

# Determination the Factors that Affect the Use of Enterprise Resource Planning Information System through Technology Acceptance Model

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## Abstract

In order to survive in today's global competitive environment, businesses have to use information systems during management and production processes. Technology Acceptance Model (TAM) is developed by Davis (1989). According to this model, the use of a new information system depends on perceived ease of use and perceived usefulness variables. This study analyzes the factors that affect the use of Enterprise Resource Planning (ERP) software, which is an information system, in the frame of TAM variables. 236 companies that use these information systems participated in the survey. It is determined that, eleven independent variables, which are taken into consideration in the scope of user characteristics, innovative characteristics, organizational and environmental characteristics factors, have statistically meaningful and positive effect on perceived ease of use and perceived usefulness which represent TAM parameters. Similarly, it is determined that, perceived ease of use and perceived usefulness have a positive and statistically meaningful effect on the use of ERP.

**Keywords:** enterprise resource planning information system, technology acceptance model, user characteristics, innovative characteristics, organizational characteristics, environmental characteristics

## 1. Introduction

Today, one of the indispensable factors in business life is the use of powerful information systems. Computers are widely used in the field of business management. Products made of computer hardware and software which enable accumulating, processing, storing, transmitting and analyzing information based on computers in order to plan, control, coordinate and make decisions in companies, are defined as information systems (Ollila & Lyytinen, 2003, p. 276).

By means of information system, companies can continue their existences in intense global competition environments, increase their economic strengths and capabilities, make correct decisions, support operations, make productions, increase product and service range, increase quality, raise productivity, introduce innovations, ensure adaptation to the environment, integrate with suppliers and customers, decrease total costs, shorten operation time and minimize stocks. Shortly, use of information systems is the basic source of development. Dependence of modern businesses on information systems is named "digital revolution" (Premkumar & Roberts, 1999, p. 467) and "age of information" (Grover, Teng, Segars, & Fiedler, 1998, p. 141).

Enterprise Resource Planning systems are the utmost of the use of information systems based on computers. Adaptation of these systems by the users causes the use of the system. Users may also have negative attitudes and beliefs about a new system. This situation directly negatively affects system performance. So, it is necessary to analyze the factors that affect the use of systems in terms of users. The necessity to understand the factors that affect company workers' use of information systems are also mentioned in the related literature (Chen & Hsiao, 2012, p. 810). Evaluating the success of the use of ERP systems relies on user acceptance. TAM is widely used in foreseeing user acceptance (Venkatesh & Morris, 2000, p. 132).

In this study, explanatory power of TAM on usage success of ERP system in organizations is going to be tested. It is predicted that, external variables will affect the use of ERP through perceived ease of use and perceived

usefulness which stand for TAM parameters. The study is significant as it points at critically significant external factors that affect users' information system use. Managers that take these factors into consideration can focus on the efficacy of information system. Otherwise, they will face user resistance and probably miss out the potential benefits of the system.

This article is made of four sections. In the first section of the study, explanatory information about enterprise resource planning is presented. Then, general information about TAM and its functioning is presented. In the next sections, the suggested model based on this substructure and its variables are explained. In research methodology, scales about variables are formed. Factor and correlation analysis of variables are carried out and hypothesis are prepared. In the last section, obtained information is evaluated and interpreted.

## **2. Enterprise Resource Planning Information Systems**

One of the most widely used and accepted information systems especially in big businesses is ERP software. ERP is the most developed software product in computer software industry. Siriginidi (2000, p. 377) defines enterprise resource planning as: the only software package that presents information architecture to organizations including real-time planning, production, customer management, resource management, quality control, asset management, distribution, sales, electronic commerce, supply chain management, automation and integration,

ERP software has been growing rapidly in information systems market (Bingi, Sharma, & Godla, 2001, p. 425). Holland and Light (1999, p. 30) mention that many companies have been using ERP solutions in managing their information systems. It has become an essential system in today's competitive world (Sheu, Chae, & Yang, 2004, p. 362). ERP presents a backbone or a kind of digital neural system function to companies (Mabert, Soni, & Venkataramanan, 2001, p. 76). The innovation that it brings increases the performance of organization. It is generally used in different kind of industries. ERP software grows 150% each year (King, 2005, p. 83), which means there is a significant increase in the number of companies that make investment on the use of the system. Primary benefits of the use of ERP systems can be classified under five definitions:

- (1) Operational benefits: decreasing stock costs, shortening processes, increasing productivity and quality, enhancing customer services.
- (2) Administrative benefits: better coordinating resources, enhancing planning and decision making, enhancing cash and order management.
- (3) Strategic benefits: supporting the growth of business, enhancing business cooperation, creating an environment for innovation, ensuring cost leadership, enabling product range, ensuring virtual environment connection with customer and suppliers.
- (4) Producing information technology substructure: flexibility in business processes, cost saving in information technology, increase in information technology structural abilities.
- (5) Organizational benefits: supporting organizational change, helping organizational learning, ensuring employee empowerment and building a common vision (Al-Mashari, Al-Mudimigh, & Zairi, 2003, p. 356).

Besides the benefits mentioned above, it should be known that ERP systems' setup cost is considerably high. On the other hand, the factors that affect the successful adaptation of the system in an organization aren't exactly known. It should also be mentioned that, once the system use started in an organization, difficult changes occur instead of routine operations.

## **3. Technology Acceptance Model**

It is a theoretical model that explains whether or not the users will adopt a new information system in an institution. It is suggested by Davis (1989) (see Figure 1). The goal of Technology Acceptance Model is to present behavior towards the practice of information systems. The model is used by various researchers in the adaptation of many different technologies (Dasgupta, Granger, & McGarry, 2002, p. 87). It is powerful in foreseeing the use of information systems (Lu, Yu, Liu, & Yao, 2003, p. 207). It is easy to adapt the model to different situations (Ndubisi & Jantan, 2003, p. 441). Learning the model will increase the use of the system.

Functioning of technology Acceptance Model includes a four stages process (see Figure 1). There are external variables in the first stage. The second stage is made of perceived ease of use and perceived usefulness. There is attitude towards using the model in the third stage. In the final, fourth stage, there is intention of behavior. These factors cause the use of the system after a definite process.

