Revista Publicando, 5 No 15. (2). 2018, 917-952. ISSN 1390-9304

A Q-analysis model to evaluate the factors and attributes of ERP success in the developing countries

Behnam Azizi[1*], Reza Ramazani Khorshid Doost[1]

1 Amirkabir University of Technology, Tehran, Iran, b.azizi@aut.ac.ir

Abstract

ERPs are indispensable for the production service centers and the improvement of manufacturing. Establishing ERPs is costly and their failure rate, specifically in the developing countries, is high. Many studies attempt to determine the KFSs for ERPs, and recently focus on evaluation models. However, fewer attentions paid to the attributes of KFSs. This paper reconsiders, using meta-analysis approach, the KSFs of ERPs in the developing countries, and applies it in a large-scale case. Then, an evaluation model is developed based on Q-analysis. Finally, some indices are introduced to determine the complexity of ERPs, and consider the relevant flexibility and sensitivity.

Keywords: Enterprise Resource Planning (EPR) Systems, Developing Countries, Connectivity Analysis (QA)

Received 17/04/2018
Approved 10/06/2018

Revista Publicando, 5 No 15. (2). 2018, 917-952. ISSN 1390-9304

1. Introduction

ERP system is a major and sensitive tools that helps organizations to enhance their functional abilities, improve their performance, develop their decision-making processes and gain competitive advantages. An ERP package helps organizations to gain competitive advantages by integrating all business keys through the development of all communication levels (Al-Mudimigh et al., 2001; Davenport, 2000). ERP system as a requirement for business process reengineering has been quickly demonstrated in the form of client-server facility (Buck-Emden, 2000).

The average cost of ERP implementation in an organization is nearly 15 million dollars. For large organizations this cost may exceed 500 million dollars (Baatz et al., 1999). Due to the high complexity, more than 10 percent of annual revenues of organization may be allocated for ERP implementation. To implement ERP, organizations may be incurred rework or time postponement costs, in addition to the cost of package (Beheshti, 2006). ERP packages are expensive and the costs for providing hardware infrastructures, updating the software codes in the legacy system, project management, executive consultants and recruitment of software specialists are also extremely high (Wenhongand Strong, 2004).

The high failure rate of ERP calls us to study and find the key factors of EPR success in organizations (Somers et al., 2000). Many EPR systems face resistance and finally failure (Aladwani, 2001). About 50 to 75 percent of U.S. companies experience some degrees of failure. A recent survey has shown that 65 percent of executive managers believe that ERP implementation may include a balanced possible damage to their organizations (Umble and Umble, 2000). Three-quarters of ERP projects face failure and many ERP projects come to a catastrophic end (Rasmy et al., 2005). Failure rates of all ERP implementations are estimated above 50 percent (Muscatello and Parente, 2006). Also 70 percent of ERP implementations fail to achieve the intended benefits.Since 2001, implementing ERP systems over the world have begun to increase. This growing trend is increases concerns about the success/failure of EPR implementation. It is therefore essential to pay attention the performance evaluation of such costly projects (Lea et al 2005). Until 2005, most analysis and reports on the EPR implementation belonged to the industrialized countries. The contribution of developing countries has been less, i.e., 10 to 15 percent (Huang and Palvia, 2001; Rajapakse and Seddon, 2005). However, it has been expected

Received 17/04/2018
Approved 10/06/2018

that the contribution of EPR implementation in developing countries increase considerably (Molla and Bhalla 2006). It also has been reported that many ERP implementations failed in the developing countries (Al-Mashiri and Zairi, 2000; Rajapakse and Seddon 2005). These reports have suggested that the implementation of ERP in developing countries – face with some specific problems, different from the ones in the industrialized countries (Xueet al., 2005; Kamhawi, 2007 and Soja, 2008). The success rate of ERP in developing countries in Asia is very low. It is therefore necessary to provide specific evaluation methods and models in this regard (Rajapakse and Seddon, 2009).

2. Literature Review

Davenport (1998) has pointed out the failure of ERP in organizations. He notes that ERP fails in many organizations and it is a significant issue, given high costs and the time spent for system implementation. He has also provided many examples of this failure and funding spent for EPR implementation. Stephen and Laughlin (1999) concluded that the factors of ERP success or failure should be identified given the high failure rate of ERP and organizations should pay attention to these factors. Buck-Emden (1999) outlined the ERP system of SAP Company. He believes that the failure rate of EPR implementation in organizations is high. Somers et al. (2000) studied the failure of ERP in U.S. organizations. They noted that the high failure rate indicates the complexity of ERP implementation in organizations.

