USING ANALYTIC NETWORK PROCESS AND GOAL PROGRAMMING METHODS FOR PROJECT SELECTION IN THE PUBLIC INSTITUTION

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Abstract:

A good selection is fundamental for the investment projects in the public institution. It is used economically and efficiently by examining the accuracy of the determination of strategic goals and objectives is of great importance. Under budget constraints in considering the project for the solution of transport problems in urban areas, the best choice is made using multi-criteria decision-making (MCDM) methods. In this study, the selection criteria were identified for investment projects. Then, it was made the application at the public institution. The alternative projects of transportation were evaluated using analytic network process (ANP) and goal programming (GP) methods. This application was made in the selection of transport projects at Ankara Metropolitan Municipality.

Keywords: Public institution, project selection, multi-criteria decision making, analytic network process, goal programming

1. Introduction

It is one of the most important decisions taken by the selection of the project manager. Physical owned business, financial and manpower resources are limited and the evaluation of these resources in the right projects increases the fitness value of the project. Multiple factor that impact the decision to select an appropriate projects include decision-maker preferences and priorities, benefits, costs, project risk of other scarce resources. While the managers are evaluating the projects, they choose the greatest contribution projects for the aims of the institution.

Decision-making problems in the broad sense; according to at least one goal or criterion can be defined as a set of options to choose the most appropriate option. According to this definition to members of the

decision-making of a decision problem, options, criteria, results, creates environmental priorities and decision-makers (Dağdeviren, 2001). Project information in the decision-making process, depends on the use of technical resources and the perception of decision makers. There are many different techniques that can be used to estimate, evaluate, and choose project. Classical project selection models focus more on the individual attributes of the candidate projects. In addition transportation project selection means identifying some alternative projects in order to maximize the net benefit to the organization.

Made an application in Ankara Metropolitan Municipality and their weighting of the project is calculated using the analytic network process the selection of transport projects method. These weights using 0-1 Goal Programming method of project selection made and the amount of resources used in the given scenario are calculated.

This study, ANP and 0-1 Goal Programming methods were used. The articles were examined in the selection of projects. About these subjects were given information at literature and project selection. The steps of the implementation of the ANP and Goal Programming method were briefly explained.

2. Project Selection Problem

The resources under certain specific objectives are studies showing that the concept of the project and in what way should achieve. According to this definition the results of each project has its own projects and by recognizing the need arises. Each project has a defined start and completion time. In addition, projects are being carried out under limited resources. The real purpose of the maximum benefit from the project outputs is provided by the use of fewer resources under many constraints (Onursal, 2009). This restricts the system quality, cost, time and resources are specified as parameters.

The project selection, a single or a group of projects to achieve the objectives of the project in the company called the selection process. In front of the decision makers in the evaluation of projects to ensure maximum benefit appears to many criteria. Selection is made according to different purposes under specified constraints.

There are more project proposals from the constraints given to the resources that they always have in the organization. To provide maximum benefit within the targets set importantly, the selection of projects Decision-makers must determine the priority selection criteria carefully. The lack of organization leads to misuse of resources, project selection criteria and wrong.

The main criteria that are of strategic importance in terms of resource requirements and benefits of the project will provide flexibility that can be realized within the possibilities, usability, and realism, shown as cost and to make analytical (Onursal, 2009). This is carried out in accordance with the criteria set objectives and will provide organizations with the ability to respond to changes in market contribution will increase.

By decision makers of the entity's mission and vision it must be perceived in a good way. When done according to the plans set out objectives and strategies comply with the project selection cannot be caught. Self-recognition company or organization at this point is of great importance.

3. Analytic Network Process

Decision-making is a process that incorporates several criteria and alternatives. Criteria generally have different levels of importance and alternatives are revealed different preferences across all criteria. We need a measurement while we are choosing these types of decisions.

Criteria decision making problems which have from time to time are available in the interactions between each other or other criteria. In cases of this type of decision-making problems where there are frequently used multi-criteria decision-making methods. Multi-criteria decision-making methods are quite diverse. The two most important models of these various methods of analytic hierarchy process (AHP) and ANP models. ANP, based on the Analytic Hierarchy Process itself, is a similar method but ANP 'also has a network approach instead of hierarchical levels of understanding. The decision problem; purposes, rather than to set priorities among the criteria and alternatives, is to allow assessment by creating a network structure (Karaa and Geyikçi, 2015). ANP from internal - to external addiction, attention is paid to the interaction and feedback. A hierarchy in Figure 1 shows a network structure and the differences between them (Yurdakul and Yıldırım, 2013).

