Determining the Critical Success Factors in ERP Systems Implementations with Fuzzy Cognitive Mapping: The Case of Turkey

[1]M.S. İlkay, [1]A.İ. Özdemir, [2]G. Seçme and [2]N.Y. Seçme
[1]Department of Business, Faculty of Economics and Administrative Sciences,
Erciyes University, Kayseri 38039, Turkey
[2]Department of Business, Faculty of Economics and Administrative Sciences,
Nevşehir University, Nevşehir, 50300, Turkey

Abstract: The purpose of this study is to determine the factors affecting ERP implementation success by using fuzzy cognitive mapping method. Fuzzy Cognitive Mapping (FCM) is used to determine critical success factors affecting ERP implementation. FCM is based on graph theory, which was formulized by mathematician Euler in 1736. Fuzz cognitive method is very useful method for exploring the subjective factors of subject and the relationships between them. In this study we draw 16 fuzzy cognitive maps with interviewers whose are the owner or manager of enterprises or ERP team managers of the ERP teams. By the constructive analysis of the individual cognitive maps, "giving ERP education to team or end users", "Conformity and reliability of data" and "Support of top level management" variables are the most central variables. By the neural network analysis we find that if the ERP education increases, raises; "meeting the business needs of ERP system", "the efficiency of project plan", "project management and time schedule" variables increases too. And according to the second scenario if top level managers support the use of ERP system increases, raises; "meeting the business needs of ERP system", "giving ERP education to team and last users", "self-sacrifice of project team", "existence responsible persons from each department in the project team" variables are increases too. Also, this paper represents a first attempt for using fuzzy cognitive mapping to determine the factors, which affect the success of ERP application.

Key words: Critic success factors, ERP, fuzzy cognitive mapping, neural networks, simulation

INTRODUCTION

Integration of information and communication technologies throughout the organization and linking all business units to each other allow managers and information users of a company to access the needed information in a timely fashion in order to make right decisions. Currently, a popular approach to the development of integrated enterprise-wide system is the implementation of an Enterprise Resource Planning (ERP) system (Beheshti, 2006). ERP integrates key business functions and provides a view of the happenings in the areas of human resources, finance, accounting, manufacturing, sales and marketing, procurement, distribution and etc. of the company to its users.

In this study, cognitive mappings refer to the causal definitions that could be affected by ERP implementation success, which are determined by top level managers or ERP project coordinators of the companies located in Kayseri, Turkey, by using ERP. The basic assumption of this approach is that there are internal cognitive models of the people relating to own observed world (Bauer, 1975). Fuzzy cognitive mapping has been used in various studies. Klein and Cooper (1982) summarized the new

approach of these studies as following: Traditionally, scientists are interested in real, objective world that events could be observed and measured. But, the decision making processes of the human being did not take place in this objective world. Always, human decision processes take place in subjective world of decision makers. Cognitive mapping opens a window to this subjective world. By this study, Critical Success Factors of ERP implementation process will be determined by using fuzzy cognitive mapping.

LITERATURE REVIEW

Overview of the research on ERP implementation success factors: ERP system implementation is a process of great complexity, with a great many conditions and factors potentially influencing the implementation. These conditions could have positive effect on the outcome of ERP project, while their absence could generate problems during implementation (Soja, 2006). So the causes of implementation problems or failures need to be understood and solutions leading to success need to be found (Calisir and Calisir, 2004).

Corresponding Author: M.S. İlkay, Faculty of Economics and Administrative Sciences, Department of Business, Erciyes University, Kayseri 38039, Turkey

ERP systems have drawn much attention of many researchers in the last two decades (Beheshti, 2006). Many researches have studied on ERP implementation success up to now. The first study on ERP systems' critical success factors was studied by (Bingi *et al.*, 1999). Also, many researchers have studied (Holland and Light, 1999; Nah and Kuang, 2001; Hong and Kim, 2002; Bradford and Florin, 2003; Somers and Nelson, 2004; Soja, 2006; Ifinedo, 2007) ERP implementation success.