Wang et al. (2001) also stated the existence of a high failure rate in implementing ERP in organizations and offered some recommendations for success. They advised organizations to gain adequate knowledge in the field of system identification prior to EPR implementation in organizations. According to the data collected from organizations implementing ERP in China, Xue et al. (2003) showed that the failure rate in Asia and developing countries is higher. Hong and Kim (2002) studied the main factors for the success and failure of ERP in organizations. They introduced the lack of organization readiness for the implementation of ERP and specific goals for the ERP as the main reasons for the failure of ERP.

Lea et al. (2005) proposed a scientific assessment procedure to address the applicability of the legacy system and the required infrastructures for ERP implementation. Then, organizations could evaluate their current situation. Albert et al. (2005) evaluated the success and failure factors for ERP implementation in organizations using a structural approach. Yhis approach provides small

Received 17/04/2018
Approved 10/06/2018

organizations with useful information on the successful implementation of the EPR system. Zhang et al. (2005) developed a structural framework based on McLean???Success model and considered the major factors to evaluate the success of ERP in China. Wang et al. (2006) studied the role of the country as the context, in which EPR is being implemented. They concluded that this factor affects other factors such as organizational readiness, benefits of the legacy system and project management. They emphasized that a country as a context for implementing an ERP system could be an independent factor. This factor also could be considered as a factor that affect other factors and be integrated with them. Al-Mashari and Ghani (2006) studied the main factors of ERP success and failure in developing countries. According to the cases cited in the literature, factors such as top management support, project management and readiness of the legacy system were extracted. Chang and Hwang (2008) presented an evaluation model based on neural network algorithm, on the main causes of ERP failure and success. Chen and Lin (2009) proposed an EPR evaluation model based on fuzzy equation systems and the relationships between EPR success factors and various parts of the business. Su and Yang (2010) offered an EPR evaluation model based on structural equations method to investigate the role of ERP in the logistic systems. They developed their model, given the structural relationship between EPR success factors and the logistical infrastructure of the organization be available (Viviana Ñañez Silva and Lucas Valdez, 2017). Their results indicated that the success of ERP systems interacts with the improvement of the logistics system. Wen-Hsien et al. (2011) presented a structural model for evaluating ERP based on the primary causes of failure and success. They constructed their model based on structural equations model and the relationships among the relevant factors. Hakim. And Hakim (2011) provided a structural approach to evaluate risks in ERP implementation in an organization. Their evaluation model addressed the readiness of the organization and the effective factors in reducing the risks including process reengineering, effective decision making and specific plans for ERP implementation. Azedine Boulmakoul and ZinebBesri (2013) used a Q-Analysis based structural approach to by giving an illustration to prove how to ensure synchronization between formal organizational structure and emergent one, due to perceived changes in business processes. They applied a theoretical foundation for understanding organizational structure ontology by means of structural analysis. Also it discusses and provides an overview of advanced business modeling environment and enterprise modeling.

Received 17/04/2018
Approved 10/06/2018

Revista Publicando, 5 No 15. (2). 2018, 917-952. ISSN 1390-9304

3- Method

In this study, a structural model is proposed to evaluate the success of ERP in organizations. The model is based on Q-Analysis which was developed by Atkin (1977). The output of this model is classified and ranked of factors affecting the success of the system in developing countries; also grouping the factors based on determining the priority and importance of the influence on success of the system. Then, the model is developed for the attributes of ERP success factors. The output of the model is to classify and prioritize the attributes of EPR success factors in developing countries as well as systematic indicators.

In this section, first, the Q-Analysis algorithm is described in brief then the method is implemented to evaluate the data provided in this study. The method introduces a set of indicators for evaluation of the ERP implementation process. Finally, for sensitivity an analysis, the model is run for various states to find out the stability of findings. The structure of the method is depicted in Figure 1.

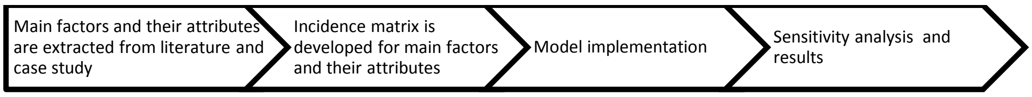

Figure.1.the structure of the method implementedin this study

3.1. Q-Analysis Method

Q-analysis, also known as “connectivity analysis” is based on the analysis of relations among system components and systematic look at issues. This method is a branch of the set theory which describes relationships between finite sets. By applying Q-analysis the behavioral complexity of a subject is reduced and its details are defined as specific sets. Based on the method, a given subject is assumed as a set of n-dimensional polygons, this method will describe the interactions among the polygons (Atkin, 1977). Authors have used the method in order to develop structural and analytical models since 70th to present. In 1983Lucien Dnckstein applied Q-Analysis to Evaluation of distribution systems in which the method used to simple way to compare designs, identify problem areas, and improve operation characteristics of a distribution system. In 1985 H. Hiessl et al used the method to develop a multi-criterion decision-making (MCDM) technique with possibly non-numerical criteria, called Multi-Criteria Q-Analysis I (MCQA-I). Later in 1997Duckstein and Nobe used Q-Analysis approach to solve a multi objective decision making problem in a hospital. They applied the method to develop a model in order to analyses of expert systems in medical image processing and analysis to illustrate the methodology. As explained in

Received 17/04/2018
Approved 10/06/2018

section 2, Q-Analysis was also used in 2013 by Azedine Boulmakoul and Zineb Besri in their paper which was aimed to presenting a structural business model. Some definitions, mainly from set theory, are needed to introduce Q-analysis that will be explained first.

