Investigation of Criteria's and Selection Efficient ERP System Using AHP Tools in Persian Electronic Commerce Company

[1]Soraya Fathollahi, [2]Mohammad Aghaei, [3]Asgar Babapour and [4]Behrooz Pourvali
[1]Shahr-e-Qods Branch, Islamic Azad University, Tehran, Iran
[2]Department of Management Studies and Technology Development,
Tarbiat Modares University, Tehran, Iran
[3]Management UAE Branch, Islamic Azad Universty, Tehran, Iran
[4]Faculty of Management, Tehran University, Tehran, Iran

Abstract: Making decision about selecting Enterprise Recourse Planning (ERP) System is an important issue which is faced with many challenges and risks. Therefore, using a comprehensive method of decision-making process for selecting the most suitable system in electronic commerce companies is very important. Unfortunately, such an attempt has not been made yet in Iran. The present study has been provided for identifying the main criteria and factors for selecting Enterprise Recourse Planning (ERP) System in electronic commerce companies using Analytic Hierarchy Process (AHP). This research is a descriptive/survey one. Initially in the process of gathering information, using documental approach, the framework and the criteria of selecting ERP System were determined. For testing the model, questionnaire tool and field approach were used. The statistical community and sample included 8 managers of Parsian Electronic Commerce Company in Tehran. The attempt of analyzing data was made using AHP approach with the help of expert choice software. The results showed that in Iran and in especially in Parsian Electronic Commerce Company duo to the existence of some problems regarding technology, the weight of technology criterion is the heaviest and after that criteria like slaes, cost and time are considred heavy, respectively. Technology should be applicable, reliable and its maintenace and repairment should be easy slae factor includes issues like vendor's credential, industrial certificate and the how-to-do process-cost factor includes isuues like the amount of company' capital and costs of implementation and improvements and finally-time factor includes issues like preparation and installation, updating and the speed of system implementation.

Key words: Enterprise Recourse Planning (ERP), AHP, electronic commerce company, selections and priorities, cost

INTRODUCTION

In today's scenario, ERP Systems are required to address more than the processes taking place within the walls of an enterprise. In the modern competition, enterprises are exploring new theories and methods to adapt to social change. e-Business is the solution to dictate a successful information economy (Sharma *et al.*, 2011). To achieve these conflicting changes, companies must constantly re-engineer or change their business practices and employ information systems such as Enterprise Resource Planning (ERP) (Unal and Guner, 2009) because Enterprise Resource Planning (ERP) Systems that aim to integrate, synchronize and centralize organizational data are generally regarded as a vital tool for companies to be successful in the rapidly changing global marketplace (Parthasarathy and Sharma, 2014) and

in the past few years, thousands of companies around the world have implemented ERP Systems. The number of companies that plan to implement ERP is growing rapidly. Since the early to mid-1990s, the ERP software market had been and now is and will be one of the fastest growing segments of the IT industry (Unal and Guner, 2009). At first glance this suggests that ERP.

Systems can be customized to fit a firm's specialized business processes (Unal and Guner, 2009). But based on a second view it is a critical issue to select the suitable ERP System which meets all the business strategies and the goals of the company; because implementations of ERP Systems are one of the most difficult investment projects because of the complexity, high cost and adaptation risks (Cebeci, 2009). There are a lot of samples in which in spite of large investments, implementing ERP Systems has failed and reaerches show that the rate