Researchers and practitioners have improved some approaches to evaluate ERP system success. One of them Diffusion of Innovation (DOI) that implies organization's innovation affect the diffusion of IT in organizations (Bradford and Florin, 2003). Another approach is the process approach that explains outcomes one event to another by time sequence like in stages of implementation life cycles (Somers and Nelson, 2004). Somers and Nelson's study (2004) indicates that success factors influences on ERP systems can be temporal. CSFs relative importance changes one stage to another in the implementation life cycle (Somers and Nelson, 2004). Other studies on ERP implementation success have been described below.

In research, Parr *et al.* (1999) got ten experts who participate in a total of 42 ERP implementation projects opinion by the way of interview with them. Ten factors necessary for successful implementation of ERP system are identified. These factors were divided into four groups related with management, personnel, software and project.

Holland and Light (1999) presented a number of potential success factors which are divided into strategic and tactical factors in ERP implementation. Nah and Kuang (2001) research based on literature review yielded a model of 11 critical success factors.

Al-Mashari *et al.* (2003) presented taxonomy of ERP critical factors. A total of 12 factors were divided into three dimensions related to ERP project stages, such as setting-up, deployment and evaluation. Ifinedo (2007) compared ERP success evaluations of business and IT managers in his study. Data analysis of Ifinedo showed that no significant statistical differences exist between the two groups on the six dimensions (vendor/consultant quality, system quality, information quality, individual impact, work group impact, and organizational impact) of ERP success operationalized with the exception of vendor/consultant quality (Ifinedo, 2007).

There are many studies on ERP success in US and west-Europe. On the other hand many researches are seen in other countries. Some of them are listed below.

Sedera *et al.* (2002) examined ERP success across different employment groups in Australian public organizations. Zhang *et al.* (2003) examined critical success factors of ERP implementation success in China. Luliana (2006) studied CSF's in Romanian SME's ERP implementation. Prokopiev *et al.* (2006), Jafari *et al.* (2006) and Kamhawi (2008) examined factors affecting ERP implementation success respectively, in South Africa, Malaysia and Bahrain. Ifinedo (2007) evaluate the ERP system success by viewpoint of business and IT managers in Finland and Estonia.

Fuzzy cognitive mapping: A cognitive map that is a qualitative model showing how a given system operates is based on the defined variables and the casual relations between these variables. Cognitive maps are especially applicable and useful tools for modeling complex relationships among variables. Cognitive mapping can be used to examine the decision-makers' maps, compare as to their similarities and differences, and discuss them. In addition the effects of different policy options can easily be modeled (Özesmi and Özesmi, 2004). Cognitive maps are directed graphs, or digraphs and their historical origins are based on graph theory, which was formulized by mathematician Euler in 1736 (Biggs *et al.*, 1976). After Euler, the graph theory has been extensively developed by various mathematicians. Harary *et al.* (1965) included this theory in numerical anthropology methods to study the structural evaluation of empirical data and called it digraph. Anthropologists have used signed digraphs to represent differences between social structures in human societies (Hage and Harary, 1983). Axelrod (1976) transformed the graphics from the subjective observations of anthropologists into to people's perceptions graphics and called it cognitive mapping (term first used by Tolman, 1948). Many studies have used cognitive mapping to examine and find out perceptions of complex systems and to develop policies (Axelrod, 1976; Bauer, 1975; Brown, 1992; Carley and Palmquist, 1992; Cossette and Audet, 1992; Klein and Cooper, 1982; Malone, 1975; Montazemi and Conrath, 1986; Nakamura *et al.*, 1982).

Kosko (1986) modified Axelrod's binary cognitive maps by applying fuzzy casual functions with real number [-1, 1] to the connections. Thus, cognitive map has been called as Fuzzy Cognitive Map (FCM). Kosko (1987) was also the first to inference of FCM by using neural network simulations, which ensure to model the effect of different policy options.

