Avrupa Bilim ve Teknoloji Dergisi
Özel Sayı 24, S. 262-267, Nisan 2021

Araştırma Makalesi

www.ejosat.com ISSN:2148-2683

European Journal of Science and Technology
Special Issue 24, pp. 262-267, April 2021

Research Article

Selection of VFQ Consultant by Using Integrated Fuzzy AHP and Fuzzy TOPSIS

Ezgi Kekilli[1*], Ufuk Cebeci[1], Levent Sılay[1]

[1*] Istanbul Technical University, İstanbul, Turkey, (ORCID: 0000-0003-3100-906X; 0000-0003-4367-6206; 0000-0002-1971-6530), ezgikekilli12@gmail.com, cebeciu@itu.edu.tr, l.silay@login.com.tr

(2nd International Conference on Access to Recent Advances in Engineering and Digitalization (ARACONF)-10–12 March 2021)

(**DOI:** 10.31590/ejosat.903959)

ATIF/REFERENCE: Kekilli, E, Cebeci, U. & Sılay, L. (2021). Selection of VFQ Consultant by Using Integrated Fuzzy AHP and Fuzzy TOPSIS. *European Journal of Science and Technology*, (24), 262-267.

Abstract

As technology advances exponentially projects are becoming more complex than before with the increase of uncertainty of circumstances. Companies have been looking for new methods, approaches and strategies since the industrial revolution. Companies must catch new developments, adapt quickly with high quality in order to survive. Hence, agility became an important issue and a competitive advantage. Even though agility starts from software development, it spreads to all other industries. Agile project management takes place in organizations and aims to create a fast response project environment since time is precious. There are lots of agile methodologies and each of them has different framework, rules and roles that are changed by the trend of a new methodology. Nowadays, one of the new agile methods is Value, Flow, Quality (VFQ) that is formed by Lean and Scrum methodologies. It is a work based educational method and aims to create a mindset and proper adaptation of an agile methodology. In this paper, VFQ is examined with its philosophy and benefits. Among three job applicants for finding most suitable VFQ consultant for a company, integrated Fuzzy AHP and Fuzzy TOPSIS method is applied.

Keywords: VFQ, Fuzzy, AHP, TOPSIS, Agile.

Entegre Bulanık AHP ve Bulanık TOPSIS Kullanarak VFQ Danışmanı Seçimi

Öz

Koşulların belirsizliği de teknoloji ve diğer koşullarla birlikte artmaktadır. Şirketler, sanayi devriminden beri yeni yöntemler, yaklaşımlar ve stratejiler arıyorlar. Hayatta kalmak için şirketler gelişmeleri yakalamalı, yüksek kalite ile hızla uyum sağlamalıdır. Dolayısıyla çeviklik önemli bir konu ve rekabet avantajı haline geldi. Çeviklik yazılım geliştirme sektöründen başlasa da diğer sektörlere yayılmış durumdadır. Çevik proje yönetimi, organizasyonlarda yer almaya ve zamanın değerli olması nedeniyle hızlı yanıt veren bir proje ortamı oluşturmayı hedeflemeye başladı. Çok sayıda çevik metodoloji vardır ve bunların her biri yeni bir metodolojinin trendiyle değişen farklı, kurallara ve rollere sahiptir. Günümüzde yeni çevik yöntemlerden biri Yalın ve Scrum metodolojileri ile oluşturulan Değer, Akış, Kalite'dir. İş temelli bir eğitim yöntemidir ve çevik metodolojiye ait zihniyeti ve uygun adaptasyonu oluşturmayı amaçlamaktadır. Bu makalede, VFQ felsefesi ve faydaları incelenecektir. Entegre Bulanık AHP ve Bulanık TOPSIS yöntemi, şirket için en uygun VFQ danışmanını bulmak için üç iş başvurusunda bulunan aday arasında uygulanacaktır.

Anahtar Kelimeler: VFQ, Bulanık, AHP, TOPSIS, Çevik.