External variables are the ones that cannot be controlled by the administration and they affect and determine behaviors (Al-Gahtani & King, 1999, p. 278). They are demographic features of individuals and environment

and job definition; menu, desktop icons, mouse, touchpad etc. that are the technical features of system, top management support, interpersonal trust, organizational factors, documentation, education level, personal abilities and work experience (Kim & Chang, 2007, p. 792; Legris, Ingham, & Colletette, 2003, p. 196). These factors primarily affect user belief which is the attitude towards an object (Gyampah & Salam, 2004, p. 733). Perceived ease of use and perceived usefulness are user beliefs. In order to estimate an individual's attitude towards using a definite system, his/her beliefs about that object can be used. Perceived ease of use and perceived usefulness shape and affect on attitude (Özer & Yılmaz, 2010a, p. 69).

Attitude towards use means like or dislike about using a technology or having positive or negative feelings about a technology (Vijayarathy, 2004, p. 751). Perceived efficacy and attitude towards use directly affect behavior intention about using a system.

Behavior intention about use is the probability of displaying a definite behavior (Al-Gahtani & King, 1999, p. 278). It shows the willingness level of an individual about displaying a behavior. In order to obtain the expected benefits of a system use, user behavior intentions should be taken into consideration. Behavior intention can singly determine system use (Jones & Hubona, 2006, p. 706).

Use of an information system is a behavior (Downing, 1999, p. 204). Here, the output is the decision of user (whether or not he/she will use the information system). Level of use shows the acceptance of the system. A system that meets the expectations of users is successful. Intention level of a behavior determines the possibility of presenting that behavior (Özer & Yılmaz, 2010b, p. 38).

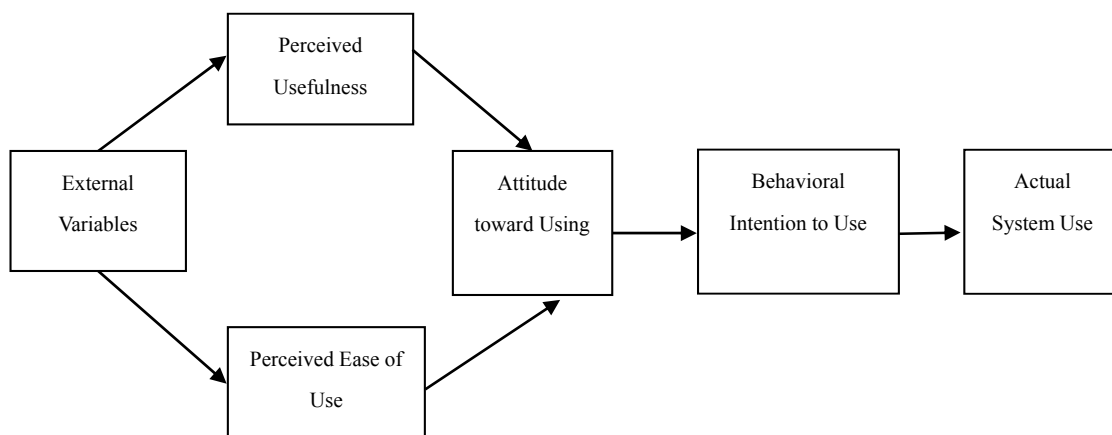


Figure 1. Technology acceptance model

Source: Davis, F.D., Bagozzi, R.P. ve Warshaw, P.R. (1989) User Acceptance of Computer Technology: A Comparison of Two Theoretical Models, *Management Science*, 35(8), p. 985.

#### 4. Research Model

In this article, a research model based on Davis's (1989) Technology Acceptance Model is presented. The model presents a frame for researching the factors that affect the use of information systems. By means of the research model, effects of external variables that affect the use of information systems are determined (see Figure 2.). Factors that affect the use of ERP information system, which is a technologic innovation, in organizations are: User features, innovative features, organizational features and environmental features (Thong, 1999, p. 187). Eleven variables that stand for the above mentioned features are taken from Roger's (1995, pp. 5-6) Diffusion of Innovation (DOI) Theory. This theory explains various external (independent) variables that affect the decision of innovation.

##### 4.1 User Characteristics

User characteristics affect the use of information system. While the effect of technological problems that occur during the setup process of new information systems is less than 10%, human factor is the leading reason (Martinsons & Chong, 1999, p. 126). Variables that form the user features are user satisfaction and user resistance. Users participate in the information system by ensuring inputs and using outputs. Meeting the information requirements of users means user satisfaction (Zviran & Erlich, 2003, p. 83). It also means users'

acceptance, increase in usefulness and decrease in costs (Adamson & Shine, 2003, p. 443). The significance of user satisfaction means the use of a new system. Gelderman (1998, p. 17) states that user satisfaction is significantly connected with organizational performance.

The second variable that forms the user characteristics is user resistance. The most important application problem of information systems is the unwillingness of users (Adams, Berner & Rousse, 2004, p. 56). ERP requires gaining new skills and compelling organizational changes. It is mentioned in the literature that resistance of workmen negatively affects the use of ERP (Hong & Kim, 2002, p. 29). It is significant to understand the reason of resistance and to manage it.

Hypothesis that are to be tested in terms of user features are:

H<sub>1a</sub>: User satisfaction, has positive effect on perceived ease of use

H<sub>1b</sub>: User satisfaction, has positive effect on perceived usefulness.

H<sub>2a</sub>: User resistance, has negative effect on perceived ease of use

H<sub>2b</sub>: User resistance, has negative effect on perceived usefulness.

#### 4.2 Innovative Characteristics

Use of information systems is an organizational innovation. Innovative characteristics mean the attitude of an organization, which adopts an innovation, towards innovation (Frambach & Schillewaert, 2002, p. 164). Variables that form the innovation features of a modal are technical compatibility, business process reengineering and total quality management. Technical compatible is the compatibility rate between an organization's present technology and systems and new system (Palvia, Sharma, & Conrath, 2001, p. 249). Information systems especially focus on ensuring integration among different departments. If the information system is compatible with present business practices and user needs, organization can adapt innovations more easily (Thong, 1999, p. 195). Incompatibility means extra cost. It is revealed that one of the most significant factors that affect the acceptance of a new system is technical compatibility (Chen & Hsiao, 2012, p. 812).