Incidence matrix

This matrix represents the connections or relations among the elements of two sets Let set X has n elements x_1 to x_n and set Y has m elements y_1 to y_m. Also suppose λ_{ij} represents a significant connection between $x_i \in X$ and $y_j \in Y$, That is, for a binary incidence matrix A it holds

$$\lambda_{ij} = \begin{cases} 1 & x_I \text{ and } y_j \text{ are connected} \\ 0 & \text{Otherwise} \end{cases} \Rightarrow A = \begin{bmatrix} \lambda_{11} & \cdots & \lambda_{in} \\ \vdots & & \vdots \\ \lambda_{m1} & \cdots & \lambda_{mn} \end{bmatrix}$$

α–-cut

Q-analysis is constructed to process binary matrices. In general incidence matrices may not be binary and then λ_{ij} are to be converted to 0 and 1 by α-cut. For this purpose, any "λ_{ij}" that is greater or smaller than α is replaced with 1 or 0, respectively. A unique α can be allocated for each row or column or even for each element. As a result, the binary matrix indicates the connectivity among the elements of the sets due to the α-value. If the set Y includes at least one element so that a (P +1) subset of X be related to it, then (P +1) elements of the set X create a p-order simplex, shown by σ_p. For example, if the jth elements of the set Y are associated with the elements of a subset $\{x_1, x_2, \dots x_{P+1}\}$, then the simplex will be as follows:

$$Y_j = < x_1, x_2, \dots x_{P+1} > \text{or} Y_j = \sigma_p$$

Any subset of the above set forms a q-order simplex (with q +1 elements), where q<p. This set is shown by σ_q and called σ_q-simplex rule, where $\sigma_q \leqslant \sigma_p$. All Y_i's form a p-order simplex. This simplex has its own bases. The set of p-order complex and its bases is called complex and shown by K. Complex K is shown as K(X, λ) that its inverse is $K_x(Y, \lambda^{-1})$. The largest value of P in the simplex subsets of the complex K is called the dimension of K and shown as N = dim K. To obtain q, matrix A should be multiplied by its transpose and then the elements of the resulting matrix should be subtracted by one. Thus, q can be extracted from the values on the diagonal of matrix $(AA^T - 1)$. Some detailed theoretical discussions of Q-analysis and its extensions are presented in literature.

Received 17/04/2018
Approved 10/06/2018

3.2. Systemic Evaluation Indicators

Structure Vector: Structure vector consists of the elements of the complex K with the same q. If the desired elements with q-level are designated byQ_q, then the following vector represents the "structure vector":

$Q_N, Q_{N-1}, Q_{N-2}, \dots, Q_0$ N= dim (k), q= 0, 1,…,n. If we fail to create more than one structure vector (i.e., a unique structure vector exists), then set K has used all of its capacity to communicate (Atkin, 1974). Also, $Q_0 > 1$ means that there is at least one set without relation with other sets.

The Structure Vector Calculation Method

The matrix $(AA^{\mathrm{T}} - 1)$ should be obtained, then Q_p(for each q) is calculated as follows: The values greater than or equal to q on the diagonal are found. For each of these values, the corresponding row is considered. If a value greater than or equal to q is found on the row or rows, the corresponding column will be considered (if the value is not found, the element corresponding to that row will be the only element of a complex k with q-connectivity). Finally the set with the elements in this row and column has q-connectivity.

Obstruction Vector

"Obstruction vector" of the system is shown by Q' such that$\acute{Q} = Q - I$Where I is a unit vector

The high value of this vector indicates the lack of flexibility in the system. This vector is a good indicator for mathematical qualitative assessment of the data of the system (Atkin, 1974).

Upper and Lower Limits of q-Connectivity

In a complex K, if we consider the simplex r, two known values can be considered for q-connectivity.

a. The high $\hat{q}$-connectivity: this amount is equal to the dimension of simplex, therefore $\hat{q} = r$ is located on the diagonal of $AA^{\mathrm{T}} - 1$ for simplex r.

b. The low q̌-connectivity: low connectivity is equal to the largest amount of connectivity of a simplex with other simplices.

In an ideal system, these two values are equal. Also, the upper limit is greater than or equal to the lower limit.