[*] Corresponding Author: ezgikekilli12@gmail.com

1. Introduction

Nowadays, organizations have higher complexity in their businesses and markets are more competitive than they used to be due to rapid technological enhancements. Survival of companies depend on changing and deciding on the correct next step. [1] Decision makers of a company, that can be in every organizational level of a company, have hard times to choose the right way. For decision makers, the selection process is very difficult to carry out, as they will have to take into consideration a lot of details as well as a lot of competing criteria. Instead of intuitive judgments, the difficulty and relevance of selection issues call for analytical methods. [2]

Furthermore, since the beginning of the agile methodology, companies have been forced to continuously improve their processes to survive. In other words, they always need to do better than before and meet the customer demands on time and with accuracy. Then, many different agile methods have been developed such as Waterfall, Scrum, Lean methodologies to achieve this goal and minimize the complexity.

From the beginning of agile thinking to now, the number of rules and iterations in methods have increased to be always up to date in a process and have a chance to choose the next step for reaching the target and controlling the process. To illustrate, in the Waterfall method process stages, lead time, and total cost were which is a agile philosophy that formed by Scrum and Lean methodologies to achieve being an agile organizations will be examined and two analytical multi-criteria decision making methods that are Fuzzy AHP and Fuzzy TOPSIS will be applied for finding best VFQ consultant for a firm.

2. Method and Application

2.1. Method

2.1.1. Fuzzy Sets

Zadeh, 1965, first proposed the fuzzy set theory, which was based on the rationality of complexity because of imprecision or vagueness, to cope with the imprecision of human thought. A significant contribution to fuzzy set theory is its ability to reflect ambiguous information. The principle also enables the fuzzy domain to be filled by mathematical operators and programming. [3] A fuzzy set is an object class with a continuity degree. A set is defined by a membership function which assigns a degree of membership to each object in a range from zero to one. Many sorting methods have been developed with fuzzy numbers in the literature and no regular sequence of numbers exists.[4]

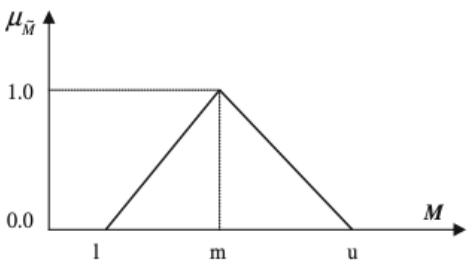

Figure 1. Triangılar Fuzzy Member [5]

2.1.2. Linguistic Variable

The values of phrases and sentences in a language are linguistic variables, according to Zadeh. [6] In other words, linguistic variables are basically numerical equivalent of words. To illustrate, age is a linguistic variable when linguistic terms are used such as young adult, adult, teenager, not old; instead of using numerical values such as 23, 45, 14, 68 years old. The problems where it is difficult to describe mathematically can be understood with the support of linguistic variables.

	Fuzzy Definition	Triangular Scale
E	Equally Important	(1,1,1)
WI	Weakly Important	(2,3,4)
FI	Fairly Important	(4,5,6)
SI	Strongly Important	(6,7,8)
AI	Absolutely Important	(9,9,9)

Table 1. Linguistic Variables and Fuzzy Definitions

2.1.3. Fuzzy Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) is one of Prof. Thomas L. Saaty's original Multi criteria decision-making processes. [7] In brief, from paired comparisons with the Eigen value approach, it is a technique to extract numeric scales for qualitative or quantitative. [8] The input can be derived from real measurements such as cost, weight, etc., or from subjective views such as feelings of satisfaction and preference. In other words, AHP is "a measurement theory through pairwise comparisons and relies on the experts' judgments to derive priority scales." One of the most common MCDM methods is AHP and has many benefits, as well as drawbacks. Its ease of use is one of its benefits. Criteria number that used is not limited, but the method has a drawback when criteria are not independent. The usage of pairwise comparisons, which are used both to compare the alternatives concerning the different criteria and to estimate criteria weights, is the key feature of the AHP system. [9]

Within ambiguous, imprecise and unpredictable contexts, Fuzzy set method proved advantages and resembles human logic in its use of approximate knowledge and ambiguity to produce decisions. It was explicitly designed to reflect not certain, vagueness mathematically and provide formalized instruments to deal with the inaccuracy inherent in many decision problems. [10] Since the Fuzzy AHP method can reflect the style of human behavior, it is quite widely used while traditional AHP cannot reflect human thinking perspective. Fuzzy AHP has two types that are type-1 fuzzy sets and type-2 fuzzy sets. The main difference between the types is the number of dimensions and extra one dimension provides an extra space for uncertainties. [11]