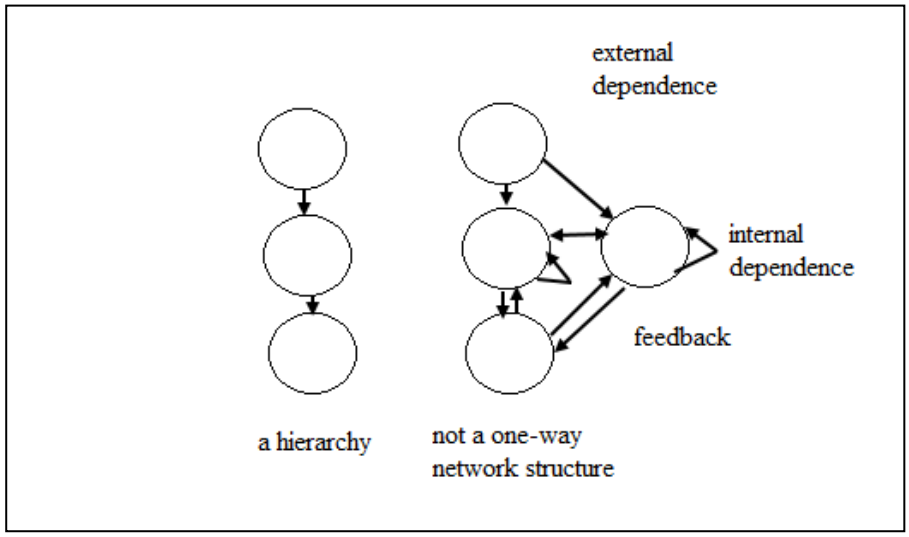

Figure 1 . Hierarchy of network structure differences between

ANP method of implementation steps can be summarized as follows:

Step 1. Defining the Problem and Model Establishment: problems defined objectives in the first phase, the criteria, sub-criteria and alternatives clearly identified and established relationship between these internal and external dependencies

Step 2. Creating Binary Comparisons Matrix and Determination of Weight: Decision creates a comparison matrix using a group of experts who met Saaty's the scale values for the problem. Aw = λ_{max} priority vector equation of war is determined by comparison matrix. In this formula, it extracts the vector is the largest core values of the comparison matrix λ_{max}.

Step 3. The matrix of Consistency Analysis done and Super Matrix Development: consistency rate for the analysis of the consistency of this comparison indicates (C) must be calculated and requested to be less than 0.10, the ratio

Step 4. Super Matrix Development: each section in the super matrix is part of a matrix and the matrix shows the relationship of the two factors. Super matrix to ensure the equalization weight at some point in their importance (2n + 1). Force is taken, where n is a large number of randomly selected limits and new matrix obtained is called the super matrix

Step 5. Selecting the best Alternative: alternative having the highest importance weight in the decision limits obtained with super matrix problems determined the best alternative.

Operations a research is one of the effective methods of decision-making in many areas of ANP in recent years and is widely used in different sectors; providing appropriate and practical solutions (Yurdakul and Yıldırım, 2013).

4. Goal Programming Method

Goal programming model is one of the most well-known of the multi-purpose mathematical programming models. In goal programming model, the decision to use the solution for every purpose from donors and are asked to determine a target value that you want to reach. Then the objective function formula for each destination and search for a solution that will minimize deviations from this objective function (Alp, 2008).

To determine the value decided by the decision makers in the models is given the desired unknown variable name. Decision-makers in the goals it wishes to achieve, there are some parameters that take into account the situation in the system. They are not likely to change the system and are referred to as systems constraints. Which it is more flexible than the system constraints and the function showing the change in the property called target constraints. Target constraints are the function of indicating the desired target value to be reached (Girginer and Kaygısız, 2009).

The function that aims to target the smallest deviation from occurring for any purpose specified function is called. The formulation used in the target programming is expressed as follows:

$$Min\ Z = \sum_{i \in m} (d_i^+ + d_i^-)$$

$$\sum_{j=1}^{n} a_{ij} x_j - d_i^+ + d_i^- = b_i$$

$$d_i^+, d_i^-, x_j \geq 0 \qquad i = 1, \dots, m \ , \ j = 1, \dots, n$$

Shape is created. Here are the decision variables x_j, the i-th value for the desired destination, the total number of decision variables n m is the total number of constraints. The purpose of target programming, these deviations for the variables to be done to minimize the deviation between the targets is shown in two dimensions, including in both negative and positive aspects. Objective function is only created those slings variable.

d_i^+= Positive deviation variable $\qquad i = 1, \dots, m$

d_i^- = Negative deviation variable $\qquad i = 1, \dots, m$

Simultaneously at least one of the positive and negative deviation variable for deviations will not occur must be zero. These variables in the minimizing only be requested by one of them made our decision makers (Güneş and Umarusman, 2003).