Eccentricity

"Eccentricity index" indicates connections and their abnormality or normality levels. Eccentricity is calculated as follows: Ecc(Yj)=$\frac{\hat{q}-\check{q}}{q+1}$

Received 17/04/2018
Approved 10/06/2018

It is desirable that this amount to be less than or close to zero. It means that the desired simplex and the corresponding element of the original set have good uniformity and coordination with other elements.

Complexity

"Complexity" involves the accumulation of the connections among simplices within a complex. The degree of complexity for a complex is a calculated as follows: $\psi(k) = \frac{2[\sum_{i=0}^{N}(i+1)Q_i]}{(N+1)(N+2)}$, N=dim(k). Small $\psi(k)$ indicates higher utility of the complex K.

4. Model Implementation

According to literature and the case study of ERP implementation in IranKhodro Company, - the largest automotive plants in the nation with more than one million vehicles per annum- the main factors and their attributes have been determined. The attributes of those factors were extracted and the incidence matrices were formed as previously described. The incidence matrix was formed in two states according to expert opinion, literature and case study. First, for the main factors and then for their attributes, rows and columns were considered identical to obtain these matrices. In other words, the sets X and Y are the same. Therefore, the incidence matrices for the main factors and their attributes are square matrices of 10 × 10 and 50 × 50, respectively. After implementing the programmed model for this case and considering the weighted values of different cuts, the categorization and classification of the main factors and their attributes were obtained for each state. Weighted values were in the range of 0 to 10 where zero indicates no connectivity and 10 shows the strongest relation. The systemic indicators such as flexibility or complexity of the system and eccentricity of each of the factors and their attributes were obtained.