The steps of the Fuzzy AHP method are explained in the following, according to the geometric mean value technique suggested by J.J.Buckley. [12] The criteria as a linguistic concept and then to their corresponding fuzzy values after constructing an 11-11 pairwise comparison matrix, as shown in the following matrix A;

$$A = \begin{matrix} 1 & a12 & \dots & a1n \\ a21 & 1 & \dots & a2n \\ \dots & \dots & \dots & \dots \\ an1 & an2 & \dots & 1 \end{matrix} = \begin{matrix} 1 & a12 & \dots & a1n \\ 1/a12 & 1 & \dots & a2n \\ \dots & \dots & \dots & \dots \\ 1/a1n & 1/a2n & \dots & 1 \end{matrix}$$

This matrix of pairwise comparison is generated according to the work of Saaty on AHP. [7] The geometric mean method is used for the next step to calculate the fuzzy geometric mean of each

$$(A)^{-1} = (l, m, u)^{-1} = \left(\frac{1}{u}, \frac{1}{m}, \frac{1}{l}\right) \quad \text{Center of Area (COA) Wi} = ((l + m + u)/3)$$

We get a n x 1 relative weight matrix Wi as a consequence. Each element that is included in this matrix is a fuzzy triangular number.

2.1.4. Fuzzy TOPSIS Method

In concept and implementation, Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), developed by Hwang and Yoon in 1981, is a basic ranking system. The traditional TOPSIS approach tries to choose alternatives that have the minimum distance from the positive ideal solution (PIS) and the longest distance from the negative ideal solution (NIS) at the same time. The positive ideal solution maximizes the benefit criteria and minimizes the cost criteria, while the cost criteria are maximized by the negative ideal solution and the benefit criteria are minimized. Also, TOPSIS does not demand independent attribute preferences. [13] Fuzzy TOPSIS is a multi-criteria decision technique that uses an Euclidean distance to determine the most appropriate solutions from a group of alternatives and it has several steps to be done:

Step 1. The evaluation criteria weights are chosen, then for calculating fuzzy weights of the criteria Fuzzy AHP is applied.

Step 2. The Fuzzy decision matrix is developed and the relevant linguistic expressions are chosen for the alternatives to the criteria.

Step 3. The fuzzy-decision matrix is developed.

Step 4. Determination of the Fuzzy PIS and Fuzzy NIS. After obtaining the weighted normalized fuzzy-decision matrix, the elements are normalized to positive TFN and their ranges become restricted to the closed interval [0,1]. Then, the FPIS A+ and FNIS A- can be defined.

Step 5. The distance from the Fuzzy PIS and Fuzzy NIS of each alternative is determined. It is possible to use the area compensation approach to evaluate the distances of each alternative from A+ and A.

Step 6. For the alternatives, the distance to the ideal value is calculated.

An mx1 matrix with final performance scores for each alternative is derived after these 6 steps. The best alternative will have the highest ranking.

2.1.5. Integrated Fuzzy AHP and Fuzzy TOPSIS

To evaluate the significance weights of the evaluation criteria, the Fuzzy AHP method is applied and to place the alternatives in rank, the Fuzzy TOPSIS approach is used in the Fuzzy TOPSIS part. The weight of the criteria that comes from Fuzzy AHP calculation becomes the input of the TOPSIS method. After using calculated weights, regarding criteria, the decision maker fills the decision matrix with data for the alternatives. Lastly, the rest of the Fuzzy TOPSIS measures are added and application steps are completed.

2.2. Application

2.2.1. Information about the Firm

Login Software was founded in 1989 to focus on innovative and customized business solutions for organizations. The company has a core principle to meet all demands of customers with a fast response. Login Software creates solutions and services that can meet the expected demands and goals of all businesses in every sector and on any size at the perfect time in connection with the right choice, high profitability, strategic strength at the forefront, steady growth, effective and innovative business management. Login Software is a Turkish company that serves the customers with its customer-oriented approach and professional, talented team. Login Software continues to provide its customers with better solutions, embracing it as a responsibility to provide instruments that will help businesses make the right decisions at the right time by presenting them with solutions that enable them to manage human resources and capital with an integrated system and turn all transactions into reportable data.

