Çok Kriterli Karar Verme Teknikleri ile Kurumsal Kaynak Planlama Sistemi Seçimi

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Araştırma Makalesi

ÖZET

Günümüzde işletmeler rekabet ortamına ayak uydurabilmek için maliyet, kalite, verimlilik, değişen iş koşullarını önceden tahmin edebilme gibi pek çok parametreye ihtiyaç duymaktadır. Kurumsal kaynak planlama sistemleri (ERP) muhasebe, satın alma, proje yönetimi, Ar-Ge, dış ticaret operasyonları gibi günlük iş gereksinimlerini gerekli bilgilerle birbirine bağlamaktadır. ERP sistemleri bir işletmenin bütün süreçlerini kapsayan verileri birleştirme özelliği taşıyor olsa da pek çok şirket, yüksek maliyetlere katlanarak satın aldıkları bu yazılımlarda hedefledikleri başarıya ulaşamamaktadır. Çalışmanın amacı kurumsal kaynak planlama sistemi kullanmaya karar veren bir firma için çok kriterli karar verme yöntemlerinden TOPSİS kullanarak en uygun sistemin seçilmesini sağlamaktır. Çalışmada literatür ve nitel çalışma sonuçları birlikte değerlendirildiğinde beş kriter; sistem yeterliliği, sistem esnekliği, maliyet, eğitim, satış sonrası destek, verimli proje yönetimi kriterleri ana kriterler olarak belirlenmiştir. Kriterlerin önem derecesinin belirlenmesi için şirket üst düzey yöneticileri ile kriter ağırlıklandırılması yapılmıştır. Çalışma sonunda en önemli kriter "maliyet" olarak belirlenmiş ve işletmenin mevcut kurumsal kaynak planlama sistemleri arasında "ERP 3" en yüksek puana sahip ERP sistemi olarak seçilmiştir.

Enterprise Resource Planning System Selection with Multi-Criteria Decision Making Techniques

Research Article

ABSTRACT

Today, businesses require to consider many parameters such as cost, quality, efficiency and being able to predict the changing business conditions in order to keep up with the competitive environment. Enterprise resource planning systems (ERP) connect daily business requirements such as accounting, procurement, project management, R&D (Research and Development), foreign trade operations with the necessary information. Although ERP systems have the feature of combining all data including all processes of an enterprise, many companies cannot achieve the success they desire in this software that they purchase by bearing high costs. Accordingly, the aim of the study is to select the most suitable system for a company that decides to use an enterprise resource planning system, by using TOPSIS, one of the multi-criteria decision making methods. When the literature and qualitative study results were evaluated together in this study, the criteria such as system competence, system flexibility, cost, training, after-sales support and efficient project management criteria were determined as main criteria. In order to determine the significance level of the criteria, a process of criteria weighting was executed with the senior managers of the company. At the end of the study, the most important criterion was determined as "cost" and "ERP 3" was selected as the ERP system with the highest score among the existing enterprise resource planning systems.

1. Introduction

Enterprise Resource Planning (ERP) is a commercial software package that enables businesses to manage in a fully automated system. In other words, ERP system is the system that provides the information integration process within the organization, combining relational business tools and data through a database [1]. By offering integrated solutions, the system ensures effective and efficient use of resources, and at the same time, it begins to have its place in the field of e-commerce by developing web-based solutions [2]. In addition to these advantages that ERP provides to businesses, unfortunately, it is known that the application success rate is quite low. One of the reasons why the success ais so low, perhaps most importantly, is the failure to choose the appropriate system for the business structure. At this point, system selection becomes important for the success [3].

ERP system selection has a difficult and complex process due to the variety of alternatives. Considering that there are dozens of software in the ERP software industry, it becomes important for an enterprise to choose the right system [4].

2. Enterprise Resource Planning System

2.1. Literature

According to Kumar and Hillsgersberg, enterprise resource planning is an information systems that provide effective and efficient use of resources by offering integrated solutions [5]. Rashid et al. [6] have discussed the historical development of the system in their studies, where they described the change of ERP over the years. Accordingly, the system, which started by the process of inventory control packages in the 1960s, and in line with material requirement planning in the 1970s, production resource planning in the 1980s, enterprise resource planning in the 1990s and expanded enterprise resource planning in the 2000s.

Based on some studies in the literature, the reason why ERP has been explained as increases organizational effectiveness and work efficiency [7, 8]. In his study, Teltumbde suggested a structural framework for choosing ERP and pointed out 10 main factors for the selection of this software. These factors are strategic fit, technology, change management, risk, applicability, business functionality, vendor identity, flexibility, cost and benefit [9]. Haddara, and Elragal on the other hand, described ERP systems as software applications in the form of modules that integrate the processes and tasks of the organization at an organizational level [10].