The second variable that forms the innovative characteristics is reviewing business processes reengineering. By using information technologies, business processes are redesigned (Hammer & Champy, 1993, p. 381). In the application of ERP system, present business processes are reviewed and either completely removed or changed; because ERP systems work much efficiently with simplified business processes (Pinar & Erdem, 2002, p. 6).

Third variable is total quality management. It includes practices such as continuous improvement in every topic with the attendance of all of the workers, meeting the needs of customers, accurate production, team work and cooperation with suppliers (Temtime, 2003, p. 53). With total quality management, a management program including good interpersonal relations, high productivity, customer satisfaction, zero error and low cost is ensured. In the empirical study of Paerson et al. (1995, p. 251), it is mentioned that total quality management has a positive effect on information technology.

Hypothesis that are to be tested in terms of innovative features are:

H<sub>3a</sub>: Technical compatibility, has positive effect on perceived ease of use.

H<sub>3b</sub>: Technical compatibility, has positive effect on perceived usefulness.

H<sub>4a</sub>: Reengineering has positive effect on perceived ease of use.

H<sub>4b</sub>: Reengineering has positive effect on perceived usefulness.

H<sub>5a</sub>: TQM, has positive effect on perceived ease of use.

H<sub>5b</sub>: TQM, has positive effect on perceived usefulness.

#### 4.3 Organizational Characteristics

Organizational characteristics are the basic factor that determines the adaptation of information system to an organization (Damanpour, 1991, p. 557). The first of the variables that forms the organizational characteristics of the model is top management support that has a significant role in shaping cultural values and it stands for the management (Chew & Sharma, 2005, p. 562). The second variable is consensus for organizational goals, the third variable is education and the fourth variable is information density. Participation level of management to information system practices means top management support (Raghunathan, Apigian, Raghunathan, & Tu, 2004, p. 4). It ensures labor force, resource, time and budget (Stratman & Roth, 2002, p. 610). There are empirical studies stating that a strong top management support has a positive effect on system's usage performance (Wilson & McDonald, 1996, p. 391). Consensus for organizational goals is the second variable.

When all of the parties have a common point and they agree on a group decision, it means there is a consensus (Dess & Origer, 1987, p. 313). Information is shared, ideas are explained and strategic decisions are made. In an empirical study on the issue, it is stated that there is a positive relation between consensus and a successful information system application (Dooley, Fryxell, & Judge, 2000, p. 1239).

Education is the third organizational characteristics. It plays a basic role in the use of information technology (Knol & Stroeken, 2001, p. 233). ERP education ensures information transfer and increases the level of proficiency. At the end of education, users get rid of the worries about the system and they become a part of it. Success level of education is evaluated according to the level of finding solutions to problems.

The fourth variable is density of information. It is the contribution of information to the added-value of company's products and services (Hu & Quan, 2005, p. 43). One of the competitive tools for developing product and service is density of information. In the study carried out by Wang (2001, p. 432), it is mentioned that information density has a significant effect on the use of information system.

Hypothesis that are to be tested in terms of organizational features are:

H<sub>6a</sub>: Top management support has positive effect on perceived ease of use

H<sub>6b</sub>: Top management support has positive effect on perceived usefulness.

H<sub>7a</sub>: Consensus at organizational purposes has positive effect on perceived ease of use

H<sub>7b</sub>: Consensus at organizational purposes has positive effect on perceived usefulness.

H<sub>8a</sub>: The education has positive effect on perceived ease of use

H<sub>8b</sub>: The education has positive effect on perceived usefulness.

H<sub>9a</sub>: The density of information has positive effect on perceived ease of use

H<sub>9b</sub>: The density of information, has positive effect on perceived usefulness.

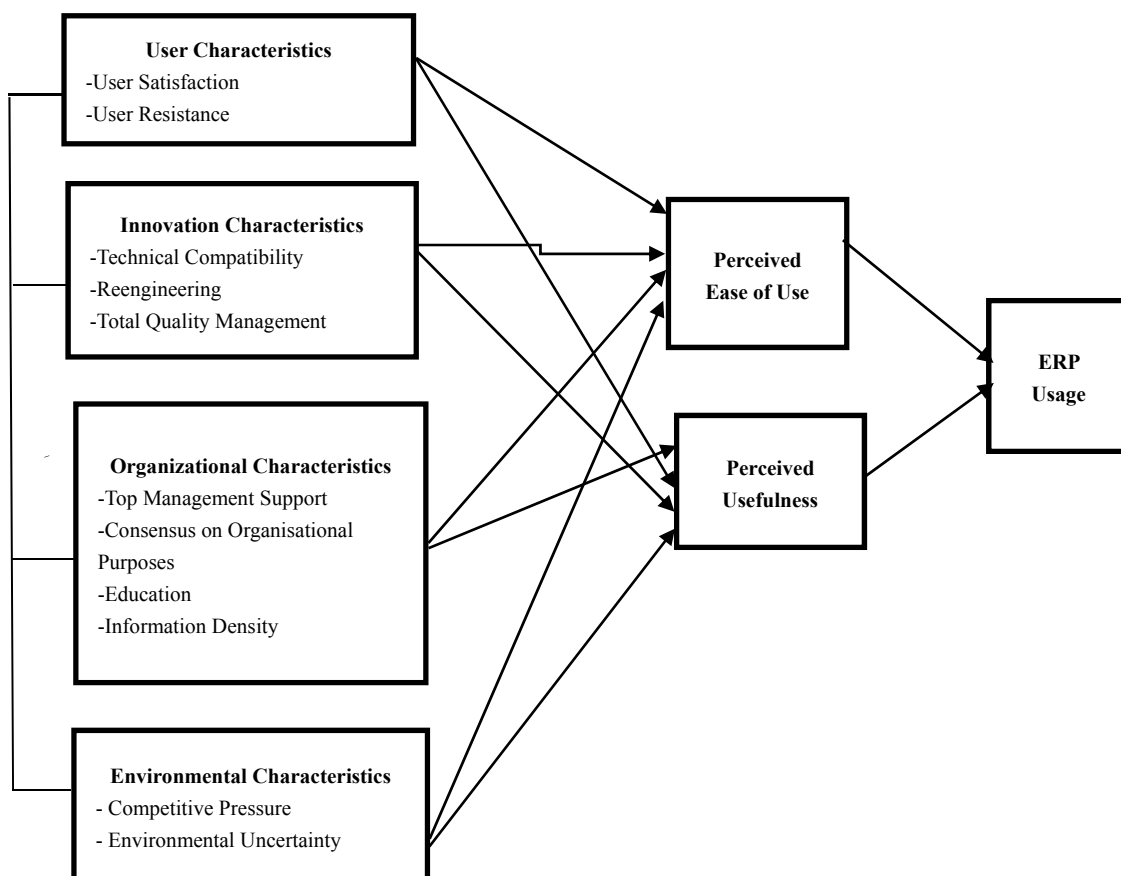


Figure 2. The research model that investigates external variables' effect on ERP usage through technology acceptance model's parameters