Login Software develops solutions in five categories which are provided by solutions family, by industry, by company scale, by line of business, by type of operation. Firstly, the solution family is formed by Login ERP that allows the entire resource system to be immediately dominated and clears the way for the correct decision at the proper moment to be made; Login HR that provides many simple applications connected with each other, and it allows a structure that starts from a small system and can cover all the businesses for efficient workforce planning; Login X-tra is a platform which provides applications independent from time and place; Login Pro is a system tool that is customized for a customer and it serves user-friendly, secured data bases. Secondly, the industry category is the part of the company that provides sector specific solutions with being responsive to the different needs, regulations and demands of each Turkish industry, built with years of experience and are always improving and suitable for both the domestic and global business worlds such as food industry, marine transport industry, retail industry, etc. Thirdly, Login offers solutions regarding company size such as family businesses, holdings and meeting with the budget to create sustainable process, profitability. Another category is determined by line of business that include finance, supply chain, manufacturing, human resources system solutions from end to end. Last category is dedicated to types of operation such as trading companies, hybrid companies, service companies to increase productivity and decrease waste by offering customized workflow solutions, right estimation calculations, efficient stock arrangements etc. Furthermore, apart from all five categories Login Software has five main services that are requirement analysis, application consultancy, support,

training, and customized projects. Services and solutions that Login Software offers, helps any company to optimize its processes and management from end to end and increase profitability. [40]

2.2.2. Elimination of the Alternatives according to the Criteria

The firm is determined eight criteria to find the best VFQ consultant. There will be many applicants, but other than three applicants are eliminated since they do not meet the criteria. Therefore, there are three applicants for VFQ consultant who are named as A1, A2, and A3 in this paper.

2.2.3. Application of Integrated Fuzzy AHP and Fuzzy TOPSIS

In order to determine the relative weights of the relevant criteria mentioned below for VFQ consultant selection, this integrated approach combines fuzzy AHP. The required properties of the VFQ consultant is considered and the suitable selection is made by decision-maker.

CRI	Criteria	Unit
C1	Education	Fuzzy
C2	Expertise	Fuzzy
C3	Sector Knowledge	Fuzzy
C4	Analytical Thinking Skills	Fuzzy
C5	Reputation	Fuzzy
C6	Price	$
C7	Communication Skills	Fuzzy
C8	Reliability	Fuzzy

Table 2. Criteria of Evaluation

Several professionals are asked for their criteria and pair-wise rankings. The matrix of comparison is developed in accordingly.

CRI	C1			C2			C3		
C1	1,000	1,000	1,000	4,000	5,000	6,000	6,000	7,000	8,000
C2	0,250	0,200	0,167	1,000	1,000	1,000	2,000	3,000	4,000
C3	0,167	0,143	0,125	0,500	0,333	0,250	1,000	1,000	1,000
C4	0,111	0,111	0,111	0,500	0,333	0,250	0,250	0,200	0,167
C5	0,500	0,333	0,250	0,167	0,143	0,125	0,111	0,111	0,111
C6	0,250	0,200	0,167	0,250	0,200	0,167	0,167	0,143	0,125
C7	0,250	0,200	0,167	0,250	0,200	0,167	0,111	0,111	0,111
C8	0,500	0,333	0,250	0,167	0,143	0,125	0,111	0,111	0,111

CRI	C4			C5			C6		
C1	9,000	9,000	9,000	2,000	3,000	4,000	4,000	5,000	6,000
C2	2,000	3,000	4,000	6,000	7,000	8,000	4,000	5,000	6,000
C3	4,000	5,000	6,000	9,000	9,000	9,000	6,000	7,000	8,000
C4	1,000	1,000	1,000	9,000	9,000	9,000	6,000	7,000	8,000
C5	0,111	0,111	0,111	1,000	1,000	1,000	2,000	3,000	4,000
C6	0,167	0,143	0,125	0,500	0,333	0,250	1,000	1,000	1,000
C7	0,167	0,143	0,125	0,500	0,333	0,250	0,250	0,200	0,167
C8	0,111	0,111	0,111	0,250	0,200	0,167	0,167	0,143	0,125