Received 17/04/2018
Approved 10/06/2018

4- Results

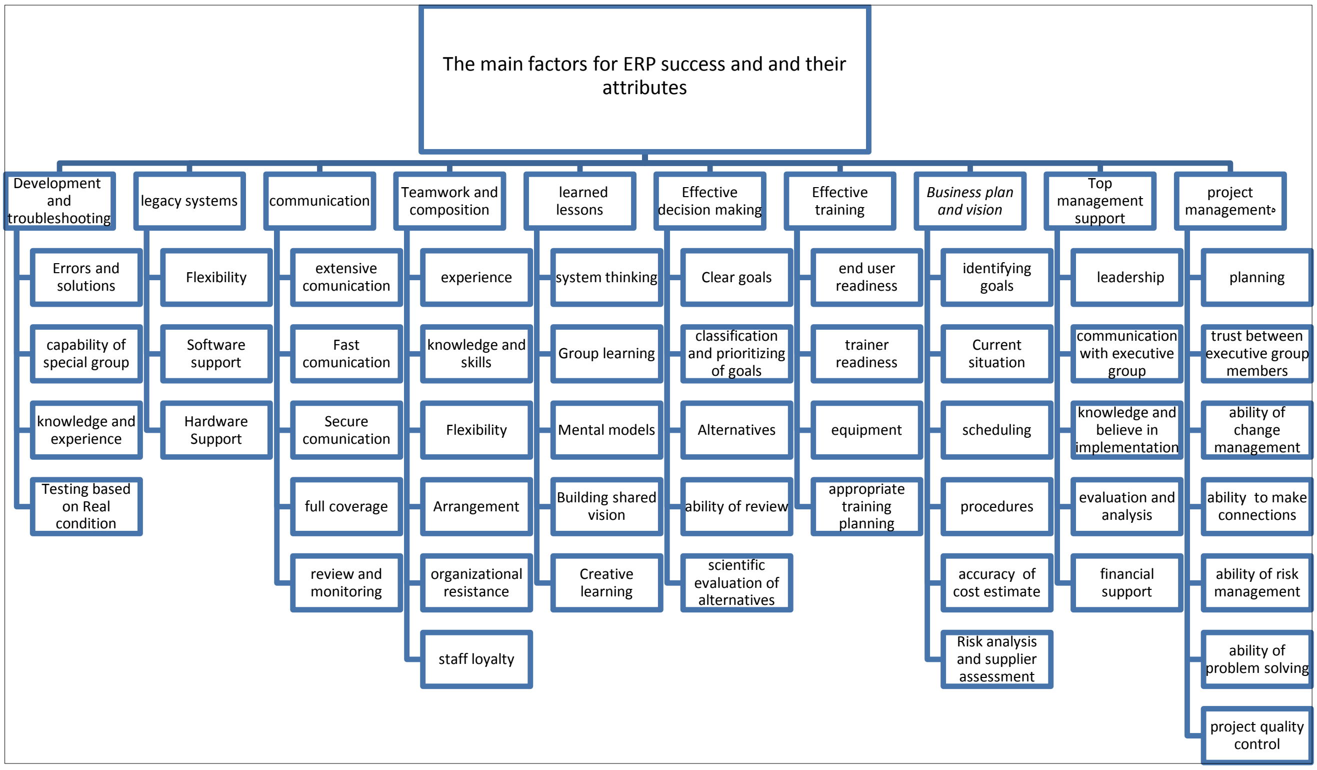

Figure 2: The main factors for ERP success and their attributes

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20	Y21	Y22	Y23	Y24	Y25	Y26	Y27	Y28	Y29	Y30	Y31	Y32	Y33	Y34	Y35	Y36	Y37	Y38	Y39	Y40	Y41	Y42	Y43	Y44	Y45	Y46	Y47	Y48	Y49	Y50
Y1	10	0	0	0	0	0	0	8	0	8	0	0	6	6	6	6	6	6	0	0	0	6	6	6	6	0	0	0	0	0	0	0	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y2		10	9	9	0	0	0	8	8	0	0	8	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	6	6	6	6	0	7	0	0	0	7	7	0	0	0	0	0	0	0	0	0	0	0	0
Y3			10	9	0	0	0	8	8	8	0	0	6	6	0	0	0	0	0	6	6	6	6	6	6	6	6	6	6	6	6	6	7	0	7	0	7	7	6	0	0	0	0	6	0	0	0	0	0	0
Y4				10	0	0	0	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	0	0	0	0	0	7	7	0	0	6	6	6	6	6	0	0	0	0	0	0	0

Received 17/04/2018
Approved 10/06/2018

10	0	9	0	0	0	8	0	6	6	0	0	6	6	0	0	0	0	6	6	6	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	5	0	0	0	5	Y5
	10	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	6	0	0	0	0	0	0	0	7	7	0	7	0	0	0	0	0	0	0	0	0	0	5	5	5	5	Y6
		10	8	0	0	8	8	6	6	6	0	0	6	0	0	0	0	6	6	0	0	0	0	0	0	0	0	0	0	0	7	0	0	6	6	6	6	6	6	5	5	5	5	5	5	Y7
			10	8	8	8	8	6	0	0	6	0	0	0	0	6	0	6	6	6	6	6	6	0	6	6	0	0	0	0	7	7	7	6	6	6	6	6	0	0	0	0	0	0	0	Y8
				10	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	6	0	6	6	6	0	0	7	7	7	7	6	6	6	6	6	0	0	0	0	5	5	0	Y9
					10	0	8	8	8	0	6	0	0	0	0	6	0	6	6	6	0	0	0	0	0	6	0	0	0	0	7	7	0	0	0	0	0	0	0	5	5	0	0	0	0	Y10
						10	8	6	6	0	0	0	6	0	0	0	0	6	6	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	5	0	5	0	Y11
							10	6	6	0	0	6	6	0	6	6	0	6	0	6	0	6	0	0	6	6	6	0	0	0	7	7	7	0	6	6	6	6	0	5	5	0	0	0	5	Y12
								10	0	6	0	0	0	0	0	0	6	6	6	6	0	0	6	0	6	6	0	0	0	0	0	6	6	0	0	0	0	0	0	0	0	0	0	0	0	Y13
									10	0	6	0	0	0	0	0	6	6	0	6	0	0	0	0	0	6	0	0	6	0	6	0	6	6	6	6	6	6	5	5	5	0	0	0	0	Y14
										10	6	0	0	0	0	0	6	6	6	6	0	6	0	0	0	0	0	0	6	6	0	0	0	0	0	0	0	0	5	0	0	0	0	0	5	Y15

Received 17/04/2018
Approved 10/06/2018

10	6 0 0 0 0 6 6 6 6 6 6 6 6 0 0 6 0 0 6 0 6 0 0 0 0 0 0 5 5 5 5 0 0 5	Y16
10	6 0 6 6 0 0 0 6 0 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 5 5 5 0 0 0 5	Y17
10	0 0 0 0 6 6 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 5 5 5 0 0 0 0	Y18
10	0 0 0 0 0 0 0 0 6 6 6 6 6 6 6 0 6 6 6 0 0 0 0 0 0 0 0 0 0 0 0	y19
10	0 0 0 0 0 0 0 0 6 0 0 6 0 0 0 0 6 0 0 0 0 0 0 0 0 0 0 0 0 0	Y20
10	0 0 0 0 0 0 0 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Y21
10	6 0 0 0 0 6 6 0 0 6 0 0 6 0 6 0 0 0 0 0 0 0 0 0 5 0 0 5	Y22
10	6 0 0 0 0 0 6 6 0 0 0 0 0 6 0 0 0 0 0 0 0 0 0 0 0 0 0	Y23
10	0 0 6 0 0 0 0 0 6 6 0 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Y24
10	6 6 0 0 0 0 0 6 6 0 6 0 0 0 0 0 0 0 0 0 0 5 0 0 0	Y25