#### 4.4 Environmental Characteristics

Environment means the part outside the organization level. The market that includes the input resources and outputs is the first industry that appears in mind. Competitive pressure and environmental uncertainty are the variables of the model under the title of environmental characteristics. Environment of organization is very important in the spreading of innovations in an organization. Organizations change by giving reactions to the changes in their environment (Dixon, Arnold, Heineke, Kim, & Mulligan, 1994, p. 98) and they become adaptable to their environment.

The first variable of environmental characteristics is competitive pressure. Business environment of an organization means competitive environment (Thong, 1999, p. 196). Competitive pressure effects the decisions of managers (Wang, 2001, p. 430). According to the density of competition in the market, company focuses on innovations on product, quality and processes (Montalvo, 2004, p. 7).

The second variable is environmental uncertainty. Not being able to guess the effects of external environment on an organization means environmental uncertainty (Hoque, 2004, p. 489). An organization with environmental uncertainty cannot determine the possible outcomes of a decision, understand cause-effect relation and related and unrelated data. So, environmental uncertainty encourages change and determines the amount of information that is necessary (Gerloff, Muir, & Bodensteiner, 1991, p. 749).

Hypothesis that are to be tested in terms of environmental features are:

H<sub>10a</sub>: Competitive pressure has positive effect on perceived ease of use.

H<sub>10b</sub>: Competitive pressure has positive effect on perceived usefulness.

H<sub>11a</sub>: Environmental uncertainty has positive effect on perceived ease of use.

H<sub>11b</sub>: Environmental uncertainty has positive effect on perceived usefulness.

#### 4.5 Technology Acceptance Model Variables

According to the model, the most important determinants of information system use behavior are perceived ease of use and perceived usefulness (Chen & Hsiao, 2012, p. 811). So, there are many studies that explain computer use behavior by the two perceptions of TAM (Ma & Liu, 2004, p. 61; Chau & Hu, 2001, p. 702; Agarwal & Prasad, 1998, p. 15; Agarwal, Tanniru, & Wilemon, 1997, p. 348; Igarria, Guimaraes, & Davis, 1995, p. 89).

Perceived ease of use is the belief level of an individual that he/she can use a definite system without giving effort (Davis, 1989, p. 320). When a user thinks that he/she can use a new technology easily, then he/she will be more willing to use it. This situation means that the system is user-friendly and meets the expectations (work performance, productivity, efficacy, costs, work quality etc.) (Staples, Wong, & Seddon, 2002, p. 118).

The level of an individual's belief about that a system will increase his/her performance is called perceived usefulness by Davis (1989, p. 320). User evaluates the advantages of a system (Ndubisi & Jantan, 2003, p. 441) and accordingly shows better performance. Empirical researches show that there is a strong and positive relation between perceived usefulness and user acceptance (Adamson & Shine, 2003, p. 444; Igarria, Guimaraes, & Davis, 1995, p. 94).

Hypothesis that are to be tested in terms of these explanations are:

H<sub>12a</sub>: Perceived ease of use has positive effect on usage of ERP.

H<sub>12b</sub>: Perceived usefulness has positive effect on usage of ERP.

#### 4.6 Usage of the ERP System

Obtaining potential benefits from the application of information system means the use of the system (Umble, Haft & Umble, 2003, p. 256). System's success is ensured when users carry out their duties. System's failure, on the other hand, means ending the use of the system when the information system doesn't meet the requirements (Markus, Axline, Petrie, & Tanis, 2000, p. 247). It is determined that the use of ERP system has a positive effect on return on asset ratio, operating revenue and cost of goods sold (Reck, 2004, p. 109).

### 5. Research Method

In this section, design and the method of the scales will be explained. Data collection method will be told. Factor analysis, validity and reliability and test results will be presented.

### 5.1 Scales of Variables

Survey form is created by benefiting from the scales in the literature whose pretest, reliability and validity are proven. Survey questions are evaluated with Likert type scale. The answer choices are: 1. I definitely don't agree, 2. I don't agree, 3. I am indecisive, 4. I don't agree, 5. I definitely don't agree. Survey form includes questions about companies' branch of activity, sales revenue, and number of employees and questions concerning the age, education level, experience, title and demographic information of workers (see Table 1.).

The first factor that forms user features is user satisfaction. Questions that evaluate the user satisfaction about the use of ERP package adapted by the organization are taken from Bradford and Florin (2003, p. 223). Questions that evaluate the user resistance are taken from the study by Jiang et al (2000, p. 27).

The first independent variable that is analyzed as innovative features is technical compatibility. Questions about it are taken from the study of Bradford and Florin (2003, p. 223). The second variable that forms the innovative features is business process reengineering questions about it are collected from the study of Al-Mashari et al. (2001, p. 445). Questions evaluating total quality management are taken from the study of Fuentes et al. (2004, p. 14).

The first variable in organizational characteristics is changeable top management support. Questions are collected from the study by Ramamurthy and Premkumar (1995, p. 349). Questions about the variable of consensus in organizational goals are adapted from the study of Knight et al. (1999, pp. 464-465). Survey questions evaluating ERP education are adapted from the article of Gyampah and Salam (2004, p. 737). Article by Porter and Millar (1985, p. 158) is used for evaluating the variable of information density.

The first factor in terms of environmental characteristics is competitive pressure. Premkumar and Roberts's (1999, p. 483) study is taken into consideration while preparing the related questions. Environmental uncertainty survey questions are collected from the study of Sutcliffe and Huber (1998, p. 805).

Perceived ease of use and perceived efficacy survey questions are prepared on the basis of Gyampah and Salam's (2004, p. 737) study. Questions evaluating ERP use, are taken from the studies by Stratman and Roth (2002, p. 609), Hong and Kim (2002, p. 38).