CRI	C7			C8		
C1	4,000	5,000	6,000	2,000	3,000	4,000
C2	4,000	5,000	6,000	6,000	7,000	8,000
C3	9,000	9,000	9,000	9,000	9,000	9,000
C4	6,000	7,000	8,000	9,000	9,000	9,000
C5	2,000	3,000	4,000	4,000	5,000	6,000
C6	4,000	5,000	6,000	6,000	7,000	8,000
C7	1,000	1,000	1,000	4,000	5,000	6,000
C8	0,250	0,200	0,167	1,000	1,000	1,000

Table 3. Pairwise Comparison Matrix (C1-C3)

CRI	ri		
C1	3,29	4,04	4,73
C2	2,21	2,62	2,98
C3	2,49	2,43	2,40
C4	1,59	1,53	1,49
C5	0,60	0,64	0,66
C6	0,62	0,56	0,52
C7	0,39	0,35	0,31
C8	0,24	0,21	0,18
Total	11,43	12,36	13,27
P^(-1)	0,088	0,081	0,075
INCR	0,075	0,081	0,088

Table 4. Pairwise Comparison Matrix (C4-C6)

CRI	Wi		
C1	0,25	0,33	0,41
C2	0,17	0,21	0,26
C3	0,19	0,20	0,21
C4	0,12	0,12	0,13
C5	0,05	0,05	0,06
C6	0,05	0,05	0,05
C7	0,03	0,03	0,03
C8	0,02	0,02	0,02

Table 5. Pairwise Comparison Matrix (C7-C8)

CRI	AW	NW	Rank
C1	0,33	0,33	1
C2	0,21	0,21	2
C3	0,20	0,20	3
C4	0,12	0,12	4
C5	0,05	0,05	5
C6	0,05	0,05	5
C7	0,03	0,03	6
C8	0,02	0,02	7
TOTAL	**1,01**		

Table 6. Fuzzy Geometric Mean Values

CRI	Description	Unit
C1	Education	Fuzzy
C2	Expertise	Fuzzy
C3	Sector Knowledge	Fuzzy
C4	Analytical Thinking Skills	Fuzzy
C5	Reputation	Fuzzy
C6	Price	$
C7	Communication Skills	Fuzzy
C8	Reliability	Fuzzy

Table 7. The Fuzzy Weights

Term	Fuzzy Number		
Very Low	1	2	3
Low	1	3	5
Average	3	5	7
High	5	7	9
Very High	7	9	9

Table 8. Averaged and Normalized Weights

Table 9. Criteria Types

Table 10. Linguistic Variables and their corresponding Fuzzy Values

	Benefical			Benefical			Benefical		
ALT/CRI	C1			C2			C3		
Candidate A1	5,000	7,000	9,000	1,000	3,000	5,000	1,000	3,000	5,000
Candidate A2	3,000	5,000	7,000	5,000	7,000	9,000	3,000	5,000	7,000
Candidate A3	1,000	3,000	5,000	7,000	9,000	9,000	5,000	7,000	9,000
Best	9,000			9,000			9,000		

Beneficial Criteria: Maximization is aimed

	Benefical			Benefical			Cost	Benefical			Benefical		
ALT/CRI	C4			C5			C6	C7			C8		
Candidate A1	1,000	3,000	5,000	3,000	5,000	7,000	10.000	1,000	3,000	5,000	3,000	5,000	7,000
Candidate A2	3,000	5,000	7,000	5,000	7,000	9,000	11.000	1,000	2,000	3,000	5,000	7,000	9,000
Candidate A3	5,000	7,000	9,000	5,000	7,000	9,000	15.000	1,000	3,000	5,000	9,000	9,000	9,000
Best	9,000			9,000			10.000	5,000			9,000		

Cost Criteria: Minimization is aimed

CRI	C1			C2			C3			C4		
Candidate A1	0,556	0,778	1,000	0,111	0,333	0,556	0,111	0,333	0,556	0,111	0,333	0,556
Candidate A2	0,333	0,556	0,778	0,556	0,778	1,000	0,333	0,556	0,778	0,333	0,556	0,778
Candidate A3	0,111	0,333	0,556	0,778	1,000	1,000	0,556	0,778	1,000	0,556	0,778	1,000

CRI	C5			C6				C8		
Candidate A1	0,333	0,556	0,778	1,000	0,200	0,600	1,000	0,333	0,556	0,778
Candidate A2	0,556	0,778	1,000	0,909	0,200	0,400	0,600	0,556	0,778	1,000
Candidate A3	0,556	0,778	1,000	0,667	0,200	0,600	1,000	1,000	1,000	1,000