Received 17/04/2018
Approved 10/06/2018

10	6	0	0	0	0	0	6	6	6	6	0	0	6	0	6	6	6	5	0	0	5	5	5	0	Y26
	10	0	0	0	0	0	6	6	6	6	0	0	6	0	6	6	6	5	0	0	5	5	5	0	Y27
		10	6	6	6	6	6	6	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	Y28
			10	0	0	6	6	6	0	0	0	0	6	0	0	0	0	5	0	0	0	0	0	0	Y29
				10	6	6	6	0	0	0	6	6	0	0	0	0	0	5	0	0	0	0	0	0	Y30
					10	0	6	0	0	0	6	6	0	0	0	0	0	0	0	0	0	0	0	0	Y31
						10	6	6	6	0	0	6	0	0	0	0	0	5	0	0	5	0	0	5	Y32
							10	7	0	0	0	7	0	0	0	0	0	0	0	0	5	5	5	5	Y33
								10	0	7	0	0	0	0	0	0	0	0	0	0	5	5	5	5	Y34
									10	7	7	0	6	6	6	0	0	5	0	0	0	5	5	0	Y35

Received 17/04/2018
Approved 10/06/2018

10	7	0	0	0	0	0	0	0	0	0	0	5	5	0	Y36
	10	7	0	0	0	0	0	5	5	5	0	0	0	5	Y37
		10	0	0	0	0	0	0	0	0	0	0	0	0	Y38
			10	0	0	6	0	0	5	5	0	5	0	5	Y39
				10	0	0	0	0	5	5	0	5	0	5	Y40
					10	0	0	0	5	5	0	5	0	5	Y41
						10	6	0	5	5	0	5	0	5	Y42
							10	0	5	5	0	5	0	0	Y43
								10	0	0	0	0	0	5	Y44
									10	0	0	5	0	5	Y45

Received 17/04/2018
Approved 10/06/2018

10	0	5	0	5	Y46
	10	5	5	5	Y47
		10	0	5	Y48
			10	5	Y49
				10	Y50

Figure 3. Incidence matrix for attributes:

Received 17/04/2018
Approved 10/06/2018

q=28 leadership

q=27 Top management financial support

q=26 ability of change management in project management

q=24 project quality control

q=23 scientific evaluation of alternatives in decision making

q=22 Software test in real condition, identifying procedures in business plan

q=20 Top management and executive group relationship, implementation group members' experiences, coordination in executive group against organizational resistant

q=19 Identifying current situation in business plan, clear goals in decision making, identifying alternatives for decision making

q=18 identifying goals in business plan, capability of espicial group in software test

q=17 classification and perioritizing of goals in decision making, abillity of review in decision making, creative lesson learning, flexibility legacy system, appropriate arrangement of executive group, Trainer's knowledge and Skills

q=16 hardware support of legacy system, System thinking in lesson learning, flexibility of executive group, software support of legacy system, Top management knowledge and believe in implementation,

q=15 extensive communication, mental models for lesson learning

q=14 ability of planning in project management, risk analysis in project management, appropriat training plan, group learning, Building shared vision, full coverage in comunication, identifying errors and solution in software test,

q=13 Appropriate Scheduling in business plan, Effective communication in project management, making trust between executive group members in project management, accuracy in estimate the costs in business plan, monitoring and review for effective communication, secure communication, top management involvement in analysis and evaluation

q=12 risk analysis and suplier assessment, staff loyalty

q=11 ability of problem solving in project management, end user rediness for training, fast communication, analysors'knowledge and experience in implementation test

q=9 training equipment, trainer rediness

Figure4. Classification of connectivity levels for the attributes of the main factors for α=5

Systemic Indicators

The systemic indicators were extracted by the implementation of the model for different states of the main factors and their attributes. For example, for α = 5, the complexity of the system is equal to ψ(k) = 8.07816. The following chart shows the eccentricity of attributes.

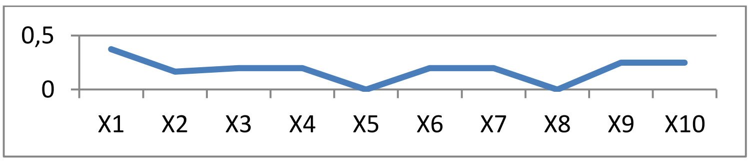

Figure5. Eccentricity of attributes for the main factors of success or failure of ERP in developing countries for α = 5

4.2. Sensitivity Analysis

Received 17/04/2018
Approved 10/06/2018

The results show that factors such as project management, top management support and the business plan and vision are at top communication ranks and their impacts on other factors is greater. Furthermore, the effective decision making and effective communication have the lowest eccentricity. The maximum eccentricity is related to project management. Attributes such as top management leadership, financial support for the project, change management in project management and the scientific evaluation of the decision-making options are at top communication ranks. The revisionability of the decision and employees loyalty have the lowest level of eccentricity. The highest eccentricity is related to project quality control. The overall complexity of the system is high in all cases where the system is stable. This shows that the evaluation of EPR implementation has a high complexity. The implementation of the model for α=1-5 gives the same results. This indicates that the system is stable to moderate communication levels. However, the results for α ≥ 7 lose their stability.

