'nin hazırlamış olduğu 2013-2017 stratejik planı incelenmiş ve plana ait uzun dönem hedefleri önem derecelerine göre sıralanmıştır. Hedefleri sıralamanın amacı stratejik plana katkısı yüksek hedeflerin belirlenerek, bu hedefleri gerçekleştirmek doğrultusunda kurumun kaynaklarını ve enerjisini doğru yönlendirmesinin ve stratejilerine daha kararlı bir şekilde ulaşmasının sağlanmasıdır. Bu sıralamanın yapılabilmesi için çok kriterli karar verme yöntemlerinden olan Bulanık AHP (Analitik Hiyerarşi Prosesi) ve Bulanık TOPSIS (İdeal Çözüme Benzerliğe Göre Tercih Sıralama Tekniği) yöntemleri kullanılmıştır. Hedeflerin değerlendirilmesinde ise SMART (Belirli-Ölçülebilir-Ulaşılabilir-Gerçekçi-Zaman Kısıtlı) metodunun kriterleri kullanılmıştır. Bu kriterlerin ağırlıkları Bulanık AHP metodu belirlenmiş olup, Bulanık TOPSIS metodu ile hedeflerin önem dereceleri elde edilmiştir. Uzun dönem hedeflerinin önem dereceleri normalize edilip Pareto analizi ile değerlendirilerek 80-20 kuralı ile stratejik plana yüksek katma değer sağlayan hedefler belirlenmiştir. Bu sayede stratejik plana yüksek katma değer sağlayan stratejilerin de belirlenmesi sağlanacaktır. Geliştirilen bütünleşik karar verme yaklaşımı ile katma değeri yüksek hedeflerinin belirlenmesi sonucunda daha etkin stratejik planlama süreci yürütüleceği öngörülmektedir.

Anahtar Kelimeler: Stratejik planlama; SMART; bulanık çok kriterli karar verme metodları; pareto analizi.

1. Introduction

Today, many universities have a strategic plan as well as many public and private institutions. If the strategic plan is prepared as it should be, time, financial and reputation loss are avoided. As an educational institution, universities are forming a strategic plan to provide a better quality and more innovative education service. Strategic planning is essential in terms of ensuring constantly developing, being in competition with other national and international universities, and being preferred by students entering the university. The strategic plan consists of defined goals that achieve each strategy, and performance indicators that show whether the goals achieved or not. However, it is a matter of debate how objectives of the strategic plan are effective in achieving the relevant strategy. In order to decide which goals are more effective, goals need to be assessed with some criterion. When this assessment is done instinctively, the success of effective outcomes can only be provided by experienced and decision makers in the field. Implementing the evaluation process by making a decision based on a mathematical method and spending the resources of the institution on the right goals will have an important role for realizing the strategies.

Sometimes, decision-making problems need to be expressed linguistically because they include uncertain situations (Toklu, 2017). When relations between criterion of the models can be expressed by linguistic variables, fuzzy techniques present successful results. For this reason, this complex model solution is sought with Fuzzy Multi-Criteria Decision Making Methods. There are so many application areas of fuzzy and classical decision-making methods when the literature is examined. SMART approach and Fuzzy TOPSIS method were used to determine effective long-term goals for the strategic plan, with the main criteria being assumed to be equal in one of the studies (Kubat ve ark., 2010). In another study suggests a model in which Fuzzy AHP and TOPSIS were used to facilitate the assessment of the effectiveness of insurance companies (Ksenija ve ark., 2017). Fuzzy TOPSIS and Fuzzy AHP methods were used for project selection problem (Söyler ve Pirim, 2014). The authors preferred the Fuzzy AHP and TOPSIS method are used to compare the performance of the banks. Criteria weights are determined with Fuzzy AHP method and the importance degrees of goals are ranked with TOPSIS method (Amile ve ark., 2013). A Fuzzy AHP application was done for personnel selection in IT companies in another study (Erdem, 2016).

In this study, the effectiveness of 2013-2017 strategic plan prepared by taking opinions of employees of Hacettepe University is investigated. First of all, 5 decision makers evaluated the goals by using the SMART method to provide linguistic variables for Fuzzy AHP. After the evaluations of the decision makers, Fuzzy TOPSIS method is used to calculate the numerical equivalents of linguistic variables. However, since the weights of the main criteria are not previously known in the Fuzzy TOPSIS method, these weights are calculated using the Fuzzy AHP method. The goals are ranked according to their importance by using these criteria weights for implementation of Fuzzy TOPSIS method. The Pareto approach has been used to determine the priority of goals according to the 80-20 rule over the normalized results.