FCM has been used as a tool to model a variety of things in different fields, such as the physiology of appetite (Taber and Siegel, 1987), political developments (Taber, 1991), electrical circuits (Styblinski and Meyer, 1988), a virtual world of dolphins, shark and fish (Dickerson and Kosko, 1994), organizational behavior and job satisfaction (Craiger *et al.*, 1996) and the economic and demographic structures of world nations (Schneider *et al.*, 1998). In addition, many researchers utilized FCM method in their studies for modeling of the ecosystem (Özesmi, 1999), modeling of neuron fuzzy cognitive maps (Tsadiras and Margaritis, 1997), using fuzzy cognitive maps as a system model for effect analysis (Peláez and Bowles, 1996), performance analysis of personnel and modeling and analysis of business
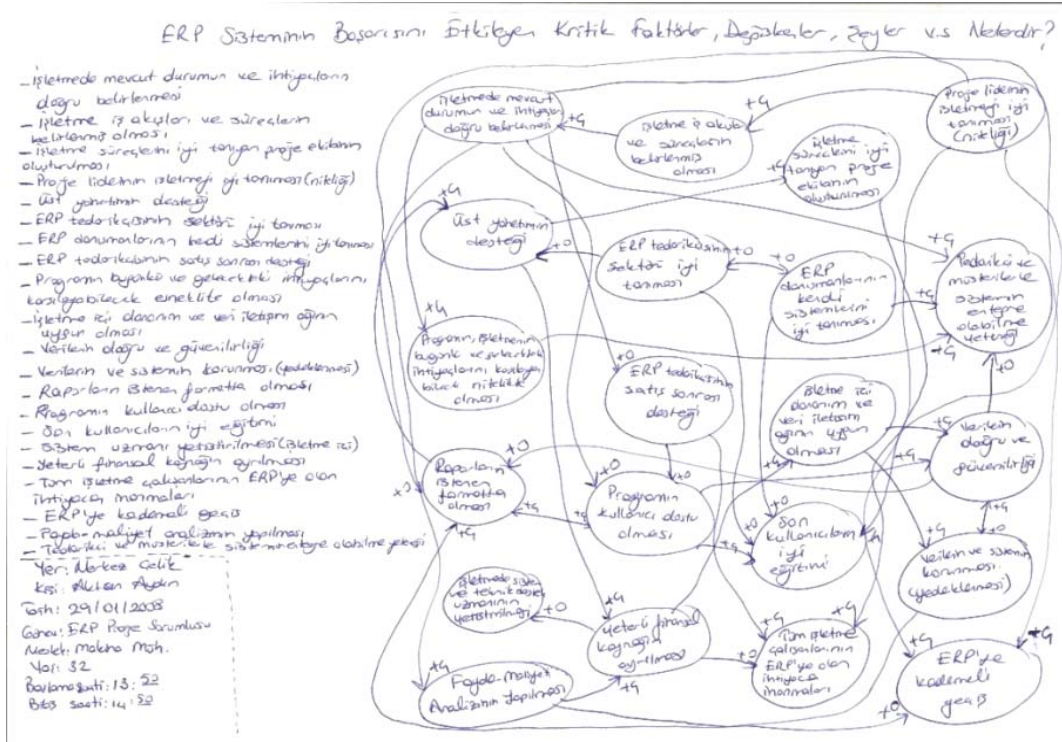
Fig. 1: An example of fuzzy cognitive mapping

performance assessment (Kardaras and Mentzas, 1997), strategic planning (Tsadiras *et al*., 1995), increasing effectiveness of information systems in strategic planning process (Kardaras and Karakostas, 1999), the information technology/information system investment evaluation process in risky conditions to provide competitive advantage for companies (Irani *et al*., 2002). Also, Yalçın and Seçme (2002) used cognitive mapping for determining industrial problems and developing solutions to these problems. Özesmi and Özesmi (2003) used FCM to analyze the perceptions of different stakeholder groups about a lake ecosystem in order to create a participatory management plan. Çoban and Seçme (2005) used cognitive mapping for the prediction of the effects of privatization on the employees.