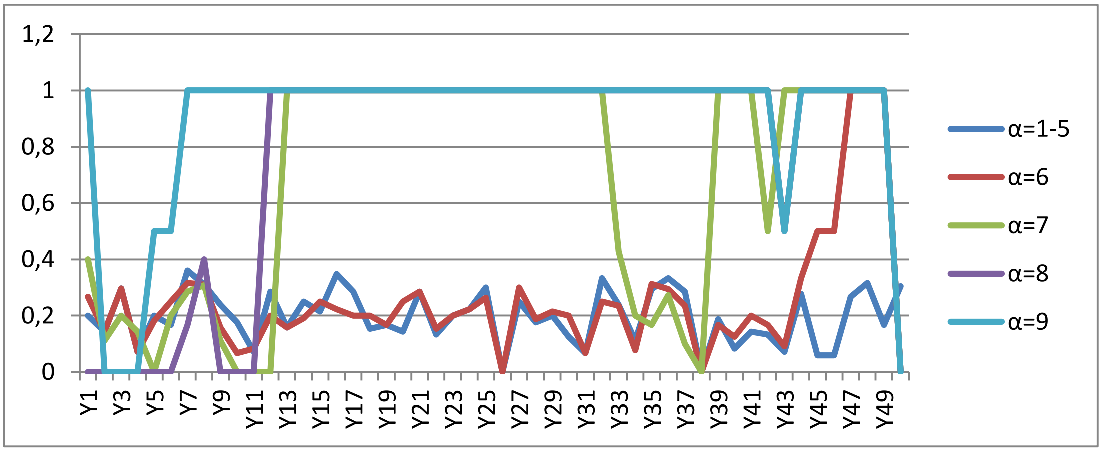

Figure6. The eccentricity of the attributes of main factors for different values of α

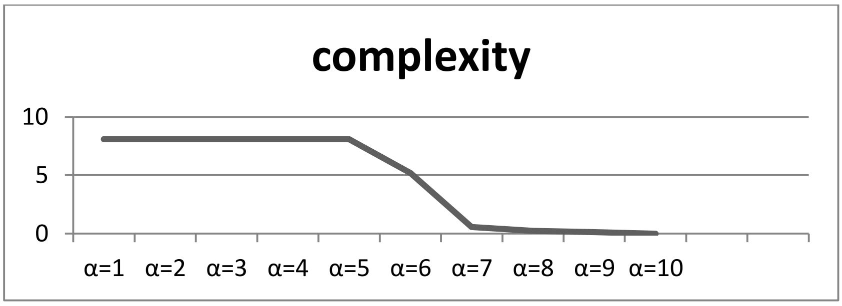

Figure7. The complexity of the system for different values of α:

Received 17/04/2018
Approved 10/06/2018

Revista Publicando, 5 No 15. (2). 2018, 917-952. ISSN 1390-9304

5. Conclusions and Suggestions for Future Studies

In this study, a structural evaluation model was proposed to assess the success or failure of ERP in developing countries. The model was established based on the EPR success factors and their attributes in developing countries. The results showed that ERP success factors can be classified. They can be prioritized according to the attributes and their relationships. The same can be done for attributes of these factors. The findings of the present study showed that the evaluation of the ERP in developing countries is an issue with high flexibility in low communication levels, but the low flexibility in high communication levels. Furthermore, EPR evaluation has high complexity at all stable communication levels. This is one of the main reasons for the difficulty of evaluating ERP. Moreover, according to the outputs, organizations can achieve better results in successful implementation of EPR by focusing on the items with higher priority. The outputs of the model presented in this study can help organizations before, during and after ERP implementation.

The results of this study include systematic evaluation indicators which are proper tools to study the implementation of the ERP from the perspective of systemic experts as well as system providers. Indicators such as complexity, difficulty and flexibility and eccentricity of the system could be useful tools for better system presentation, given the attributes and success factors of the systems as the elements of the system. Paying attention to these indicators can lead providers to a way to improve the indicators. The present model has been provided based on the major effective factors and their attributes in organizations. Obviously, all these factors have an impact on organizational performance indicators. Therefore, the preparation of incidence matrix with zero and one for the case where performance indicators are taken into account as set Y is meaningless, because all elements of the matrix must be filled with 1. It is therefore necessary to weight data, and then the appropriate cuts must be used to convert data into zero and one. Since the present model describes the success factors and their attributes by structural evaluation, it can also be used on other systems similar to ERP. Obviously, in that case it is necessary to extract the attributes and factors relating to that system by a scientific study. In addition a study to measure and evaluates the effects of attributes on organizational success indexes directly, and also a study to evaluate each attribute effect on other factors in addition to its direct correlated factor would be considerable advancements of the model.