Table 11. Fuzzy TOPSIS Step 1-1

CRI	C1	C2	C3	C4	C5	C6	C7	C8
Weights	0,33	0,21	0,20	0,12	0,05	0,05	0,03	0,02

Table 12. Fuzzy TOPSIS Step 1-2

ALT/CRI	C1			C2			C3			C4		
Candidate A1	0,181	0,254	0,326	0,023	0,070	0,117	0,022	0,065	0,109	0,014	0,041	0,068
Candidate A2	0,109	0,181	0,254	0,117	0,164	0,211	0,065	0,109	0,152	0,041	0,068	0,096
Candidate A3	0,036	0,109	0,181	0,164	0,211	0,211	0,109	0,152	0,196	0,068	0,096	0,123
A*	0,181	0,254	0,326	0,164	0,211	0,211	0,109	0,152	0,196	0,068	0,096	0,123
A-	0,036	0,109	0,181	0,023	0,070	0,117	0,022	0,065	0,109	0,014	0,041	0,068

Table 13. Fuzzy TOPSIS Step 2-1

ALT/CRI	C5			C6	C7			C8		
Candidate A1	0,017	0,028	0,040	0,045	0,006	0,017	0,028	0,006	0,009	0,013
Candidate A2	0,028	0,040	0,051	0,041	0,006	0,011	0,017	0,009	0,013	0,017
Candidate A3	0,028	0,040	0,051	0,030	0,006	0,017	0,028	0,017	0,017	0,017
A*	0,028	0,040	0,051	0,045	0,006	0,017	0,028	0,017	0,017	0,017
A-	0,017	0,028	0,040	0,030	0,006	0,011	0,017	0,006	0,009	0,013

Table 14. Fuzzy TOPSIS Step 2-2

Fuzzy PIS	C1	C2	C3	C4	C5	C6	C7	C8
Candidate A1	0,000	0,127	0,087	0,055	0,011	0,000	0,000	0,008
Candidate A2	0,072	0,038	0,044	0,027	0,000	0,004	0,007	0,005
Candidate A3	0,145	0,000	0,000	0,000	0,000	0,015	0,000	0,000

Table 15. Calculated Weights from Fuzzy AHP

Fuzzy NIS	C1	C2	C3	C4	C5	C6	C7	C8
Candidate A1	0,145	0,000	0,000	0,000	0,000	0,015	0,007	0,000
Candidate A2	0,072	0,094	0,044	0,027	0,011	0,011	0,000	0,004
Candidate A3	0,000	0,127	0,087	0,055	0,011	0,000	0,007	0,008

Table 16. Fuzzy TOPSIS step 4-1

Table 17. Fuzzy TOPSIS step 4-2

Table 18. Fuzzy TOPSIS step 5, Fuzzy PIS

Table 19. Fuzzy TOPSIS step 5, Fuzzy NIS

As a result, Candidate A3 is the best VFQ consultant to be chosen among the three candidates.

3. Results and Discussion

3.1. Results

As a result of the calculations of integrated Fuzzy TOPSIS and Fuzzy AHP, candidate A3 is the most suitable VFQ consultant, candidate A2 is in the second row and candidate A1 is the least suitable VFQ consultant candidate among all three candidates.

Table 19. Fuzzy TOPSIS step 6

ALT/CRI	**Di***	**Di-**	**CCi**	**Rank**
Candidate A1	0,288	0,167	0,367	3
Candidate A2	0,198	0,263	0,571	2
Candidate A3	0,160	0,295	0,649	1

4. Conclusions and Recommendations

Project management approaches have been changing rapidly as technology advancesexponentially. Projects are becoming more complex, but access to information is getting easier. Agility turns into necessity for organizations and pace of change is faster. Companies need to adapt quicker than before. Hence, agile project management is examined to determine what is necessary to become agile for the survival of companies in this competitive business world. Common tools that are used in organizations and the dissimilarity between agile project management and traditional project management is studied to observe the necessity of agility. Then, Scrum is researched in detail. Roles, artifacts, cycles of Scrum represent the main iterative approach of agile project management and there are certain rules since Scrum provides a framework. Lastly, Lean conversion is analyzed by evaluating its philosophy and application to understand VFQ approach.