In this study, Fuzzy Cognitive Mapping (FCM) method was used. Cognitive maps were obtained through interviews with people who use ERP. Cognitive models are complex systems, consisting of various variables have interaction each other. Cognitive mapping is an effective method because it reflects the subjective opinions of the interviewee and it does not contain predetermined questions. Cognitive mapping is a clear and transparent method. It does not create anxiety on the part of the interviewee and it is easy to prepare. It also helps to collect data by give chance holistic comparison on the subject and to set up cause-effect connections.

MATERIALS AND METHODS

Collecting data: In order to draw cognitive maps, the questions of "What are the factors that affect ERP application success?" and "How do these factors affect each other?" were asked to the interviewees. Project managers and plant managers, who applied ERP in their plants, were interviewed. By using open ended questions, the interviewee(s) were provided an atmosphere to express their opinions freely without any restrictions and direction on them. Respondents' variables were listed on a paper size of 50 cm × 35 cm. After the interviewee(s) had made a list of all variables and were sure that they had no more variables to add, they were asked about the causal relationships among these variables indicating the strengths of the relationship with a number between -1 and 1 [-strong (-1), -medium (-0,5), -a little (-0,25), zero (0), a little (0,25), medium (0,5), strong (1)]. The directions of the relationship were indicated with arrowheads. As it can be understood from the casual relationships, these are linguistic variables. Lingual expressions like strong, medium and a little are regarded as the natural representation of the preference or judgment in this method. These characteristics indicate the applicability of the fuzziness.

A total of 16 FCMs were used in the analyses. It was seen that the average age of interviewees was 39,4 and the drawing time of maps varied between 20 and 100 min. One of the sample for cognitive maps is given in Fig. 1.
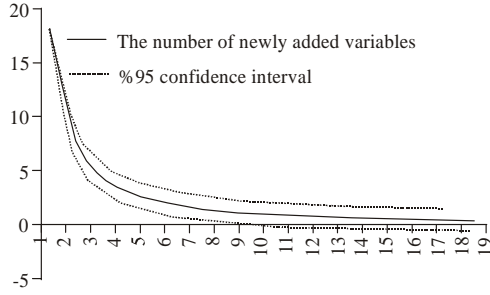
Fig. 2: The number of newly added variables and saturation

Saturation analysis: FCMs were created with different individuals in such a way that the sample represents the population sufficiently. In order to do this, Estimates 7.50 (Colwell, 1997) program was used to examine accumulation curves of the total number of variables versus number of interviews. Average accumulation curve was created by using Monte Carlo techniques to randomly select the order of the interviews many times, i.e, 500 and to determine how the variables accumulate. In addition to this, both the accumulated curves and the number of new variables added per interview were evaluated in order to obtain a sufficient sample.

At the end of the 16 interviews, a total of 51 different variables were obtained from the maps. Beginning from the 13th map, a clear slow down was observed in the increase of the number of variable under 1. Beginning from the 10th map, the number of new added variable decreased less than 1, as it can be seen in Fig. 2.

This means that the sample size represents the population sufficiently and the drawing maps are enough for study. After this point, new added variables are specific for the individual(s) and they indicate extreme issues. In other words, the findings reflect that the obtained sample size determined important wishes of groups.

Analysis of the data: There are two main ways of analyzing FCMs. First way is to analyze the structural indices values by using comparative statistical methods. The second way is to use neural network simulations found by Kosko (1992a, b). In this study, both analyses were used for determining of the factors affecting ERP application success.