5. Literature Review

Many studies were made on the selection of projects in the literature and were often used mathematical programming and multi-criteria decision-making methods in these studies.

Lee and Kim (2000), used to ANP and 0-1 integer programming model for project selection in the information systems. Badri et al. (2001) used the 0-1 goal programming method for project selection in information systems. Dağdeviren and Eren (2001) AHP and 0-1 Goal Programming method using have made a practice of for the selection of the suppliers firm. Erdem and Kavrukkoca (2002) applied the AHP method for project selecting the decision making process. Meade and Presley (2002) applied using the ANP method in the selection of R & D projects. Dey (2004) used the AHP for oil industry in India evaluated the proposed projects at the problems in the pipes.

Shang et al. (2004) made the choice of using the AHP in transport projects. Cheng and Li (2005) made the project selection using the ANP method in industrial practice. Mohanty et al. (2005) in the selection of R & D projects have used the fuzzy ANP method.

Rabbani et al. (2006) used the R & D target of 0-1 integer programming method of choice in the project. Su et al. (2006) used the choice of using the AHP sorting and transportation projects. Wey and Wu (2007) used ANP and 0-1 integer goal programming methods for project selection in transportation systems. Ares and Serra (2008) they made the selection of the proposed project for urban waste water management using the AHP. Šelih et al. (2008) the selections of road infrastructure projects used the AHP. Chang et al. (2009) they do project selection using ANP and goal programming methods to assess the former transport strategy.

Arslan (2009) made an application using AHP and fuzzy systems in operation. Kim et al. (2009) in information systems for project selection were used the ANP. Habib et al. (2009) made the selection of R & D projects were using the ANP. Rafiei and Rabbani (2009) they used the Fuzzy AHP in project selection. Amiri (2010) studies have used the AHP and fuzzy TOPSIS method to the selection of projects and analyze infrastructure. Teng et al. (2010) they used the Fuzzy AHP and made an application in transportation projects. Boran et al. (2011) in six sigma projects they have made the choice of using fuzzy ANP. Bağ et al. (2012) used the method of ANP and 0-1 goal programming for nurse scheduling problems Chang K. (2013) using ANP and TOPSIS method to project selection in the food companies. Görgülü et al. (2013) used ANP and TOPSIS method for optimal investment strategy selection problem. Jones et al. (2013) used the AHP in the selection of urban transport projects. Ivanović et al. (2013) project selection using ANP is made for transportation in the Balkans. Özbek and Eren (2013) have made the choice of third-party logistics company with ANP method. Khalili et al.

(2013) studied project selection problems with fuzzy goal programming and TOPSIS method. Tiwari et al. (2013) in the six sigma project selection have made an experimental study using fuzzy AHP.

Bedir et al. (2015) using AHP and PROMETHEE method for selection third party logistics firm. Grady et al. (2015) have used the ANP method for the selection of international development projects. Hamurcu and Eren (2015a) have made an application using multi-criteria decision-making methods (AHP and TOPSIS) for monorail route selection in Ankara. Hamurcu et al. (2015) using ANP and goal programming methods for shift schulding in their work. Hamurcu and Eren (2015b) using AHP and Goal Programming method for project selection. Özder et al. (2015) using TOPSIS and goal programming method for supplier selection. They verified some criteria about choosing the best supplier. An author uses TOPSIS for weights and uses goal programming for choosing the best one. Özder and Eren (2015b) using AHP and Goal Programming method for supplier selection. According to AHP weights they integrated the model for selection the best supplier. Özder et al. (2015) TOPSIS and Goal Programming for supplier selection for another study. Özder and Eren (2015b) have used ANP and Goal Programming for supplier selection for getting the best supplier for the firm. Öztaysi (2015) they used the AHP and fuzzy systems for the selection of enterprises in information systems project work. Salehi (2015) using fuzzy AHP and fuzzy VIKOR method has made the choice of projects. Barfod M. and Salling K. (2015) Using the methods of AHP and SMARTER have made the choice of transport infrastructure projects. Vinodh and Swarnakar (2015) Using DEMATEL-ANP-TOPSIS methods have made the six sigma project selection. Hamurcu and Eren (2016) using multi-criteria decision-making methods have made monorail route selection. Özder et al. (2016) using ANP and PROMETHEE method for academic staff selection. They specified some criteria for the best academic staff selection then they applied the weights of the criteria to the PROMETHEE method.

6. A Case Study

In this study, ANP and 0-1 Integer goal programming methods with Ankara Metropolitan using an application was made for the selection of Transportation Projects in the Municipality.