---

Corresponding Author: Mohammad Aghaei, Department of Management Studies and Technology Development,
Tarbiat Modares University, Tehran, Iran

of failure in such a process is high (Pacheco-Comer and Gonzalez-Castolo, 2012). An estimated 40-70% of ERP implementations experienced some degree of failure (Wu, 2011). However, many companies install their ERP Systems hurriedly without fully understanding the implications for their business or the need for compatibility with overall organizational goals and strategies. Accordingly, the importance of selection process becomes very clear and the use of a comprehensive decision-making process for selecting the most suitable ERP System in electronic commerce companies becomes very necessary. ERP selection process involves identifying criteria and their relative weights and evaluating the alternatives. AHP methodology overcomes such an evaluation process using a hierarchical structure for prioritizing objectives (Alanbay, 2005). Nevertheless there are few studies that by using this method have tried to make improvement in the process of selecting ERP in electronic commerce companies. Some of the studies have contributed to the introduction of ERP or its implementation in various industries. Some other studies have mentioned the potential advantages that may be achieved through implementing ERP Systems. In some cases these reaesrches have been done with focus on extending some of ERP 'common assessment criteria but often for achieving a specific goal have been considerd irrelevant regarding companoies' strategies and have not been able to explain the process of extracting suitable criteria for the requirements of that company well, since it has a long and problematic implementation process and is a very expensive investment it is important to make a healthy selection about which ERP fits the organization the most (Alanbay, 2005). But based on the emerging process of the use of ERP System, some crucial questions arise: how should we select an ERP System? Is AHP Method a sutiable one for selecting ERP Systems in electronic commerce companies? What criterion does AHP offer for optimal selection of ERP Systems inelectronic commerce companies? The present study whlie investigating the related literature on selecting ERP Systems based on AHP Method, intends, through applying AHP Method to identify ERP's criteria for electronic commerce companies.

Literature review: The concept of ERP was originally developed by Gartner Group in the United States in the early 90's (Xu, 2012) Enterprise Resource Planning (ERP) Systems have been heavily adopted in developed countries in the past decade and most studies on ERP adoption and selection focuses on these countries (Boltena *et al.*, 2011). This new idea is desired in today's e-business market where manaegers need information management skills more than before (Wu and Fung, 2011). Therefore, it is a new management idea and management model as well as an advanced management

system. It integrates the customer's needs, internal business activities as well as resources of suppliers and distributors. It considered the business process as a connecting tight supply chain including suppliers, manufacturing plants, distribution networks and clients (Xu, 2012). The problems of traditional information systems made this new system appear. ERP is a business management system that integrates all facets of the business including planning, manufacturing, sales and finance so they can become more closely coordinated by sharing information (Ahn and Choi, 2008) and can process a lot of organizational data and integrate its operations. The semantic web technologies can be applied in the context of ERP to enable the integration of heterogeneous information extracted from various sources. Recent advances in Persian ontology-driven technologies (Taheri and Shamsfard, 2011) can contribute to manage information of ERP applications in Iran.

It has a central database that contains all of the transactions that an organization could register; depending on its set of functional modules. Those functional modules could be: material management, production, sales, marketing, distribution, financial services, human resources, reports, etc. that the whole organization with its internal and external environment, encompasses them. The ability of connecting to internet and exploiting subsidiary capabilities and advantages are the most imprtant advantages of this new system (Mital *et al.*, 2014). Accordingly, by making use of e-Business approaches, organizations can have the ERP integration benefits of flexibility, reduction in cost, more effective and quick responses, etc. By integrating ERP with e-Business, a new extended ERP System emerges that creates business which is more lively, more focused and highly competitive than traditionally structured business (Sharma *et al.*, 2011). Nevertheless, some potential risks and failures threat ERP Systems.

Since, the business environment is characterized by high uncertainty, the process of ERP System assessment involves numerous problems (Wei *et al.*, 2005). These problems can be related to factors likeusage, technology, implementation or system vendors. Paul and Servant (1987) believe that one of the main reasons for failure in system selection is the understandable lack of knowledge within the company (Farzaneh, 2014). Nevertheless, more common mistakes also appear like imperfect understanding of the need of user, customizing and its problems, integrating old systems with ERP, type of software and cost factor. A variety of variables related to ERP System makes the selection process more complex. As a result, selecting a suitable ERP System needs a step-by-step framework which any company based on its needs and goals should follow it and in such circumstances, investigating the background of researches and the practically done operatins is an