After coding all the maps in Microsoft Excel as square adjacency matrices, the indices values were calculated, social cognitive maps were obtained, and these maps were compared to each other by using statistical techniques. The structural features of cognitive maps were analyzed with Graph theory, which is the map in the form of square adjacency matrices. Graph theory indices that are density index, in degree, out degree, transmitter, centrality, hierarchy index and complexity index were calculated by using these matrices. In the following equations, these mentioned indices are explained and each one is showed with mathematical notations.

The connection index means the density (D) of the maps. To calculate density, the number of available connections (C) is divided by the maximum number of connections possible between N variables (Hage and Harary, 1983). This shows how connected or sparse the maps are:

$$D = \frac{C}{N(N-1)} \quad \text{or} \quad D = \frac{C}{N^2} \tag{1}$$

The type of variables in a map is important because of the interaction between different types of variables. For instance, same type of variables facilitates the understanding of the structure of a cognitive map. In a map, there exist three types of variables. These variables are transmitter variables (forcing functions), receiver variables (utility variables) and ordinary variables (means) (Eden *et al.*, 1992; Harary *et al.*, 1965), which are defined according to their out degree $od(V_i)$ and in degree $id(V_i)$.

Out degree is the row sum of absolute values of a variable in the adjacency matrix. It shows the cumulative strengths of connections exiting the variables, where N is the total number of variables:

$$od(V_i) = \sum_{k-1}^{N} \overline{a}_{ik} \tag{2}$$

In degree is the column sum of absolute values of a variable. It shows the cumulative strength of variables entering the variable.

$$id(V_i) = \sum_{k-1}^{N} \overline{a}_{ki} \tag{3}$$

Transmitter variables have positive out degree, and zero in degree. Receiver variables have a positive in degree, and zero out degree. Ordinary variables can be either receiver or transmitter variables, depending on the ratio of their in degrees and out degrees.

The centrality $(td(V_i))$ of a variable is the sum of its in degree and out degree and the centrality index shows that the variable(s) is most mentioned.

$$c_i = td(V_1) = od(V_1) + id(V_1) \tag{4}$$

Another structural measure of a cognitive map is the hierarchy index (*h*) (MacDonald, 1983):

$$h = \frac{12}{(n-1)n(n+1)} \sum_i \left[od(v_i) - \left(\sum od(v_i) \right) n \right]^2 \tag{5}$$

If h is equal to 1, the map is fully hierarchical; and if h is equal to 0, the system is fully democratic. Democratic maps are much more adaptable to local environmental changes because of their high level of integration and dependence (Sandell, 1996).

Thus the first step in analyzing cognitive maps is to describe and tabulate the number of variables and connections and the graph theory structural indices for comparing among the interviewees or different groups of stakeholders.

Individual cognitive maps of interviewees can be augmented, and additively superimposed to form a Social Cognitive Map (SCM). A social cognitive map displays different behaviors rather than an individual cognitive map. SCMs are also defined as "team maps" (Kosko, 1987; Eden *et al.*, 1992; Kosko, 1992a; Kosko, 1992b; Özesmi, 1999; Özesmi and Özesmi, 2003). In this paper, social cognitive map refers to the augmented individual map of project managers and plant managers, who applied ERP in their plants in Kayseri.

The second method of computing FCMs is neural networks simulations (Kosko, 1986; Kosko, 1987; Reimann, 1998; Dickerson and Kosko, 1994). This computational method is not necessarily concerned with the structure, but it deals with the outcome, or inference of the map (Kosko, 1987). In the neural network computational method, a vector of initial states of variables (I^n) is multiplied with the adjacency matrix A of the cognitive map. The results are transformed to the interval (0, 1) using a logistic function, which is $1/(1+e-\alpha x)$. The transformation provides a better understanding and representation of activation levels of variables and enables us to compare qualitatively the causal output of variables. These steps are repeated through the iterations while the matrix values become steady state. To run "what-if" scenarios, desired variables are set to a desired value (0 or 1) at state vector for each simulation step and the relative effects of desired variables are determined. FCM simulation helps us to forecast the relationship between the dependent variables and the independent variables as the theoretically transformed results at the end of the iterations can reach limit cycle or chaotic attractor (Dickerson and Kosko, 1994). In this paper, our matrix values became steady state before 20 iteration steps and all values of variables obtained in simulations go on a steady limit.