### 5.2 Universe and Data Collection

The survey form was firstly practiced on accounting and data processing managers in 40 companies that were using ERP. The practice was carried out as a pilot study. Factor analysis was carried out on the data collected in this process in order to be used in pretest. Obtained findings met the expected results; besides that, some questions were reviewed and restated in the frame of some suggestions.

Universe of the research is made of the companies using ERP system in Turkiye. But there has been no organization that lists the companies using ERP system. So, it is not possible to identify the entire universe. Because of this, surveys were posted to a total of 610 companies whose names were taken from the customer reference lists belonging to companies selling ERP and give consultancy service about it. 5 of the collected surveys were eliminated. Finally, there were a total of 236 participators in the sample. Participation level is approximately 40% (see Table 1).

Table 1. Features of survey participators according to some criterion

Variables	Valid Gap	Frequency	Percentage (%)
Age	18-25	16	7%
	26-35	126	53%
	36-44	65	28%
	45-54	24	10%
	55+	5	2%
<b>Total</b>		<b>236</b>	<b>100%</b>
Education	Highschool	11	5%
	Associate/Bachelor degree	196	83%
	Post graduate/Doctorate	29	12%
<b>Total</b>		<b>236</b>	<b>100%</b>
Experience in Firm	1-3 Years	94	40%
	4-6 Years	49	21%
	7-11 Years	55	23%

	12+	38	16%
<b>Total</b>		<b>236</b>	<b>100%</b>
Branch of Acitivity	Metal Industry	77	32%
	Petrochemistry Industry	42	18%
	Textile Industry	30	13%
	Services	28	12%
	Food Industry	23	10%
	Forest Products Industry	13	6%
	Electric/Energy Industry	8	3%
	Electronic Industry	8	3%
	Mining/Land Industry	7	3%
<b>Total</b>		<b>236</b>	<b>100%</b>
Manpower	10-49 Person (small scale enterprise)	30	13%
	50-249 Person (medium scale)	97	41%
	250+ (big business)	109	46%
<b>Total</b>		<b>236</b>	<b>100%</b>
Title	Accounting supervisor	139	59%
	IT/ERP specialist	55	23%
	Human-resource manager	18	8%
	General director/Coordinator	15	6%
	Marketing supervisor	9	4%
<b>Total</b>		<b>236</b>	<b>100%</b>

### 5.3 Factor Analysis, Validity and Reliability

As all of the scales that are used were tested before in the previous researches, they are strong in terms of theory and test; but it is still necessary to determine the number of factors that they focus on in terms of variables; for this aim, heuristic factor analysis (HFA) is used in SPSS 18 program. Kaiser-Meyer-Olkin (KMO) sample size sufficiency and Barlett test is used in order to test the homogeneity of variables and to analyze the suitability of factor analysis. KMO is an index used for measuring the sufficiency of sample size for factor analysis; in order to do this, the method compares the size of observed correlation factors and partial correlation coefficients. KMO 0,901, obtained with HFA and Barlett test value ( $p < 0, 00$ ) show that analysis results are meaningful and proper for factor analysis (Mitchell, 1994, p. 6). Barlett test results ( $p < 0.000$ ) show that there is a relation among the variables in the universe.

Cronbach  $\alpha$  coefficients are used in order to evaluate the reliability and internal consistency of the scales that are used. Cronbach  $\alpha$  tests the reliability and internal consistency of a scale when differences are tested (Cronbach, 2004, p. 4). Cronbach  $\alpha$  values of all of the variables are above 0, 70. Cronbach  $\alpha$  values of variables are above correlation values among variables, according to this result, it can be said that, there is enough validity for sortation (Gaski, 1984, p. 21).

The user satisfaction that creates user characteristics (explained variance 8,440% and reliability coefficient is 0,860) with user resistance (explained variance 20,220% and reliability coefficient is 0,864) are gets explained with 2 factors. Total variance rate of user characteristics is 70,298% (see Table 2).

Table 2. Factor loads and Cronbach Alpha values of user characteristics

User Characteristics (Ratio of Total Variance Explanation: 70,298%)	Factor 1	Factor 2
<b>1. User Satisfaction (Cronbach <math>\alpha</math>: 0.860) (total explained variance: 8,440%)</b>		
The established system meets our expectations	0.742	
Necessary information is obtained on time.	0.806	
Content of information meets our needs	0,795	
Content of information is reliable.	0.800	
<b>2. User Resistance (Cronbach <math>\alpha</math>: 0.864) (total explained variance: 20,220%)</b>		
Workers worried about that the work content would change		0.764
Workers feared about losing status and power at the new system.		0.870
Workers were worried because of the uncertainties brought by the new system		0.832
Workers were afraid from losing their jobs		0.745



Many workers were resistant to ERP system	0.774
Many workers wanted ERP system to fail	0.620

Innovative characteristics are explained with three factors; technical compatibility (explained variance 16,361% and reliability coefficient 0,867), business process reengineering (explained variance 12,900% and reliability coefficient 0,742), total quality management (explained variance 26,191% and reliability coefficient 0,824). Innovative characteristics group explains 55,452% of total variance (see Table 3).

Table 3. Factor loads and Cronbach Alpha values of innovative characteristics

Innovative Characteristics	Factor 1	Factor 2	Factor 3
<b>(Ratio of Total Variance Explanation: 55,452%)</b>			
<b>1. Technical Compatibility (Cronbach <math>\alpha</math>: 0.867) (total explained variance: 16,361%)</b>			
ERP system, is compatible with present system	0.881		
ERP system, is compatible with the present hardware	0.854		
ERP system, is compatible with present business practices	0,863		
<b>2. Reengineering (Cronbach <math>\alpha</math>: 0.742) (total explained variance: 12,900%)</b>			
Harmonization of processes with ERP required a significant amount of time and effort		0.446	
Business processes were redesigned for simplicity during ERP system establishment		0.572	
Time and effort were given in order to harmonize documents with ERP		0.471	
Roles and responsibilities are changed		0.834	
Skill requirements are changed		0.759	
Processes that don't produce added-value were eliminated		0.656	
<b>3. Total Quality Management (Cronbach <math>\alpha</math>: 0.824) (total explained variance: 26,191%)</b>			
Our process and activities, are focused on customer satisfaction			0.686
Our managers and consultants, encourages customer satisfaction and improvement			0.795
Customer satisfaction and meeting their demands are very important			0.811
Improvement of products, services and processes is encouraged in our organization			0.737
Expected work process in this organization is teamwork			0.652
Every worker in the organization participate improvement of products, services and processes			0.552

At the end of heuristic factor analysis, organizational factors are explained with four factors. These factors are; top management support (explained variance 37,462% and reliability coefficient is 0,934), consensus on organizational goals (explained variance 7,093% and reliability coefficient is 0,73), education (explained variance 13,469% and reliability coefficient is 0,883), information density (explained variance 9,666% and reliability coefficient is 0,762). Organizational characteristics explain 67,691% of group's total variance (see Table 4).