important step in selection process. The review of related literature shows that the first concern in the process of selecting ERP is applying a decision-making approch for such a selection. Moreover, duo to the great importance of this issue in lots of researches, using AHP Method has been strongly emphasized and this method helps us to select the most suitable system based on determined criteria. Such criteria are selected by the experts of company and based on related literature.These criteria, in a lot of cases are common among various companies but their priorities may vary from one company to the other. In a reaeserch done by Liang and Lien (2006) for selecting the optimal ERP Software through combining AHP Method and ISO 9126 Standard, two features for selecting ERP System have been suggested: qualitative features of Software and managerial features. Qualitative features of Software include 6 key qualitative criteria and 21 standard sub-criteria which explain qualitative features of ERP Software and include:

Functionality: This attribute is defined as the degree to which the software functions satisfies. Stated or implied needs and can be broken down into five sub-characteristics as follows: suitability, accuracy, interoperability, compliance and security.

Reliability: This attribute is defined as the capability of software that could maintain its level of performance under stated conditions for a stated period of time. It can be decomposed into three sub-characteristics as follows: maturity, fault tolerance and recoverability.

Usability: This attribute is defined as the degree to which the software is available for use and can be broken down into three sub-characteristics as follows: understandability, learnability and operability.

Efficiency: This attribute is defined as the degree to which the software makes optimal use of system resources. It can be decomposed into two sub-characteristics as follows: efficiency of time behavior and efficiency of resource behavior.

Maintainability: This attribute is defined as the ease with which repair may be made to the software and can be broken down into four sub-characteristics as follows: analyzability, changeability, stability and testability.

Portability: This attribute is defined as the ability of software that can be transferred from one environment to another. It can be decomposed into four sub-characteristics as follows: adaptability, installability, conformance and replaceability. Managerial characteristics generally include sale, cost and time factors from which sub-criteria are extracted.

Sub-criteria of vender factors: market share and reputation, industrial credential, service and support, training solution.

Sub-criteria of cost factors: Software cost, hardware cost, annual maintenance cost, staff training cost.

Sub-criteria of time factors: Time for planning and preparation, time for BPR and system tuning, time for testing and go-live (Liang and Lien, 2006). Alanbay in research done for selecting ERP using Expert Choice Software based on AHP Method has mentioned some criteria for selecting ERP System which are related to factors like seller, user and technology. The most imprtant of such criteria include customizability, implementability, maintenace, real time changes, flexibility, user' familiarity with this system, cost, requiredsystem, after sales support and training, back-up system, reporting and analysing features, vendor credentials, integration with other applications and softwares, integrating internet network and financing options. Albany after determinig the mentioned criteria for selecting ERP, created the structure of AHP Method. These criteria were classified into technology, user and vendor groups, then the subsidiary calculation was performed and after that the main weight of each option and goal based on AHP Method was determined and finally it became clear that criteria related to user, vendor and technology are important, respectively (Alanbay, 2005). Ahn and Choi (2008) based on Home shopping industry that is one of e-Business forms have investigated the criteria used for selecting ERP System based on AHP Method and have sated that the most important criteria for decision-making process are criteria like business capability and coverability, supportive services, technology and costs. The framework suggested by these researches includes some important requirements like strategy and vendor credential but ultimately specifies 10 criteria: suitable strategy, technology, variation management, risk, the power of implementation, business capability, vendor credential, flexibility of system, cost and capability of being benefited by some factors. Finally, these researchers state that criteria like business capability and coverability, supportive services, technology, totalcosts, vendor credential and time are among the most important ones. After perfroming AHP Method, 5 criteria including business capability and coverability, supportive services, technology, total costs and vendor credential were selected and at last there was a shared agreement on criteria like business capability and coverability (C^1), supportive services (C^2) and technology (C^3) (Ahn and Choi, 2008).