RESULTS

The findings of structural analyses: Fuzzy cognitive maps depend on the interview time or the length of the subject, and also on the experience of the interview. Thus, while comparing the variables and indices in cognitive maps for different subjects and different interviews, maps alone can not reflect the right results (Eden *et al.*, 1992).

Table 1: Graph theory indices for the individual cognitive maps & social cognitive map

	Individual cognitive map		Social cognitive map
	Mean	SD	
No. of variables, N	20.58	1.62	51
No. of transmitter Variables, T	2.92	2.39	3
No. of receiver variables R	2.92	2.11	0
No. of ordinary variables, O	14.75	3.60	48
Hierarchy index, h	0.08	0.04	0,36
No. of connections, C	48.5	011.74	4.8
Density, D	0.12	0.03	0.18
Connection/Variable, C/N	2.35	0.52	8.39

Therefore, to understand whether there is a relationship between a number of described variables and the interviewers' age and the interview time or not, correlation analyzes and t test were used. These analyses showed that there is no relation between neither the number of described variables and interviews' age r = -0.283; t = 0.000000), nor the number of described variables and the interview time r = 0.308; t = 0.000003). The mean age of our interviews was found 39.4±7.8. And the mean time for drawing the maps is 47.13 min, while the shortest interview time is 20 min and the longest interview time is 100 min.

Graph theory indices values obtained from structural analyses of cognitive maps are seen in Table 1. At the end of the 16 cognitive maps, there are 20.58 variables in average affecting ERP application success.

The number of receiver variables indicating the expectations from the system was found as 2.92. The number of transmitter variables, which affect the system independently, was also found as 2.92. The ratio between connections number per variable numbers; that is the indicator of the density between the described variables and the casual relations (or connection no per variable) is 2.35.

Hierarchy index showing the hierarchical structure in the maps was calculated as 0.08. The closer to zero the hierarchy index of a map, the more the map is democratic. On the contrary the closer to one the hierarchy index of a map, the more the map is hierarchical. The previous studies showed that democratic maps can adapt to local changes quiet fast because of their high level of integration and dependence (Sandell, 1996). With respect to individual cognitive maps, this can indicate a system that is open to change. The average number of connections (48.50) described in individual maps refer to the collective dynamics of the system. It shows that the interviewees think that the system is relatively complex and versatile.

The findings of Social Cognitive Maps (SCM) were analyzed and the analyses showed that a total of 51 variables were said by interviewees. While 3 of 51 were ordinary variables, there were not any receiver variables.

Table 2: Some indices values in different studies to compare this study

	No. of variables	No. of connections	Connections/variable	Density
Cossette and Audet (1992)	57.00	87.00	1.53	0.03
Özesmi (1999)	19.70	28.31	1.64	0.11
Yalçın and Seçme (2002)	21.43	43.54	2.07	0.11
Özesmi and Özesmi (2004)	24.50	43.70	1.78	0.09
Çoban and Seçme (2005)	16.07	21.50	1.32	0.09
In this study	20.58	48.50	2.35	0.12

Table 3: The first ten most central variables and their centralities

	Centrality	In degree	Out degree
Giving ERP education to team or last users	67.50	38.75	28.75
Conformity and reliability of data	63.50	55.00	85.00
Support of top level management	62.25	36.00	26.25
Right, fast and flexible reporting/output	48.75	33.75	15.00
Qualifications and experience of project manager	46.25	12.00	34.25
Responsible people from each departm. in project team	40.75	21.50	19.25
Knowing business and task of consultant	38.75	5.00	33.75
Collecting data fast and conveniently for the system	35.25	18.50	16.75
The flexibility of ERP system	34.75	17.25	17.50
The authority/efficiency of ERP consultant	34.50	3.5.0	31.00