Many methods have been proposed on the complexity of the decision-making process ongoing in real life. The population of the region is pretty much the applied "Transport Infrastructure Development Studies", which aimed to bring solutions to urban problems are made. Population growth, transportation, natural disasters and so on taking a multi-criteria decision-making method for the transportation problem, especially in cities that will host the forefront of many of the problems the selection of proposed projects has been used to resolve this problem. Transportation issues that form the structure of the criteria, sub-criteria and alternatives in bringing through the best solution alternatives 8 project establishing a relationship between the ANP and the choice of the project is made with 0-1 Integer Goal Programming. It examined the structure of the region where this information is determined by the application and in the light. . The evaluation of the proposed 8 project on the basis of the specified 3 main criteria and 9 sub-criteria has been made. Said main criteria; (1) Environment, (2) Economic, (3) Social, is the sub-criteria based on these criteria; environmental criteria sensitivity in below may be implemented project, the planning and design of the project, energy use, maintenance costs of the projects under the economic criteria, investment costs, travel time and finally social criteria under the transport demand, there is a density integration and improved population. Saaty (1980)'s pairwise comparison matrices using a 1-9 scale has been formed. These criteria are made on the basis of the choice of Transportation Projects.

Among the criteria; planning and design criteria for integration, investment costs and improved population density, energy use, maintenance costs, travel time, transport demand, transport demand integration, and improved population density affects the integration of the sub-criteria. A criterion, sub-criteria for the evaluation of candidate projects and expert opinion because there is a need to structure the relationship to be established depends on the judgment of the decision makers. A relationship established among the criteria is shown in figure 2.

Criteria for evaluating the interaction between the pairwise comparison matrices have been created and made calculations taking into account the above figure, the criteria are determined by weight Super Decisions package program. The weight determined by the ANP method is illustrated in Figure 3.

According to the results of alternative weight (P1, P2, P3, P4, P5, P6, P7, P8) = (0.123257, 0.074294, 0.086262, 0.072196, 0.121943, 0.126783, 0.087210, 0.308055) was calculated as. These weights are used as Priorities in goal programming formulation that is (P8, P6, P1, P5, P7, P3, P2, P4) = (0.308055, 0.126783, 0.123257, 0.121943, 0.087210, 0.086262, 0.074294, 0.072196). Assumptions can be made available within 8 project selection and targets have been identified in this study. There is a one obligatory goal: (1) target amount of the budget allocated for the currently selected project was examined under three scenarios. These scenarios

(S1) maximum budget allocated $ 2 billion 'is. (S2), the maximum budget allocated $ 750 million 'is. (S3) budget allocated $ 1 billion 'is. Candidate projects include projects by adding 5 and 6 models project constraints associated with the selected application will be made for one of these projects in the same area is created. Relevant parameters are given in table 1 and scenarios were considered deviations are analyzed separately. Scenario 1 (S1) generated formulation are given in Table 2. In this paper shows decision variables; xj = projects to be selected (j=1, 2, 3…8). These variables are used in goal programming formulation.