MATERIALS AND METHODS

The present study is a descriptive/survey research. For gathering information, initially in order to investigatethe related literature and the framework of research, library mangement system was used. In this stage, related studies are reviewed and the result of such a process is selecting a theoretical framework and extracting 4 prioritized criteria and 27 options as used criteria for selecting ERP System in e-Business. These criteria were used as mesuring tools and modeling frameworks. The measurement tool is valid because its criteria and questions are selected from related literature. Also, the designed questionnaireas a pre-test was given to experts whose advisory ideas in a form of an applicable version were considered. Then, for testing the model the field-based method and questionnaire tool were used. The ststistical community of the research included 8 experienced managers of Parsian Electronic Commerce Company of Tehran and its statistical sample is corresponded with statistical community. For implementing the process, the researcher in a face-to-face situation, distributes the questionnaire among the members of statistical community and gives necessary explanations to them to answer the questionnaire correctly. After gathering information, using Expert Choice Software, the AHP analysis was performed in order to determine the inportance of criteria in e-Business.

RESULTS AND DISCUSSION

The AHP, developed by Saaty is designed to solve complex multi-criteria decision problems. It is a flexible and powerful tool for handling both qualitative and quantitative multi-criteria problems. The strength of this approach is that it organizes tangible and intangible factors in a systematic way and provides a structured yet relatively simple solution to the decision-making problems in addition, by breaking a problem down in a logical fashion from the large, descending in gradual steps to the smaller and smaller, one is able to connect through simple paired comparison judgments, the small to the large (Unal and Guner, 2009). The model is illustrated with an example and managerial implications are discussed. Based on the AHP, Expert Choice (EC) is a decision nsupport software that reduces complex decisions to a series of pair wise comparisons and then synthesizing the results (Alanbay, 2005). It is clear that some of the challenges existed in an individual level are not available in corporate AHP (Ahn and Choi, 2008). Accordingly, the present research was performed in two stages. The aim of first stage is identifying the most important criteria in establishing ERP System through reviewing previous literature and the aim of second stage is identifying the weight and priority of selected criteria in the previous stage using AHP Method identifying the important criteria used for selecting ERP System in e-Business may be the most important issue for prioritizing criteria in AHP Method is providing the correct criteria and options that should be carried out based on reviewing previous literature. Therefore, by studying some of the most related researches, the mentioned criteria were determined. Among the researches done those written by Liang and Lien (2006), Alanbay (2005) and Ahn and Choi (2008) were used as guiding models for determining factors, criteria and stages of the process. Accordingly, in the present study, the qualitative feature of the software which is suggested for identifying ISO 9126 Standard in the research done by Liang and Lien (2006) as well as the most important criteria suggested in empirical researches done by Alanbay (2005) and Ahn and Choi (2008) as the related criteria with the software-sale, cost and time has been considerd. The type of classification which we have used for selecting ERP System based on AHP Method has been determined considering two dimensions of qualitative criteria of software (C^1) and managerial features including factors related to sales and implementation (C^2), factrors related to cost (C^3) and factors related to time(C^4) (Table 1 and 2).

Table 1: Selecting ERP System through using AHP Method for electronic commerce companies

Systems	Options	Criteria	Goal
Applicable and corresponded with business	B_{11}	Technology criterion	Selecting ERP System through using AHP Method for electronic commerce companies
Reliability and validity of software	B_{12}		
Ease of maintenance	B_{13}		
Vendor credential	B_{21}	Sales criterion	
Industrial certificate	B_{22}		
Implementation approach	B_{23}		
Total amout of investment	B_{31}	Cost criterion	
Cost of implementation	B_{32}		
Maintenance and improvement cost	B_{33}		
Needed time for preparation and installation	B_{41}	Time criterion	
Updating	B_{42}		
System speed	B_{43}		

Table 2: Applying AHP Method for selecting ERP System in e-Business

Indices	Tchnology	Sales	Cost	Time
Technology	1	1	1/2	1/3
Sales	1	1	1/2	1/2
Cost	2	2	1	3
Time	3	2	1/3	1
Total	7	6	2.333	4.833