2.2. Enterprise Resource Planning Criteria Selection

ERP applications are of vital importance for organizations. Businesses use a ERP system regardless of their commercial and administrative size. However, when ERP systems are evaluated in terms of their initial costs and annual maintenance costs, it is necessary to say that although they will turn into financial gain in terms of their operational contribution in the long run, they are also likely to have a certain financial burden [11]. Although expectations from ERP systems are high, they do not always provide significant organizational improvement [12]. Accordingly, many ERP projects have failed due to budget and time limits [13] When the literature and qualitative study results were evaluated together, various criteria were determined for the selection of appropriate enterprise resource planning. These are system competence, system flexibility, cost, training, after sales support and efficient project management criteria.

- System flexibility; is the ability for the system to be transformed into the process or design as needed in a short time. The flexibility of the system and its openness to improvements in line with user demands enable the user to perceive the system easily [14].
- System adequacy; it is a factor that illustrate whether or not the specifications expected from the system are met [1].
- Cost; constitutes the most important item for enterprises in the selection of a resource planning system. The cost is that the software can be purchased at an affordable price or the purchased system can gain serious cost advantage [15].
- Education; has an important place in perceiving the system as easy. Bueno and Salmeron [16] found that training has an impact on perceived ease of use in their study of ERP systems.
- Support after sale; serves as a structure that manages many parameters from acceptance to solution, in accordance with the intense business tempo of companies that provides technical support and

service to the solution of any problem that occurs during the use of the system [1].

- Efficient project management; includes the use of a technology by the users, the planning of the transition process, the arrangement of the resources in this direction are included in the project management [17].

Table 1. Criteria's and symbols

Criteria	Symbols	Sources
System flexibility	SF	[14]
System adequacy	SA	[1]
Cost	C	[15]
Education	E	[16]
Support after sale	SAS	[1]
Efficient project management	EPM	[17]

3. Research Method

3.1. TOPSIS

People are faced with decision-making processes in many times throughout their lives, and although the decision-making process is considered easy at the initial stage, it actually appears as a complex process [18] Decision making is a process consisting of certain stages, and individuals evaluate the situation with a specific approach in the decision-making process, consider alternatives and their possible consequences, and finally comes out to certain individual choices as a result of their evaluation [19].

First introduced by Hwang and Yoon in 1981, the TOPSIS method is an approach for dealing with complex systems related to making a preferred choice among several alternatives [20]. The advantages of the TOPSIS method, which is one of the multi-criteria decision making methods, are briefly stated as being simple to use, considering all kinds of criteria, being rational and understandable, and having quite clear calculations [21]. Therefore, the TOPSIS method, one of the multi-criteria decision making techniques, was used in this study for corporate source software selection.

3.2. TOPSIS Process

In general TOPSIS process has 6 steps [21] :

Step 1: Preparing decision matrix

The decision matrix column contains column criteria (n) and on the line as an alternative (m).

$$X_{ij} = \begin{bmatrix} X_{11} & X_{12} & X_{13} & ... & X_{1n} \\ X_{21} & X_{21} & X_{23} & ... & X_{2n} \\ - & - & - & - & - \\ X_{m1} & X_{m2} & X_{m3} & ... & X_{mn} \end{bmatrix}$$
(1)

Step 2: Normalized matrix

$$r_{ij} = \frac{Xij}{\sqrt{\sum_{i=1}^{m} Xij^2}}$$

i= 1,2,……..,m ;   j= 1,2,…………,n   (2)

Step 3: Calculating the weighted normalized decision matrix

yij=wirij

i= 1,2,……..,m and j= 1,2,…..,n   (3)

Step 4: Calculating the positive and negative ideal solution

$$A^+ = (y_1^+, y_2^+, ... y_n^+)...............$$

$$A^- = (y_1^-, y_2^-, ... y_n^-)...............$$

$$(y_j^+) \begin{cases} max_i y_{ij} \\ min_i y_{ij} \end{cases}$$
if j, benefit attribute
if j, cost attribute

$$(y_j^-) \begin{cases} min_i y_{ij} \\ max_i y_{ij} \end{cases}$$
(4)