2. Fuzzy AHP and Fuzzy TOPSIS Methods

The Fuzzy AHP is an appropriate method to decide in case of ambiguity that the inter-criterion relations can only be expressed linguistically. Chang's extent analysis method is utilized in this study (Chang, 1996). The extent analytical method synthesizes evaluations of pairwise comparison based on decision-making methods. The Fuzzy TOPSIS method provides a solution by considering decision-makers' divergent opinion on problems that are complicated and require group decision. Decision makers use linguistic variables to calculate the importance of the criterion and the criterion values of the alternatives, as in many decision-making methods. Chen's Fuzzy TOPSIS method is used for the solution to the problem where a group decision has to be made and linguistic uncertainties exist (Chen, 2000). This method is preferred because of including simple computation process and being easy to implement.

3. Case Study Implementation

There are 11 strategies shown in Table 1 and 86 defined goals to carry into effect these strategies in the 2013-2017 strategic plan of Hacettepe University. In this study, in order to manage an effective strategic planning process, goals are first evaluated using the criteria of SMART method. The Fuzzy AHP method is used to determine weights of the 5 criteria of the SMART method. Then, the goals are evaluated by decision makers for each criterion and the importance degrees of the goals are calculated by Fuzzy TOPSIS and ranked. Hierarchical representation of the proposed model is presented in Figure 1.

Table 1. Strategies of Hacettepe University.

Strategy no.	Strategies
S1	Improving the quality of education and training.
S2	Developing research capacities, opportunities and encouraging to research.
S3	Creating appropriate management systems to ensure that the university is efficient and effective in its operations.
S4	Creating and implementing internal and external policies.
S5	Establishing, executing and sustaining university, public and private sector cooperation.
S6	Improving the quality and diversity of the health care services.
S7	Developing of physical and technological infrastructure possibilities.
S8	Developing and enhancing information sources, services, and technological facilities of libraries.
S9	Creating renewable clean energy resources to reduce energy costs and increase environmental sensitivity.
S10	Working with the slogan 'Smokeless Hacettepe' for our staff and students to give them up.
S11	Providing platforms for students and employees to express ideas and suggestions easily.

For example, S3 has 4 goals and these are;

- The infrastructures of the information systems of the university will be completed and integrated by the end of 2013.
- All the units of Hacettepe University will be prepared the guidelines on working procedures and principles by the end of 2013.
- The internal control process work will be completed by the end of 2015.
- The administrative and academic staff of Hacettepe University will be provided with in-service training on management systems and the continuity of the systems will be ensured by the end of 2015, respectively.

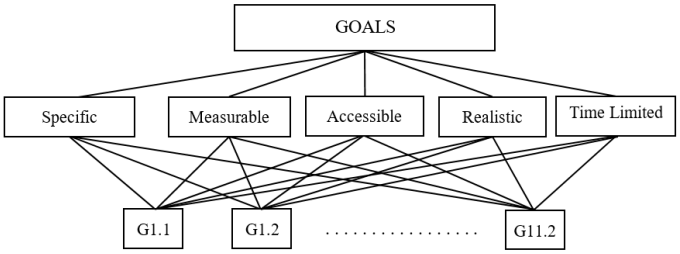


Figure 1. Hierarchical Representation of the Proposed Model.

After the evaluation of 5 decision makers, taking into account of average values of this assessment, weights of main criteria are obtained by applying the steps of Fuzzy AHP method. Normalization values of these weights are presented in Table 2.

Table 2. Weights of Main Criteria.

	S	M	A	R	T
Normalized weights	0.207	0.138	0.309	0.332	0.012

Evaluations of each goal are made with linguistic variables in Fuzzy TOPSIS implementation. Goals are assessed based on criteria of SMART method by decision makers. Thanks to Chen's developed method linguistic variables transformed to the numeric values and then fuzzy decision matrix and fuzzy normalized decision matrix are obtained. Then normalized weights calculated in Fuzzy AHP and normalized decision matrix calculated in Fuzzy TOPSIS are multiplied for obtaining weighted normalize matrix. Finally, fuzzy negative (d_{i-}) and positive (d_{i+}) ideal solution are defined based on Fuzzy TOPSIS method. d_{i-} and d_{i+} are the distance between the goal and negative, positive ideal solution, respectively and briefly given in Table 3.