Table 3: The results of computations relative importance of technology index

Indices	Technology	Sales	Cost	Time	Relative importance of index
Technology	0.35290	0.04958	0.250	0.47360	0.28155304
Sales	0.35290	0.04958	0.250	0.31578	0.24207936
Cost	0.17460	0.02479	0.125	0.05263	0.09472380
Time	0.11764	0.02479	0.375	0.15780	0.16883000

Table 4: Compute the rate of unadaptability

N	1	2	3	4	5	6	7	8	9	10
IRI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.51

The number of pairwise comparisons for the indices will be 6: = the number of pairwise comparisons for the indices = $\binom{4}{2}$. After forming the matrix of pairwise comparisons for the indices we will normaliseits values. To this end, each value of the matrix will be divided by the sum of its coloumn, for example for the first coloumn:

$$0.47368421 \quad 0.25000000 \quad 0.04958678 \quad 0.35294118$$

It is better to compute the results to third decimal place. After normalisation for computing relative weight we will compute each mathematical mean index of each row. For example, for the first row we have:

$$0.47368421 + 0.25000000 + 0.04958678 +$$
$$0.35294118 = 0.281$$

This shows the relative importance of technology index. The results of computations are shown in Table 3. Now researcher should compute the rate of adaptation in ordre to make it clear whether adaptation among our pairwise comparisons exists or not. Here, we only compute rate of adaptation for pairwise comparisons of indices. In the 1st step, we will multiply the matrix of pairwise comparisons of indices by the vector of relative weights:

$$\begin{bmatrix} 1 & 1 & 2 & 3 \\ 1 & 1 & 2 & 2 \\ \frac{1}{2} & \frac{1}{2} & 1 & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{2} & 3 & 1 \end{bmatrix} \times \begin{bmatrix} 0.2815 \\ 0.2420 \\ 0.0947 \\ 0.1688 \end{bmatrix} = \begin{bmatrix} 1.219 \\ 1.0507 \\ 0.4128 \\ 0.6678 \end{bmatrix}$$

In the 2nd step, we will divide the result by the vector of relative weights of indices in order to achieve the adaptation vector of CV. In this case we have:

$$\begin{bmatrix} 0.2815 \\ 0.2420 \\ 0.0947 \\ 0.1688 \end{bmatrix} \div \begin{bmatrix} 1.219 \\ 1.0507 \\ 0.4128 \\ 0.6678 \end{bmatrix} = \begin{bmatrix} 4.331623 \\ 4.340510 \\ 4.358119 \\ 3.955939 \end{bmatrix}$$

In the 3rd step, we will get the mathematical average of this vector whch is called λ_{max}:

$$\lambda_{max} = 4.332 + 4.341 + 4.3582 + 3.956 = 0.101$$

In the 4rth step, we calculate unadaptability index as follows:

$$\prod = \frac{\lambda_{max} - 4}{4 - 1}$$

In the 5th step, we should compute the rate of unadaptability. The letter n is equivalent to 4 and shows the number of indices, so the value of IRI based on following image is equivalent to 0.9 (Table 4). Therefore, the rate of unadaptability is computed as follows:

$$\prod = \frac{\lambda_{max} - 4}{4 - 1} = 0.99$$

$$CR = \frac{\prod}{IRI} = \frac{0.99}{0.9} = 0.10001$$

Therefore, adaptation in pairwise comparisons is accepted. Finally, after identifying criteria and indices for selecting ERP System, it should be cleared that which factors from the perspective of related elite have a very great importance. In this research, this process was performed according to determined factors and criteria using AHP approach. Based on obtained results in Iran and especially in Parsian electronic commerce company, the criterion of technology has the heaviest weight and greatest importance, so has the top level of priority. Then in the second level the criterion of sales and in the third level criterion of cost were placed in the respectively. Among the options of technology criterion, items like usability, reliability and the ease of maintenace were selected. Among the options of sales criterion, items like vendor credential, industrial certificate and the approach of implementation were emphasized. Among the options of cost criterion, items like the amount of the capital of company, implementation cost and the improvement cost were emphasized. And finally in the last level the criterion
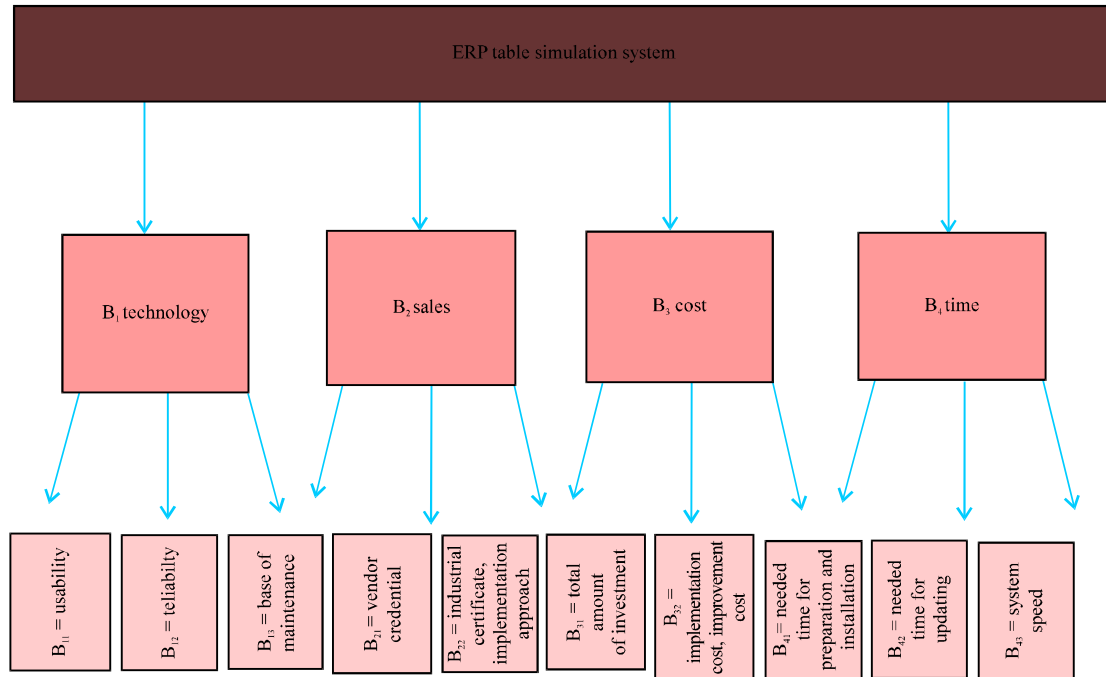
Fig. 1: The model of analysis has been according to the AHP Method

of time has been placed due to its minimum imprtance and weight. This critrion includes options like preparation and installation, updating and system speed. Ultimately, according to the AHP Method, the model of analysis has been shown in Fig. 1.

CONCLUSION

This study tried to select ERP System basd on AHP Method for e-Business companies. While reviewing the related literature on the process of electing ERP Systems based on AHP Method, some related studies were selected as the framework of the process of selecting criteria and prioritizing them. Indeed, reviewing related literature and mentioning some samples from studies in which the process of selecting ERP System has been performed based on AHP Method were peformed for determining the research framework and model. Accordingly, this study through studying related literature was able to identify a lot of criteria needed by managers of e-Business companies in a form of model and to test the model empirically for dtermining the most important criteria. The AHP Method prioritised four main criteria namely technology, sales, cost and time, respectively. Based on obtained results in Iran and especially in Parsian Electroinc Commerce Company due to the existence of some problems, the weight of technology criterion is cnsidered the heaviest. In contrast,