Figure 2. Interdependent relationship among the criteria

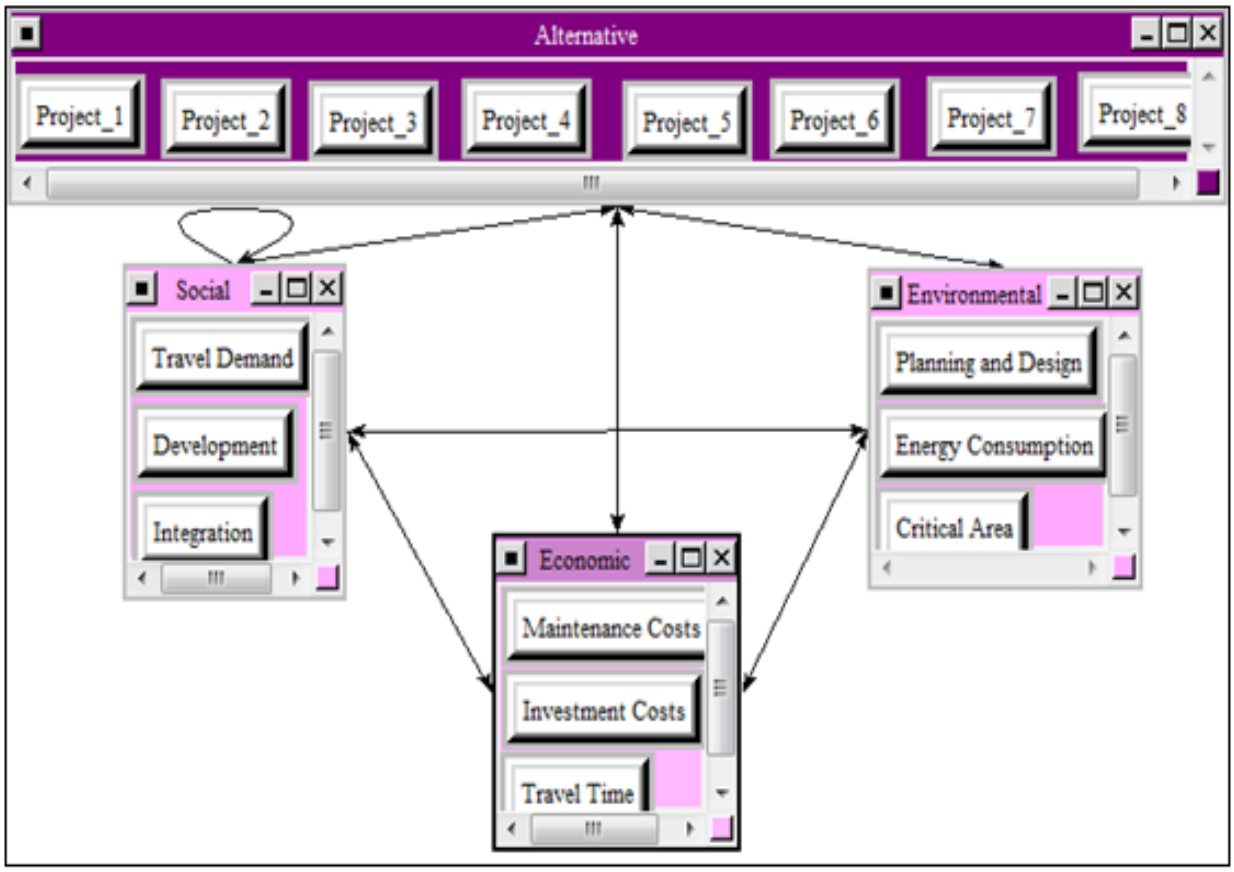

Figure 3. The weight of criteria

Name	Graphic	Ideals	Normals	Raw
Project_1		0.400113	0.123257	0.039072
Project_2		0.241173	0.074294	0.023551
Project_3		0.280021	0.086262	0.027345
Project_4		0.234362	0.072196	0.022886
Project_5		0.395848	0.121943	0.038655
Project_6		0.411560	0.126783	0.040190
Project_7		0.283099	0.087210	0.027645
Project_8		1.000000	0.308055	0.097652

Table 1: Cost Resources Usage Information on Transportation Project

	Transportation Project resource usage (a_{ij})								
	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	b_i
Budgeted cost (*10^6 $)	410$	186$	300$	288$	430$	425$	151$	710$	S1/S2/S3

Based on these data and the previously computed ANP values, we can formulate the goal constraints for this problem in Table 2. This 0-1 GP model was solved using LINDO 6.1 in a few seconds of computer time.

Table 2: 0-1 GP Model Formulation

0-1 GP model formulation	Goals
Min Z=	
P1 (d_1^+) + P2 ($0.123257d_2+0.074294d_3+0.086262d_4^-$	Satisfy obligatory goal and
$+0.072196d_5^-+0.121943d_6^-+0.126783d_7^-+0.087210d_8^-$	Select highest ANP weighted
$+0.308055d_9^-$)	Transportation Projects.
subject to	
$410x_1+186x_2+300x_3+288x_4+430x_5+425x_6+151x_7+710x_8$	Avoid over-utilizing max
$+ d_1^- - d_1^+ =S$	budgeted dollars
$x_1 + d_2^- =1$	Select Project 1
$x_2 + d_3^- =1$	Select Project 2
$x_3 + d_4^- =1$	Select Project 3
$x_4 + d_5^- =1$	Select Project 4
$x_5 + d_6^- =1$	Select Project 5
$x_6 + d_7^- =1$	Select Project 6
$x_7 + d_8^- =1$	Select Project 7
$x_8 + d_9^- =1$	Select Project 8
$x_5+x_6<=1$	Select Project 5 or Project 6
xj =0 or 1 j=1,2,…8	

The above model was adopted in establishing and changing the right solution constant for the other scenario results was obtained.

Table 3: Scenario of ANP and 0-1 GP Model Solution

Scenario (*10^6 $)	Budgeted Cost	Select Project	Project Resource Usage
Scenario 1	2000 $	x_2, x_3,x_6,x_7,x_8	1996 $
Scenario 2	750 $	x_8	710 $
Scenario 3	1000 $	x_7,x_8	861 $

According to the obtained results it is seen that the project has been selected 7 in all scenarios. On the other scenarios analyzed for scenarios 1 four project, two projects were selected for scenario 2 and scenario 3. Selected project and the amount of resources used are shown in Table 3.