The rest of the variables (48 variables) were the transmitter variables. I n SCM, there were a total of 48 connections among variables. Connection number per variable was 8.39. The density of SCM was 0.18 and hierarchy index was 0.36. This system revealed by our research is a rather democratic and low density system.

Though project managers and plant managers, who applied ERP in their plants, contacted different points, as a whole they all indicated the similar model.

When the indices values of this study are compared with other studies, which previously used the same method, the model in this study appears to be denser and to have a stronger interaction (Table 2).

Especially the indices number of connections and the connection number per variable are higher than other studies. This situation shows that variables in the system have more dense interactions together. Same situation can also be said for density indices. The power of the interaction of the system shows the effect of the density indices value. The more dense the maps, the more complex subjects and power interactions between variables in maps.

While the variables were ordered according to their centrality degree, the most central (most important) variable was "to give ERP education to team or last users". The second most central variable was "conformity and reliability of data" (Table 3).

We can understand how much these central variables affect and are affected by other variables by looking at the out degree and in degree. Hence, it is easy to see and understand the relationships between variables in the maps. If a variable has a big effect on other variables, this is out degree. On the contrary, if a variable is affected by the other variables, this is in degree. When we look at the Table 3, we can see that the "qualifications and experience of the other project manager" has big effect on other variables (out degree) and, "to give ERP education to team and last users" is the most important variable and it is under the effect of other variables (in degree).

Findings of neural networks simulations: The second way of analyzing FCM is the neural network simulations. After the cognitive maps are drawn and the adjacency matrix is coded, it is possible to run the model in order to see where the system will go and to determine the system's steady state. In the simulation analyses, we have used logistic function $(1(1+e^{-1*x})$ to transform the results into interval [0, 1]. This non-negative transformation allows for a better understanding and representation of activation levels of variables, and also enables a qualitative comparison among the casual output of variables. The resulting transformed vector is repeatedly multiplied by the adjacency matrix and transformation is carried out until the system converges into a fixed point. In our study, the system converges in less than 20 simulation time steps.

In this study, two scenarios were run to predict the effects of variables on ERP success: the first one is the analysis of the factors, which will meet the expectations from the ERP systems of business and raise the success of system, and the second is to predict these variables' effects on other variables.

According to the first scenario, if ERP education variable is enabled, expanded or raised the efficiency, which variables raise because of the effect of education. Because of this, the most central variable, which is "giving ERP education to team and last users", is strengthened. At the end of this scenario, some variables became more important than the other variables. These are; meeting the business needs of ERP system, the efficiency of project plan, project management and time schedule, system authority of last users, the existence of responsible persons from each department in the project team, the flexibility of ERP system and collecting the data fast and conventional to the system (Fig. 3).
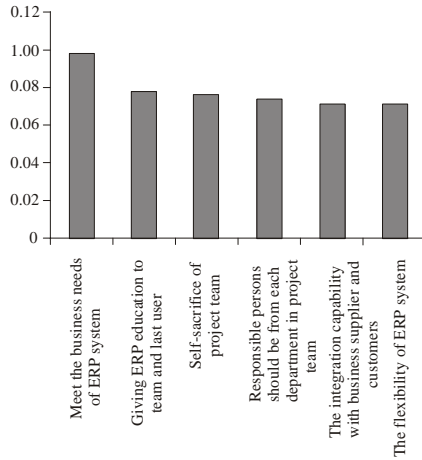
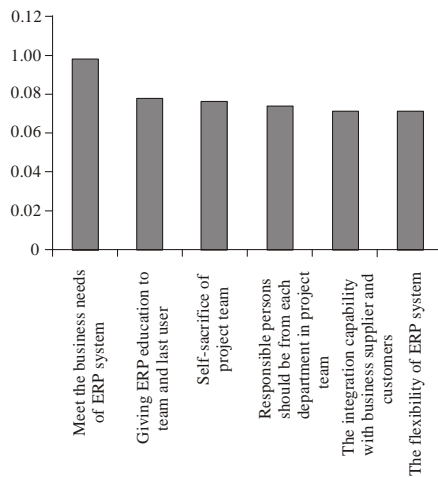Fig. 3: The relative effect of giving ERP education to team and last users