Table 4. Factor loads and Cronbach Alpha values of organizational characteristics

Organizational Characteristics (Ratio of Total Variance Explanation: 67,691%)	Factor1	Factor2	Factor3	Factor4
<b>1. Top Management Support (Cronbach <math>\alpha</math>: 0.934), (total explained variance: 37,462%)</b>				
Top management is provided adequate finance, physical resource and employee for ERP application	0.654			
Top management's participation in ERP system is strong	0.797			
Top management, take cares of ERP system	0.852			
Top management supports the use of ERP in company's activities	0.847			
Top management, considers ERP system as a strategic resource	0.812			
Top management supports the adaptation of ERP system	0.831			
<b>2. Consensus on Organizational Purposes (Cronbach <math>\alpha</math>: 0.730), (total explained variance: 7,093%)</b>				
When ERP practice started, there was a consensus on special goals		0.779		
Before the use of ERP, use reason was explained with a short and plain language		0.781		
<b>3. Education (Cronbach <math>\alpha</math>: 0.883), (total explained variance: 13,469%)</b>				
After education program, my level of understanding ERP system highly increased			0.747	
Education for the new system gave me confidence			0.825	

Education is long and detailed enough	0.854
Educators are wise and helped me in understanding the system	0.801
<b>4. Information Density (Cronbach <math>\alpha</math>: 0.762), (total explained variances: 9,666%)</b>	
We have got many suppliers	0.719
We have got many customers	0.653
Sales of the product requires a high amount of information	0.725
Production process is made of many steps	0.813
Producing the production, requires a lot of time	0.631

Variables of environmental characteristics are competitive pressure (explained variance 42,320% and reliability coefficient is 0,848) and environmental uncertainty (explained variance 14,029% and reliability coefficient is 0,762). Environmental characteristics explain 56,349% of total variance (see Table 5).

Table 5. Factor loads and Cronbach Alpha values of environmental characteristics

<b>Environmental Characteristics (Ratio of Total Variance Explanation: 56,349%)</b>	<b>Factor1</b>	<b>Factor2</b>
<b>1. Competitive Pressure (Cronbach <math>\alpha</math>: 0.848), (total explained variance: 42,320%)</b>		
If we don't adapt ERP technology, our customers will chose our rivals	0.810	
ERP technology is necessary for surviving in the market	0.758	
Our customers demands us to use ERP technology	0,841	
Use of ERP technology is necessary in order to continue working with our suppliers	0.793	
<b>2. Environmental Uncertainty (Cronbach <math>\alpha</math>: 0.762), (total explained variance: 14,029%)</b>		
Customers' demands and preferences in the industry are relatively changeable		0.588
Our company should frequently change products, services and production style in order to be competitive		0.576
Our company changes its technology frequently in order to cope with its rivals		0.676
It is difficult to predict the moves of rivals		0.613
Our company produces very different product/services		0.747
Tactics and competitions of rivals are very different		0.684

At the end of the heuristic factor analysis, explained variance of perceived ease of use is 7.39% and reliability coefficient is 0.77, explained variance of perceived usefulness is 34.27% and reliability coefficient is 0.93. TAM model variables explain 70, 30% of total variance (see Table 6).

Table 6. Factor analysis results of technology acceptance model variables

<b>Technology Acceptance Model's Variables (Ratio of Total Variance Explanation: 70,30%)</b>	<b>Factor1</b>	<b>Factor2</b>
<b>1. Perceived Ease of Use (Cronbach <math>\alpha</math>: 0.77), (total explained variance: 7,39%)</b>		
It is easy for employee to learn the ERP system	0.860	
Generally it is easy to use ERP system	0.878	
Interaction with ERP system, is clear and understandable	0,637	
<b>2. Perceived Usefulness (Cronbach <math>\alpha</math>: 0.93), (total explained variance: 34,27%)</b>		
Works are completed more quickly with ERP system.		0.845
ERP system, increases work performance		0.849
ERP system, increases productivity		0.820
ERP system, increases efficiency		0.779
ERP system, makes the work easier		0.832

Total explained variance of ERP usage is 11,430% and it's reliability coefficient is 0,899 (see Table 7).

Table 7. ERP usage factor loads and Cronbach Alpha values

<b>ERP Usage (Cronbach <math>\alpha</math>: 0.899) (total explained variance: 11,430%)</b>	<b>Factor 1</b>
ERP system, has improved the efficiency of distribution function	0.556
The cost of ERP project, was over the estimated budget	0.610

Performance of ERP system meets the expectations	0.914
ERP system is successful	0.874

#### 5.4 Correlation Analyses

Correlation analysis is used in order to determine the level and direction between two variables. In this research, Paerson correlation is used in order to determine the relation between variables. Paerson coefficient values vary between -1 and +1; -1 means negative relations while +1 means positive relations.

If Paerson correlation is between 0, 70 and 1, relations between variables are strong, if it is between 0, 70 and 0, 40, relations are medium and if it is below 0, 20, relation can be ignored. Correlation analysis is shown in Table 8. Results of hypothesis are presented in Table 9.

H<sub>1a</sub>: The user satisfaction, has positive effect on perceived ease of use.

Correlation is meaningful at the level of %1. H<sub>1a</sub> hypothesis has been supported.

H<sub>1b</sub>: The user satisfaction, has positive effect on perceived usefulness.

Correlation is meaningful at the level of %1. H<sub>1b</sub> hypothesis has been supported.

H<sub>2a</sub>: The user resistance, has negative effect on perceived ease of use.