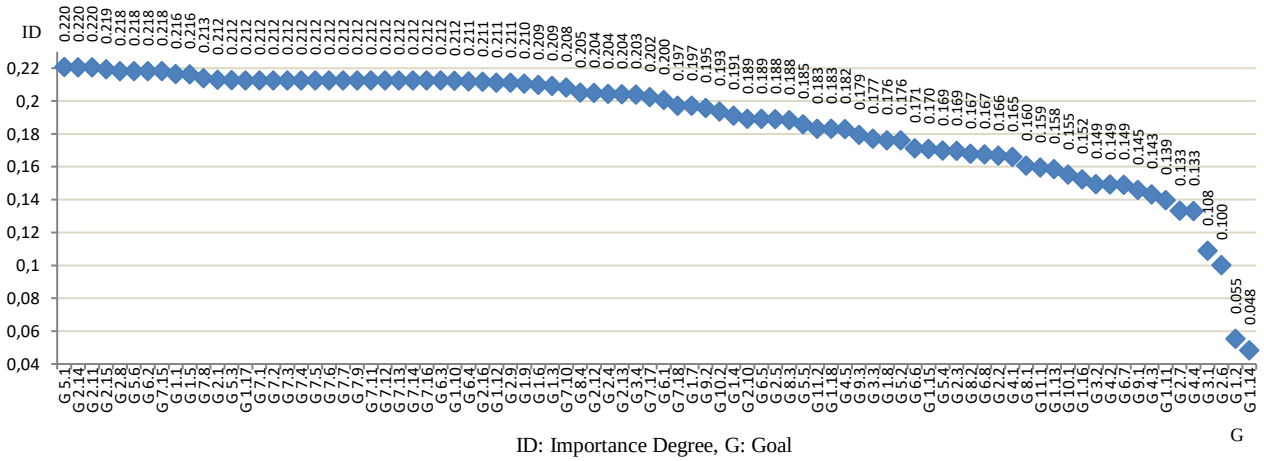
Table 3. Negative and Positive Ideal Solutions.

Goals	d_{i-}	d_{i+}
G1.1	1.118	4.050
G1.2	0.278	4.757
⋮	⋮	⋮
G11.2	0.926	4.131

Closeness coefficients (CC) of goals are calculated with the Equation 1.

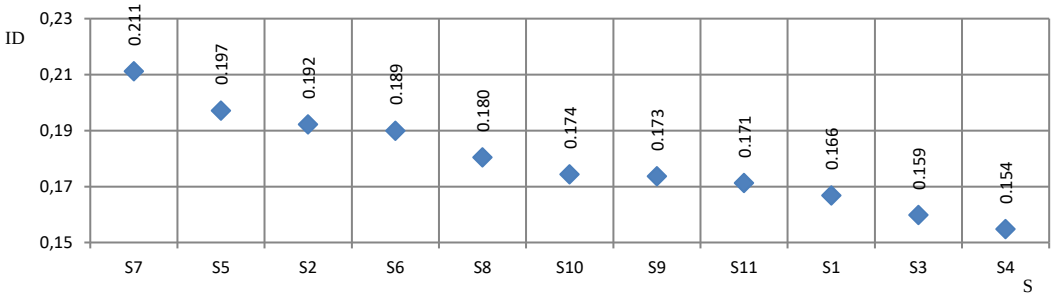
$$CC = \frac{d_{i-}}{d_{i-}+d_{i+}}. \quad (1)$$

The CC values of goals show their importance degree shown in Figure 2. Average CC value of goals are calculated and this value show us the importance degree of related strategies shown in Figure 3.



ID: Importance Degree, G: Goal

Figure 2. Importance Degree of Goals.



ID: Importance Degree, S: Strategy

Figure 3. Importance Degree of Strategies.

4. Pareto Analysis Approach for Eliminating Goals

Pareto analysis is an effective technique for diagnosing and analyzing a problem. This approach aims to determine the concepts that really affect the problem. There are various examples in the literature about acceptance rate of this method such as 90-10, 80-20, 70-30 (%) to determine these concepts. In this study, 80-20 acceptance rate is preferred. When the Pareto analysis is performed, first all the data are summed and the values are divided by each data to find the percentage value of it in the whole data. Then percentage values are summed cumulatively. As a result of this process, the portion up to 80% is defined as the values to be considered. Percentage values of goals are calculated via Equation 2.

$$\%CC_i = \frac{cc_i}{\sum_{i=1}^{86} cc_i} \quad (2)$$

63 of goals, which are effective on the strategies, are identified and 23 of goals are eliminated considering 80-20 rule of Pareto analysis. Effective 63 of goals are shown in Figure 4 based on Pareto Analysis and revised importance degree of related strategies shown in Figure 5 after 23 of goals eliminated.