the researches background shows that in developed countries, the criterion of technology is not considered the most important one. For example in the research done by Ahn and Choi (2008), after performing AHP Method, 5 criteria of business capability and coverability, supportive sevices, total cost, technology and vendor credential were selected and finally an agreement oncriteria like business capability and coverability (C1), supportive services (C2) and technology (C3) was achieved (Ahn and Choi, 2008). In the research done by Alanbay criteria of user, vendor and technology have been prioritise drespectively (Alanbay, 2005). In both of these studies in contrast with the result of the present study, the criterion of technology has the least importance. Maybe the reason of this issue is that in the majority of previous studies, the high level of competition in business markets has led authorities to consider criteria like time and user superior to technology criterion.

REFERENCES

Ahn, B.S. and S.H. Choi, 2008. ERP system selection using a simulation-based AHP approach: A case of Korean homeshopping company. J. Operational Res. Soc., 59: 322-330.

Alanbay, O., 2005. Erp selection using expert choice software. ISAHP, Honolulu, Hawaii, July 8-10, 2005. http://www.isahp.org/2005Proceedings/Papers/AlanbayO_ERPSelection.pdf.

Boltena, A.S., J.M. Gomez and M. Rieken, 2011. Development of a Conceptual Model to Support ERP System Selection in Developing Countries. In: ENTERprise Information Systems, Cruz-Cunha, M.M., J. Varajao, P. Powell and R. Martinho (Eds.). Springer, New York, ISBN: 978-3-642-24358-5, pp: 190-197.

Cebeci, U., 2009. Fuzzy AHP-based decision support system for selecting ERP systems in textile industry by using balanced scorecard. Exp. Syst. Applic., 36: 8900-8909.

Farzaneh, M.K., 2014. Evaluation of use of ERP in E-commerce: Methods and strategies. Res. J. Applied Sci. Eng. Technol., 7: 4171-4174.

Liang, S.K. and C.T. Lien, 2006. Selecting the optimal ERP software by combining the ISO 9126 standard and fuzzy AHP approach. Contemporary Manage. Res., 3: 23-44.

Mital, M., A. Pani and R. Ramesh, 2014. Determinants of choice of semantic web based Software as a service: An integrative framework in the context of e-procurement and ERP. Comput. Ind., 65: 821-827.

Pacheco-Comer, A.A. and J.C. Gonzalez-Castolo, 2012. An empirical study in selecting enterprise resource planning systems: The relation between some of the variables involve on it. Size and investment. Procedia Technol., 3: 292-303.

Parthasarathy, S. and S. Sharma, 2014. Determining ERP customization choices using nominal group technique and analytical hierarchy process. Comput. Ind., 65: 1009-1017.

Sharma, H., D. Lavania and N. Gupta, 2011. ERP + E-BUSINESS = An emerging relationship. Int. J. Manag. Value Supply Chains, 2: 1-9.

Taheri, A. and M. Shamsfard, 2011. Mapping farsnet to suggested upper merged ontology. Proceedings of the 7th Asia Information Retrieval Societies Conference, December 18-20, 2011, Dubai, pp: 604-613.

Unal, C. and M.G. Guner, 2009. Selection of ERP suppliers using AHP tools in the clothing industry. Int. J. Clothing Sci. Technol., 21: 239-251.

Wei, C.C., C.F. Chien and M.J.J. Wang, 2005. An AHP-based approach to ERP system selection. Int. J. Prod. Econ., 96: 47-62.

Wu, C.H. and W.C. Fang, 2011. Combining the fuzzy analytic hierarchy process and the fuzzy delphi method for developing critical competences of electronic commerce professional managers. Quality Quantity, 45: 751-768.

Wu, W.W., 2011. Segmenting and mining the ERP users perceived benefits using the rough set approach. Exp. Syst. Applic., 38: 6940-6948.

Xu, L., 2012. The evaluation of ERP sandtable simulation based on AHP. Phys. Procedia, 33: 1924-1931.