7. Conclusions

The application of the ANP- 0-1 GP model to example demonstrates a procedure for finding weights that considers interdepended among criteria or alternatives. The proposed model shows a methodology to use in a project selection problem having an interdependent relationship.

Transportation Project evaluation problems, have interdependent property. Therefore, group decision making is more helpful to determine such an interdependent property. Group discussion is very effective to determine important problems. This results is seen an example solving project having multiple criteria, interdependence of difficulty. Although there are lots of difficulties for solving problems considering interdependent property, most of real-word problems.

This paper shows solving project interdependence based on ANP and 0-1 GP by interviewing groups of experts. Using this Method we conclude that we can solve problems having multiple criteria, interdependence and resource feasibility. In addition, we developed the work on Transportation Project selection by considering the impact relationship among criteria. All the selected criteria evaluating alternative transportation projects, has been a solution to correct the problem that exists in the city.

References:

Alp, S. (2008) "Doğrusal Hedef Programlama Yöntemi Kullanılarak Kent içi Otobüsle Toplu Taşma Sistemi İçin Bir Model Oluşturulması Ve Uygulanması", Marmara Üniversitesi Sosyal Bilimler Enstitüsü, Doktora Tezi

Amiri, M. P. (2010) "Project Selection for Oil-Fields Development by Using the AHP and Fuzzy TOPSIS Methods", Expert Systems with Applications, vol. 37, no. 9, p. 6218-6224.

Ares, J., Serra, J. (2008) "Selection of Sustainable Projects for Floodplain Restoration and Urban Wastewater Management at the Lower Chubut River Valley (Argentina).", Landscape and Urban Planning, vol. 85, no.3, p. 215-227.

Arslan, T. (2009) "A Hybrid Model of Fuzzy and AHP for Handling Public Assessments on Transportation Projects", Transportation, vol. 36, no. 1, p. 97-112.

Badri, M. A., Davis, D., Davis, D. (2001) "A Comprehensive 0-1 Goal Programming Model for Project Selection", International Journal of Project Management, vol. 19, no. 4, p. 243-252.

Bağ, N., Özdemir, M., Eren, T., (2012) "0-1 Hedef Programlama ve ANP Yöntemi ile Hemşire Çizelgeleme Problemi Çözümü", International Journal of Engineering Research and Development, vol. 4, no. 1, p. 2-6

Barfod, M. B., Salling K. B. (2015) "A New Composite Decision Support Framework for Strategic and Sustainable Transport Appraisals" Transportation Research Part A: Policy and Practice, vol. 72, p. 1-15.

Bedir N, Özder E, Eren T. (2015) "The Third Party Logistics Firm Selection Using AHP-PROMETHEE Methods.", 13th International Logistics and Supply Chain, Congress: İzmir, 802-813.

Boran, S., Yazgan, H. R., Goztepe, K. (2011) "A Fuzzy ANP-Based Approach for Prioritising Projects: A Six Sigma Case Study.", International Journal of Six Sigma and Competitive Advantage, vol. 6, no. 3, p. 133-155.

Chang, K. L. (2013) "Combined MCDM Approaches for Century-Old Taiwanese Food Firm New Product Development Project Selection.", British Food Journal vol. 115, no. 8, p. 1197-1210.

Chang, Y. H., Wey, W. M., Tseng, H. Y. (2009) "Using ANP Priorities with Goal Programming for Revitalization Strategies in Historic Transport: Case Study", Expert Systems with Applications, vol. 36, no. 4, p. 8682-8690.

Cheng, E. W., Li, H. (2005) "Analytic Network Process Applied To Project Selection.", Journal of Construction Engineering and Management, vol. 131, no. 4, p. 459-466.

Dağdeviren, M. Eren T. (2001) "Tedarikçi Firma Seçiminde Analitik Hiyerarşi Prosesi Ve 0-1 Hedef Programlama Yöntemlerinin Kullanılması", Gazi Üniversitesi Mühendislik-Mimarlık Fakültesi Dergisi, vol. 16, no. 2, p. 41-52.

Dey, P. K. (2004) "Analytic Hierarchy Process Helps Evaluate Project in Indian Oil Pipelines Industry", International Journal of Operations & Production Management, vol. 24, no .6, p. 588-604.

Erdem, S. and Kavrukkoca, G. (2002) "Sürekli İyileştirme Projelerinin Seçiminde Analitik Hiyerarşi Süreci'nin Kullanımı", 1. Ulusal Kalite Fonksiyon Göçerimi Sempozyumu, İzmir: Dokuz Eylül Üniversitesi, p. 1-16.