VFQ was born the essential idea of two agile methodologies: Scrum and Lean and it is a work-based educational philosophy. Therefore, it is important to understand the root of VFQ that is an effective and relatively new approach. Moreover, to find a true VFQ consultant a multi-criteria decision making method that is integrated fuzzy AHP and fuzzy TOPSIS are implemented among three candidates to determine the best and analysis is based on analytical calculations rather than intuitive selection processes unlike what happens in most of the companies. Fuzzy TOPSIS method is put into use with the calculated weights of the criteria that are derived from the Fuzzy AHP method. According to Fuzzy TOPSIS results, candidate A3 is the most suitable VFQ consultant, candidate A2 is in the second row and candidate A1 is the least suitable VFQ consultant candidate among all three candidates.

To sum up, VFQ has an important role for agile methodology and it is important to find the correct consultant for a company. When result of the MCDM method is investigated, the selection of Candidate A3 is the most appropriate choice for hiring.

For future research, VFQ applications can be observed in different industries and sectors. Comparative analysis can be made between different agile methodologies and hybrid systems can be also formed. Regarding to formed methods, criteria and their importance level of the integrated Fuzzy AHP and Fuzzy TOPSIS method can be determined by considering the sector, the approach, the project and the team. Afterwards, VFQ consultant selection can be done by using the other hybrid MCDM methods. Furthermore, there are many more MCDM tools such as VIKOR, ELECTRE, etc to use and many more fuzzy decisions to be made.

5. Acknowledge

We would like to thank Tekin ÇETİNKAYA for sharing his vast knowledge and support on VFQ.

References

[1] Güngör, Z., Serhadlıoğlu, G., & Kesen, S. E. (2009). A fuzzy AHP approach to personnel selection problem. Applied Soft Computing, 9(2), 641-646.

[2] Mahmoodzadeh, S., Shahrabi, J., Pariazar, M., & Zaeri, M. S. (2007). Project selection by using fuzzy AHP and TOPSIS technique. World Academy of Science, Engineering

[3] Kahraman, C., Cebeci, U., & Ulukan, Z. (2003). Multi-criteria supplier selection using fuzzy AHP. Logistics information management.

[4] TELLİ, S. S. (2020). SELECTION OF OPTIMAL URBAN REFUGEE SHELTER DESIGN BY USING INTEGRATED FUZZY AHP AND FUZZY TOPSIS (Unpublished bachelor's thesis). İstanbul Technical University.

[5] Ertuğrul, İ., & Karakaşoğlu, N. (2008). Comparison of fuzzy AHP and fuzzy TOPSIS methods for facility location selection. The International Journal of Advanced Manufacturing Technology, 39(7-8), 783-795

[6] Zadeh, L. A. (1975). The concept of a linguistic variable and its application to approximate reasoning—I. Information sciences, 8(3), 199-249.

[7] Saaty, T. L. (1980). The Analytic Hierarchy Process Mcgraw Hill, New York. Agricultural Economics Review, 70.

[8] Vaidya, O. S., & Kumar, S. (2006). Analytic hierarchy process: An overview of applications. European Journal of operational research, 169(1), 1-29.

[9] Velasquez, M., & Hester, P. T. (2013). An analysis of multi-criteria decision making methods. International journal of operations research, 10(2), 56-66.

[10] Chan, F. T., Kumar, N., Tiwari, M. K., Lau, H. C., & Choy, K. (2008). Global supplier selection: a fuzzy-AHP approach. International Journal of production research, 46(14), 3825-3857.

[11] Cebeci, U. (2020). SELECTING LEAN SIX SIGMA MANAGER BY USING TYPE-2 FUZZY AHP WITH A REAL CASE APPLICATION IN A LOGISTICS FIRM. Proceedings on Engineering, 2(3), 223-236.

[12] Buckley, J. J. (1985). Fuzzy hierarchical analysis. Fuzzy sets and systems, 17(3), 233-247.

[13] Behzadian, M., Otaghsara, S. K., Yazdani, M., & Ignatius, J. (2012). A state-of the-art survey of TOPSIS applications. Expert Systems with applications, 39(17), 13051-13069.