Step 5: Calculating distance with ideal solution

$$D_i^+ = \sqrt{\sum_{j=1}^{n} y_{ij-} y_j^+}$$

i= 1,2….,m

$$D_i^- = \sqrt{\sum_{j=1}^{n} y_{ij} - y_j^-} \qquad (5)$$

Step 6: Calculating the preference value

$$V_j = \frac{D_i^-}{D_i^- - D_i^+}$$

$$i = 1, 2, \ldots, m \qquad (6)$$

4. Result and Discussion

As stated in this study, x business which operates in the automotive industry, which has employees worldwide, with significant market share in leading economies outside Turkey such as USA, UK, France, Germany and Italy is a company which operates nearly in 70 countries. Using the TOPSIS method, one of the multi-criteria decision making techniques for the ERP software selection problem, it is aimed to reach the useful results that will help the decision makers. The company wants to choose one of the available software, namely SAP, Oracle, Logo, Microsoft Dynamics, Canias, Bilişim and Syspro ERP, considering the criteria that affect the software selection.

In this study, in determining the criterion weights for the selection of ERP software, the decision makers consisting of the managers of the production, accounting, finance and sales departments of the company and academicians have weighted the criteria based on the literature. After determining the importance level of the criteria, ERPs were listed according to their performance with TOPSIS method.

Table 2. Weights for the 6 criteria

	SF	SA	C	E	SAS	EPM
Score	7	8	9	6	7	7
W_j	0,159	0,182	0,205	0,136	0,159	0,159
Direction	+	+	-	+	+	+

After determining the criteria and weights in Table 2, the decision maker determines the list of alternatives to be selected. The first step of implementing TOPSIS in decision support systems prepares the decision matrix.

Table 3. Decision matrix

	SF	SA	C	E	SAS	EPM
ERP 1	0,03	0,06	0,08	0,06	0,07	0,08
ERP 2	0,04	0,10	0,08	0,05	0,05	0,06
ERP 3	0,06	0,09	0,07	0,06	0,08	0,07
ERP 4	0,05	0,05	0,08	0,04	0,07	0,05
ERP 5	0,09	0,08	0,10	0,06	0,06	0,06
ERP 6	0,08	0,05	0,09	0,06	0,05	0,04

Table 4. The distances of weighted normalized matrix with ideal solution

A^*	0,09	0,10	0,07	0,06	0,08	0,08
A^-	0,03	0,05	0,10	0,04	0,05	0,04

The positive and negative ideal solutions were determined by taking the maximum and minimum values for each criterion.

Table 5. Best ERP of each alternative

S_j^*		S_j^-		C_j		Ranking	
$S1^*$	0,741	$S1^-$	0,595	$C1^*$	0,45	ERP 1	4
$S2^*$	0,665	$S2^-$	0,595	$C2^*$	0,47	ERP 2	3
$S3^*$	0,364	$S3^-$	0,729	$C3^*$	0,67	ERP 3	1
$S4^*$	0,778	$S4^-$	0,372	$C4^*$	0,32	ERP 4	6
$S5^*$	0,468	$S5^-$	0,756	$C5^*$	0,62	ERP 5	2
$S6^*$	0,758	$S6^-$	0,556	$C6^*$	0,42	ERP 6	5

S* shows the distance of each alternative from positive ideal solution, illustrates the distance of each alternative from negative ideal solution and C* shows the best ERP of each alternative.

As a result of the ranking, the software with the highest performance was determined as ERP 3, followed by ERP 5 in the second and ERP 2 in the third. Again with the same data, the ERP's with the lowest performance are ERP 4 and ERP 6, respectively.

5. Conclusion and Recommendations

Recently, the development of information technology has influenced most of companies. Especially in today's world where competition is intense, companies to survive requires to adapt themselves to new technological improvements and they must use high technologies efficiently as well. ERP becomes crucial for companies to manage their resources efficiently and by adapting ERP in all managerial processes in companies allow them to increase customer satisfaction, reduce costs and maintain or increase market share. At this point, it is important to choose the right ERP software to right managerial process. Based on the findings of the present study, system

adequacy is an important criterion in establishing the ERP system; therefore, before deciding right ERP software selection, the needs of an enterprise should be determined in the most realistic way and the functional characteristics of ERP software which expected to meet these needs should be introduced clearly. In line with these needs, the decision to choose the ERP system should be done correctly. In future studies, it may be better to reach different group of people for whom expert opinions will be obtained and to increase the number of experts. In addition, in future studies, different criteria weighting methods and a different criterion structure could be preferred to reach more useful results. In addition to the criterion weighting problem, one or more of the selection methods can be used to evaluate the alternatives of the ERP system.

Statement of Conflict of Interest
Author has declared no conflict of interest.

Author's Contributions
The contribution of the author is 100%.

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