Fig. 4: The relative effect of support of top level manager

According to the second scenario, if top level managers support the use of ERP system, this can have important implications for the business. In order to see this interaction, the variable indicating "the support of top level manager" is strengthened or extended. At the end of the second scenario, the following variables are shown: meeting the business needs of ERP system, giving ERP education to team and last users, self-sacrifice of project team, existence responsible persons from each department in the project team, the integration capability with business suppliers and customers and the flexibility of ERP system (Fig. 4).

DISCUSSION

ERP system implementation projects need to spend a large amount of money, time and efforts. The failure of ERP system implementation will cause to waste all resources spend for this project. In this study fuzzy cognitive mapping method was used to determine the factors affecting ERP application success. Cognitive maps were obtained through interviews with project managers and plant managers who applied ERP system in their plant. This is the first attempt to determine the factors affecting ERP success using cognitive mapping.

A total of 16 FCMs were used in the analyses. Fuzzy cognitive mappings were analyzed in two ways. In the first way, the structural indices values were analyzed by using comparative statistical methods. In the second way, neural network simulations were used.

According to the results of structural analyses of 16 cognitive maps, a total of 51 variables were said by interviewers in social cognitive maps. 3 of 51 variables were found ordinary variables. The rest of the variables (48 variables) were the transmitter variables and there was not found any receiver variables. In SCM, there were a total of 48 connections among variables. Connection number per variable was 8.39. This system revealed by our research is a rather democratic and low density system.

When the indices values of this study are compared with other studies, which previously used the same method, the model in this study appears to be denser and have a stronger interaction. Especially the indices number of connections and the connection number per variable are higher than other studies. This situation shows that variables in the system have more dense interactions together. Same situation can also be said for density indices.

While the variables were ordered according to their centrality degree, the most central (most important) variable was "to give ERP education to team and last users". The second most central variable was "conformity and reliability of data".

We saw that the "qualifications and experience of the other project manager" has big effect on other variables (out degree) and, "to give ERP education to team and last users" is the most important variable and it is under the effect of other variables (in degree).

In this study, two scenarios were run to predict. The first one is the analysis of the factors, which will meet the expectations from the ERP systems of business and raise the success of system, and the second is to predict these variables' effects on other variables.

According to the first scenario, if ERP education variable is enabled, expanded or raised the efficiency, which variables raise by the effect of education. Because of this, the most central variable, which is "giving ERP education to team and last users", is strengthened. At the end of this scenario, some variables became more important than the other variables. These are; meeting the business needs of ERP system, the efficiency of project plan, project management and time schedule, system authority of last users, the existence of responsible

persons from each department in the project team, the flexibility of ERP system and collecting the data fast and conventional to the system.

According to the second scenario, if top level managers support the use of ERP system, this can have important implications for the business. In order to see this interaction, the variable indicating "the support of top level manager" is strengthened or extended. At the end of the second scenario, the following variables are shown: meeting the business needs of ERP system, giving ERP education to team and last users, self-sacrifice of project team, existence responsible persons from each department in the project team, the integration capability with business suppliers and customers and the flexibility of ERP system.

Briefly, it is appeared that most important critical success factors at ERP implementation stage are training the ERP team and last users, and Top management support.

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