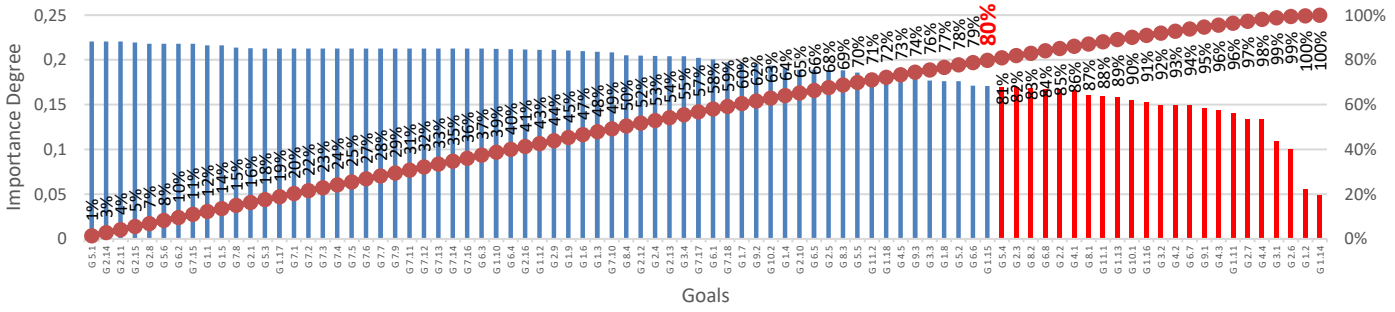


Figure 4. Goals Exceeding the Threshold Value.

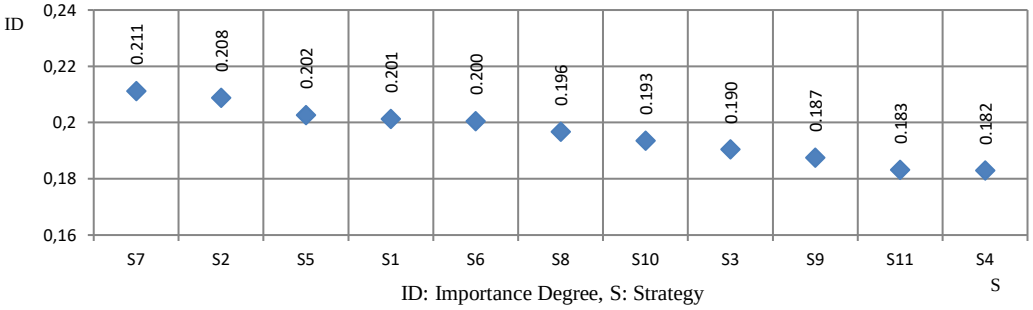


Figure 5. Importance Degree of Strategies after Eliminating Process.

5. Conclusion

In this study, the goals, essential component of Hacettepe University 2013-2017 strategic plan, are evaluated by decision makers using criteria of SMART approach and the weights of these criteria are calculated by Fuzzy AHP approach. Then, Fuzzy TOPSIS steps are applied for calculating importance degree of 86 of goals for determining more effective ones on the strategies. Importance degrees of goals are normalized for assessing with Pareto analysis and ranked cumulatively taking account of 80-20 rule of this approach. Thanks to this approach, goals that add high added value to the strategic plan are determined. 63 of goals are identified and how to effect this situation to the importance degree of strategies is detailed investigated. For example, S1 (Improving the quality of education and training) and S3 (Creating appropriate management systems to ensure that the university is efficient and effective in its operations) strategies became more critical than before. Rank of S2 (Developing research capacities, opportunities and encouraging to research) and rank of S5 (Establishing, executing and sustaining university, public and private sector cooperation) strategies are replaced, means that S2 became essential for managing effective strategic plan process. High added value goals and strategies have been determined thus, it is envisaged that more effective strategic planning process will be carried out with the developed integrated decision-making approach. In addition to this, proposed model can also be applied when new strategies are developed.

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