Girginer, N. and Kaygısız, Z. (2009) "İstatistiksel Yazılım Seçiminde Analitik Hiyerarşi Süreci Ve 0–1 Hedef Programlama Yöntemlerinin Birlikte Kullanımı", Eskişehir Osmangazi Üniversitesi Sosyal Bilimler Dergisi, vol. 10, no. 1, p. 211-233.

Görgülü, İ., Korkmaz, M., Eren, T. (2013). "Analitik Ağ Prosesi Ve TOPSIS Yöntemleri İle Optimal Yatırım Stratejisi Seçimi", Sigma Mühendislik ve Fen Bilimleri Dergisi, vol. 31 no. 2, p. 203- 213,

Grady, C. A., He, X., & Peeta, S. (2015) "Integrating Social Network Analysis with Analytic Network Process for Internatıonal Development Project Selection", Expert Systems with Applications, vol. 42, no. 12, p. 5128-5138.

Güneş, M. and Umarusman, N. (2003) "Bir Karar Destek Aracı Bulanık Hedef Programlama ve Yerel Yönetimlerde Vergi Optimizasyonu Uygulaması", Review of Social, Economic & Business Studies, vol. 2, p. 242-255.

Habib, M., Khan, R., Piracha, J. L. (2009) "Analytic network process applied to R&D project selection", International Conference on IEEE, p. 274-280.

Hamurcu, M. and Eren T. (2015a) "Ankara Büyükşehir Belediyesi'nde Çok Ölçütlü Karar Verme Yöntemi ile Monoray Güzergâh Seçimi" Transit 8. Uluslararası Ulaşım Teknolojileri Sempozyumu ve Fuarı, İstanbul, Türkiye, p. 401-409.

Hamurcu, M. and Eren T. (2015b) "Using Analytic Hierarchy Process and Goal Programming Methods for Investment Project Selection in Ankara" The International Conference on Multiple Objective Programming and Goal Programming, Tlemcen, Algeria, p. 30-31.

Hamurcu, M. Ünal, F.M and Eren T. (2015) "The Solution of Shift Scheduling Problem by Using Analytic Network Process and Goal Programming Method" The International Conference on Multiple Objective Programming, Tlemcen, Algeria, p.13-14.

Hamurcu, M. and Eren T. (2016) "A Multicriteria Decision-Making for Monorail Route Selection in Ankara" 32nd International Academic Conference on Engineering, Technology and Innovations (IACETI), Dubai, UAE, p.6-10

Ivanović, I., Grujičić, D., Macura, D., Jović, J., Bojović, N. (2013) "One Approach for Road Transport Project Selection", Transport Policy, vol. 25, p. 22-29.

Jones, S., Tefe, M., Appiah-Opoku, S. (2013) "Proposed Framework For Sustainability Screening Of Urban Transport Projects in Developing Countries: A Case Study Of Accra, Ghana.", Transportation Research Part A: Policy and Practice, vol. 49, p. 21-34.

Karaa, İ. E. and Geyikçi, U. B. (2015) "Determinatıon of the Weıghts and Logıstic Cost Drıvers in Logıstıc Sector by Analytıc Network Process", Suleyman Demirel University Journal of Faculty of Economics & Administrative Sciences, vol. 20, no. 1, p. 101-113.

Khalili-Damghani, K., Sadi-Nezhad, S., Tavana, M. (2013) "Solvingmulti-Period Project Selection Problems Withfuzzy Goal Programming Based on TOPSIS and A Fuzzy Preference Relation", Information Sciences, vol. 252, p. 42-61.

Kim, I., Shin, S., Choi, Y., Thang, N. M., Ramos, E. R., Hwang, W. J. (2009) "Development of a Project Selection Method on İnformation System Using ANP and Fuzzy Logic.", World Academy of Science, Engg. And Tech., vol. 3, no. 5, p. 1286-1291.

Lee, J. W., Kim, S. H. (2000) "Using Analytic Network Process and Goal Programming for Interdependent Information System Project Selection", Computers & Operations Research, vol. 27, no. 4, p. 367-382.

Lindo Systems, Inc (1997) Hyper LINDO/ PC Release 6.01, Chicago, USA.

Meade, L. M., & Presley, A. (2002) "R&D Project Selection Using the Analytic Network Process", Engineering Management, IEEE Transactions on, vol. 49, no. 1, p. 59-66.

Mohanty, R. P., Agarwal, R., Choudhury, A. K., Tiwari, M. K. (2005) "A Fuzzy ANP-Based Approach to R&D Project Selection: A Case Study.", International Journal of Production Research, vol. 43, no. 24, p. 5199-5216.