According to correlation chart H<sub>2a</sub> hypothesis has not been supported. User resistance has no meaningful negative effect on perceived ease of use.

H<sub>2b</sub>: User resistance, has negative effect on perceived usefulness.

According to correlation chart H<sub>2b</sub> hypothesis has not been supported. User resistance has no meaningful negative effect on perceived usefulness.

H<sub>3a</sub>: Technical compatibility, has positive effect on perceived ease of use.

The correlation is meaningful at the level of %1. H<sub>3a</sub> hypothesis has been supported.

H<sub>3b</sub>: Technical compatibility, has positive effect on perceived usefulness.

The correlation is meaningful at the level of %1. H<sub>3b</sub> hypothesis has been supported.

H<sub>4a</sub>: Reengineering has positive effect on perceived ease of use.

The correlation is meaningful at the level of %5. H<sub>4a</sub> hypothesis has been supported.

H<sub>4b</sub>: Reengineering has positive effect on perceived usefulness.

The correlation is meaningful at the level of %1. H<sub>4b</sub> hypothesis has been supported.

H<sub>5a</sub>: TQM, has positive effect on perceived ease of use.

The correlation is meaningful at the level of %1. H<sub>5a</sub> hypothesis has been supported.

H<sub>5b</sub>: TQM, has positive effect on perceived usefulness.

The correlation is meaningful at the level of %1. H<sub>5b</sub> hypothesis has been supported.

H<sub>6a</sub>: Upper management support, has positive effect on perceived ease of use.

The correlation is meaningful at the level of %1. H<sub>6a</sub> hypothesis has been supported.

H<sub>6b</sub>: Upper management support, has positive effect on perceived usefulness.

The correlation is meaningful at the level of % 1. H<sub>6b</sub> hypothesis has been supported.

H<sub>7a</sub>: Consensus in organizational purposes, has positive effect on perceived ease of use.

The correlation is meaningful at the level of %1. H<sub>7a</sub> hypothesis has been supported.

H<sub>7b</sub>: Consensus in organisational purposes, has positive effect on perceived usefulness.

The correlation is meaningful at the level of %1. H<sub>7b</sub> hypothesis has been supported.

H<sub>8a</sub>: The education, has positive effect on perceived ease of use.

The correlation is meaningful at the level of %1. H<sub>8a</sub> hypothesis has been supported.

H<sub>8b</sub>: The education, has positive effect on perceived usefulness.

The correlation is meaningful at the level of %1. H<sub>8b</sub> hypothesis has been supported.

H<sub>9a</sub>: The information density has positive effect on perceived ease of use.

The correlation is meaningful at the level of %1. H<sub>9a</sub> hypothesis has been supported.

H<sub>9b</sub>: The information density, has positive effect on perceived usefulness.

The correlation is meaningful at the level of %1. H<sub>9b</sub> hypothesis has been supported.

H<sub>10a</sub>: The competitive pressure, has positive effect on perceived ease of use.

The correlation is meaningful at the level of %1. H<sub>10a</sub> hypothesis has been supported.

H<sub>10b</sub>: The competitive pressure, has positive effect on perceived usefulness.

The correlation is meaningful at the level of %1. H<sub>10b</sub> hypothesis has been supported.

H<sub>11a</sub>: The environmental uncertainty, has positive effect on perceived ease of use.

The correlation is meaningful at the level of %1. H<sub>11a</sub> hypothesis has been supported.

H<sub>11b</sub>: The environmental uncertainty, has positive effect on perceived usefulness.

The correlation is meaningful at the level of %1. H<sub>11b</sub> hypothesis has been supported.

H<sub>12a</sub>: Perceived ease of use, has positive effect on ERP usage.

The correlation is meaningful at the level of %1. H<sub>12a</sub> hypothesis has been supported.

H<sub>12b</sub>: Perceived usefulness, has positive effect on ERP usage.

The correlation is meaningful at the level of %1. H<sub>12b</sub> hypothesis has been supported.

Table 8. Descriptive statistics and correlations of variables

	Av.	St.Dv.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. User Satisfaction	3.7924	.70290	1.00													
2. User Resistance	2.9449	.88648	-.006	1.00												
3. Technical Compatibility	3.5155	.91597	.537**	-.099	1.00											
4. Reengineering	3.6138	.62857	.138*	-.433**	-.007	1.00										
5. TQM	3.8803	.47947	.344**	.062	-.196**	.291**	1.00									
6. Top Management Support	3.9679	.72766	.432**	-.143*	-.314**	-.003	.408**	1.00								
7. Consensus	3.6045	.60168	.324**	-.179**	.275**	-.007	-.252**	.499**	1.00							
8. Education	3.7281	.76700	.489**	-.157*	.311**	-.064	.376**	.595**	.461**	1.00						
9. Information Density	4.0800	.56477	.237**	-.063	-.108	-.179**	.465**	.294**	.196**	.311**	1.00					
10. Competitive Pressure	3.3832	.79844	.124	-.138*	.146*	-.257**	.306**	.095	-.106	-.353**	.397**	1.00				
11. Environmental Uncertainty	3.3932	.56611	.180**	-.141*	.079	-.180**	.422**	.194**	-.140**	.260**	.451**	.520**	1.00			
12. Perceived Ease of Use	3.6360	.55861	.482**	-.091	-.293**	.138*	-.378**	.348**	-.248**	.342**	.193**	.171**	.195**	1.00		
13. Perceived Usefulness	3.9513	.75456	.652**	-.082	-.404**	-.210**	-.367**	.309**	-.181**	.337**	.215**	.256**	.210**	.487**	1.00	
14. ERP Usage	3.4517	.62565	.480**	-.081	-.386**	-.165*	-.319**	.358**	-.264**	.550**	.278**	.437**	.379**	.339**	.491**	1.00

\* Correlation is meaningful at 0.05 level.

\*\* Correlation is meaningful at 0.01 level.