Onursal, B. (2009) "Proje Seçiminde Bulanık TOPSIS Yöntemi İle Bir Model Önerisi: İnşaat Sektörü Uygulaması", İstanbul Teknik Üniversitesi Fen Bilimleri Enstitüsü, Doktora Tezi

Özbek, A. ve Eren, T. (2013) "Analitik Ağ Süreci Yaklaşımıyla Üçüncü Parti Lojistik (3PL) Firma Seçimi", Atatürk Üniversitesi İ.İ.B.F. Dergisi, vol. 27, no. 1, p. 95-113.

Özder E, Eren T, Çetin Özel S. (2015) "Supplier Selection with TOPSIS and Goal Programming Methods: A Case Study.", Journal of Trends in the Development of Machinery and Associated Technology, vol. 19, no. 1, p. 109-112.

Özder E, Eren T. (2015a) "Tedarikçi Seçiminde Analitik Hiyerarşi Prosesi Ve Hedef Programlama Yöntemlerinin Entegrasyonu: Örnek Bir Uygulama." 15. Üretim Araştırmaları Sempozyumu: Ege Üniversitesi, İzmir, p. 125-131.

Özder E, Eren T. (2015b) "Integration of Analytic Network Process and Goal Programming Methods in Supplier Selection: A Case Study." XVITH International Symposium on Econometrics, Operations Research and Statistics, Edirne, 483-485.

Özder E, Eren T, Çetin Özel S. (2015) "Supplier Selection with Topsis and Goal Programming Methods: A Case Study." 19th International Research/Expert Conference - Trends and Development of Machinery and Associated Technology: Spain, Barcelona, p. 169-178.

Özder E, Bedir N, Eren T. (2016) "Academic Staff Selection with ANP & PROMETHEE Method: A Case Study in Turkey." 32. International Academic Conference on Engineering, Technology and Innovations (IACETI), Dubai, UAE, p. 1-5.

Öztaysi, B. (2015) "A Group Decision Making Approach Using Interval Type-2 Fuzzy AHP For Enterprise Information Systems Project Selection", Journal of Multiple-Valued Logic & Soft Computing, vol. 24, no. 5, p. 475-500.

Rabbani, M., Tavakkoli-Moghaddam, R., Jolai Ghazvini, F., Ghorbani, H. R. (2006) "A Comprehensıve Model for R and D Project Portfolıo Selectıon wıth Zero-One Lınear Goal-Programmıng", International Journal of Engineering-Transactions a: Basics, vol. 19, no. 1, p. 55-66.

Rafiee, H., Rabbani, M. (2009) "Project Selection Using Fuzzy Group Analytic Network Process", World Academy of Science, Engineering and Technology, vol. 58, no. 4, p. 457-46.

Salehi, K. (2015) "A Hybrid Fuzzy MCDM Approach for Project Selection Problem", Decision Science Letters, vol. 4, no. 1, p. 109-116.

Saaty, T. L., (1980) "The Analytic Hierarchy Process", McGraw-Hill, USA.

Šelih, J., Kne, A., Srdić, A., Žura, M. (2008) "Multiple-criteria decision support system in highway infrastructure management." Transport, vol. 23, no. 4, p. 299-305.

Shang, J. S., Tjader, Y., Ding, Y. (2004) "A Unified Framework for Multicriteria Evaluation of Transportation Projects.", Engineering Management, IEEE Transactions on, vol. 51, no. 3, p. 300-313.

Su, C. W., Cheng, M. Y., Lin, F. B. (2006) "Simulation-Enhanced Approach for Ranking Major Transport Projects.", Journal of Civil Engineering and Management, vol. 12, no. 4, p. 285-291.

Teng, J. Y., Huang, W. C., Lin, M. C. (2010) "Systematic Budget Allocation for Transportation Construction Projects: A Case İn Taiwan", Transportation, vol. 37, no. 2, p. 331-361.

Tiwari, S. K., Singh, R. K., Srivastava, S. C. (2013) "Six Sigma Project Selection Using Extent Fuzzy AHP: An Empirical Study", International Journal of Research in Industrial Engineering vol. 2, no. 2, p. 50-63.

Vinodh, S. and Swarnakar V. (2015) "Lean Six Sigma Project Selection Using Hybrid Approach Based on Fuzzy DEMATEL–ANP–TOPSIS", International Journal of Lean Six Sigma, vol. 6 no. 4, p. 313-338.

Wey, W. M., Wu, K. Y. (2007) "Using ANP Priorities With Goal Programming İn Resource Allocation İn Transportation", Mathematical and Computer Modelling vol. 6 no.7, p. 985-1000.

Yurdakul, M. and Yıldırım, E. (2013) "Analitik Ağ Süreci Yöntemi İle En Uygun Pazarlama Stratejisinin Belirlenmesi", Dumlupınar Üniversitesi Sosyal Bilimler Dergisi EYİ Özel Sayısı, p. 211-226.