Table 9. Results of hypotheses

Hyp. No:	Hypotheses	Results
H <sub>1a</sub> :	User satisfaction, has positive effect on perceived ease of use.	Supported
H <sub>1b</sub> :	User satisfaction, has positive effect on perceived usefulness	Supported
H <sub>2a</sub> :	User resistance, has negative effect on perceived ease of use.	Not Supported
H <sub>2b</sub> :	User resistance, has negative effect on perceived usefulness.	Not Supported
H <sub>3a</sub> :	Technical compatibility, has positive effect on perceived ease of use	Supported
H <sub>3b</sub> :	Technical compatibility, has positive effect on perceived usefulness	Supported
H <sub>4a</sub> :	Reengineering, has positive effect on perceived ease of use.	Supported
H <sub>4b</sub> :	Reengineering, has positive effect on perceived usefulness.	Supported

H <sub>5a</sub> :	Total quality management, has positive effect on perceived ease of use.	Supported
H <sub>5b</sub> :	Total quality management, has positive effect on perceived usefulness	Supported
H <sub>6a</sub> :	Top management support, has positive effect on perceived ease of use.	Supported
H <sub>6b</sub> :	Top management support, has positive effect on perceived usefulness	Supported
H <sub>7a</sub> :	Consensus on organizational purposes, has positive effect on perceived ease of use.	Supported
H <sub>7b</sub> :	Consensus on organizational purposes, has positive effect on perceived usefulness.	Supported
H <sub>8a</sub> :	Education, has positive effect on perceived ease of use.	Supported
H <sub>8b</sub> :	Education, has positive effect on perceived usefulness	Supported
H <sub>9a</sub> :	Information density, has positive effect on perceived ease of use.	Supported
H <sub>9b</sub> :	Information density, has positive effect on perceived usefulness.	Supported
H <sub>10a</sub> :	Competitive pressure, has positive effect on perceived ease of use.	Supported
H <sub>10b</sub> :	Competitive pressure, has positive effect on perceived usefulness.	Supported
H <sub>11a</sub> :	Environmental uncertainty, has positive effect on perceived ease of use	Supported
H <sub>11b</sub> :	Environmental uncertainty, has positive effect on perceived usefulness.	Supported
H <sub>12a</sub> :	Perceived ease of use, has positive effect on ERP usage.	Supported
H <sub>12b</sub> :	Perceived usefulness, has positive effect on ERP usage.	Supported

## 6. Conclusion

The primary contribution of this study to science is that it presents the effects of external variables on ERP through perceived ease of use and perceived usefulness which form Technology Acceptance Model. Organizations should take four factor groups into consideration before they start making investment on their information systems. In other words, variables that determine the success of information system in companies are user characteristics, innovative characteristics, organizational characteristics and environmental characteristics. In this study, a total of eleven variables that represent these features are analyzed.

User characteristics are represented with user satisfaction and user resistance. At the end of the statistical study, it is determined that user satisfaction has a positive effect on ERP use through perceived ease of use and perceived usefulness. User factor is significant as human beings enter data to the system and take print out from it. It should be mentioned to the users that, information system to be used is user friendly, it is easy to learn it and it will have a positive effect on their work. The reasons of using ERP system and benefits of it should be explained. When parameters are analyzed, it is seen that user resistance has a negative effect on perceived ease of use and perceived usefulness; but this effect isn't statistically important. Possible user resistance to the system should always be considered and precautions should be taken in terms of management in order to avoid such obstacles.

The most important factors that affect a successful ERP use are innovative characteristics, technical compatibility, business processes reengineering and total quality management. Findings obtained from the statistical analysis show that ERP use is positively affected by perceived ease of use, perceived usefulness, technical compatibility, business process reengineering and total quality management practices.

During the establishment of information system, it should be mentioned that ERP software is compatible with the present technology in the organization. The basic goal of ERP system is to ensure the integration of information and resources. ERP establishment brings business process reengineering and total quality management practices with it. Business process reengineering required by ERP software should be radically redesigned and a detailed study should be carried out. Practices that bring no added value to the organization should be eliminated and structures and procedures should be simplified. Total quality management philosophy depends on continuous enhancements with the participation of all of the workers. In this way, ERP use increases as change and cooperation is ensured. Total quality management makes a positive contribution as it ensures feedback through information system.

Benefits which can be obtained through the practice of new information system depend on the compatibility with organizational characteristics. It is determined that the effects of top management support, consensus with organizational goals, density of information and education on perceived ease of use, perceived usefulness and ERP use are statistically significant. Active support of managers that represent the top management is significant in the process of change. Top management personnel's encouraging and supportive behavior is one of the keys to the use of the system; because top management finances the costs of system, ensures necessary resources and use the information produced by the system. Consensus on organizational goals means sharing responsibilities and giving significant decisions as a group and agreeing on the same ideas. This situation eases

the practice of decisions and coordination is ensured. It brings satisfactory results. On the other hand, significance of education in the use of ERP is indisputable; it is a part of application process. In-company training course eliminates negative attitudes of users towards the system and ensures better performance. In the end, benefits that are expected from ERP system use will be maximized. Another reason that causes the adaptation of ERP information system is the necessity of managing information in an organization. Information from customers and suppliers are gathered. It is significant and necessary to use ERP systems in order to product, develop and market products that are highly technological. It is determined that, statistically, competitive pressure and environmental uncertainty variables that represent environmental characteristics have a positively meaningful effect on perceived ease of use and perceived efficacy. One of the motivation reasons that direct organizations to ERP systems is competitive pressure and environmental uncertainty. These two variables positively affect the use of ERP through perceived ease of use and perceived usefulness. Thus, organizations that will practice ERP systems will be able to turn competitive pressure and environmental uncertainty into advantage. Adaptation of ERP system will not differentiate rivals, but change the nature of competition in their favor. Management should prefer and use ERP system software as its system. According to technology acceptance model, use of a new information system in an organization especially depends on perceived ease of use and perceived usefulness variable. Performance of information systems depends on personal aspects, expectations and perceptions of system users; so, system use should be simplified and eased.

In this study, it is determined that perceived ease of use and perceived efficacy parameters, which are the basic variables of TAM, have positively meaningful effect on ERP use and the hypothesis are supported. Success of information system is the benefits obtained from it. When ERP system is put into practice, the potential benefits will be seen and system's success will be understood. ERP systems are reliable in managing multifunctional and multinational companies and the ones that have many branches. Organizational activities and abilities will be enhanced with the use of ERP system.

Academic studies about ERP system are theoretical information resources for companies that produce ERP systems, give consultancy services, use the system and companies that are planning to use the system. Writers hope that ideas and data in the article will promote new research efforts and contribute to the literature.

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