Received 17/04/2018
Approved 10/06/2018

6. References:

1. Ala'a Hawari and Richard Heeks. (2010). Explaining ERP failure in a developing country: a Jordanian case study. Journal of Enterprise Information Management, 22(1), 135-160.
2. Aladwani, A.(2000).Change management strategies for successful ERP implementation. Business Process Management Journal, 7(3), 266-275.
3. Alfred Simms. (1984). Reducing the construction time for building projects.International Journal of Project Management, 2(4), 225-231.
4. Al-Mashiri. M. and Zairi. M. (2003). Information and business process equality: the case of SAP R/S implementation. Electronic Journal of Information Systems in Developing Countries, 2(4), 18-29.
5. Al-Mudimigh, A., Zairi, M. and Al-Mashari, M. (2001). ERP software implementation: an integrative framework, European Journal of Information Systems, 10(4), 216-226.
6. Amin Hakim and, Hamid Hakim. (2010). A practical model on controlling the ERP implementation risks. Journal of Information Systems,35(2), 204-214.
7. Ann Mooney, Michael Mahoney, and Barbara Wixom. (2008).Achieving Top Management Support in Strategic Technology Initiatives.Current Issues in Technology Management, 12(2). Available at:https://www.stevens.edu/howe/sites/default/files/MooneyMahoneyWixom_0.pdf
8. Armin Franke.(1987). Risk analysis in project management.International Journal of Project Management, 5(1), 29-34.
9. Atkin.R.H. (1972).From cohomology in physics to q-connectivity in social science. International Journal of Man-Machines Studies, 4(1) ,341-362.
10. Atkin.R.H. (1974).Mathematical Structure in Human Affairs. Heinemann Educational. the University of Wisconsin – Madison. ISBN:0435820257, 9780435820251, 31-179.
11. Atkin.R.H. (1977). Combinatorial connectives in social system, Brikhauserverlag. Basel and Stuttgart.
12. AzedineBoulmakoul and ZinebBesri. (2013). Structural Analysis Foundations for Enterprise Organizational Re-engineering. International Journal of Computer Applications, 74(13), 38-44.

Received 17/04/2018
Approved 10/06/2018

13. Baatz.E, Koch C and Slater. D. (1999). The ABCs of ERP, CIO Magazine, available at: www.cio.com/research/erp/edit/122299_erp.html
14. Barki, H. and Pinsonneault, A. (2002). Explaining ERP Implementation Effort and Benefits with Organizational Integration. Cahiers du GreSI. Issue 2, Part 1, ISSN 0832-7203.
15. Beeharry. A and Schneider.G.M. (2005). Creating a campus network culture in a newly developing economy. Information Technology for Development, 7(1), 3-16.
16. Bih-Ru,Mahesh C. Guptab, Wen-Bin Yuc. (2005). A prototype multi-agent ERP system: an integrated architecture and a conceptual framework. Technovation 25(4), 433–441.
17. Bingi. P and Sharma,.M.K and Godla, Critical issues affecting an ERP implementation, Information Systems Management, V.16, N.3, 1999, PP. 7-14
18. Bocij, P., Greasley, A., Hickie, S. (2008).Business Information Systems: Technology, Development and Management for the e-business (4th ed.). London: Financial Times and Prentice Hall
19. Boon. J.A. (2005). Information and development. Information Society, 8(4), 227-241.
20. Davenport, T. H. (1998). Putting the enterprise in the enterprise system. Harvard Business Review, 40(1),121-131.
21. Davenport, T.H.(2000). Mission Critical: Realizing the Promise of Enterprise Systems. Harvard Business School Press, ISBN-10: 0875849067, ISBN-13: 978-0875849065.
22. DeLone. W. and McLean. E. (2005). Information systems success: the quest for the dependent variable. Information Systems Research, 3(1), 60-95.
23. ETG Wang and G Klein, JJ Jiang. (2006).ERP misfit: country of origin and organizational factors.Journal of Management Information Systems,23(1), 263-292.
24. Eva Bolfíková, Daniela Hrehová and, Jana Frenová, Manage''s. (2010). decision-making in organizations–- empirical analysis of bureaucratic vs. learning approach. Journal of Economics and Business, 28(1) 135-163.
25. H. Hiessl and I. Duckstein and E.J. Plate, Multiobjective. (1985). Q-analysis with concordance and discordance concepts. Applied Mathematics and Computation, 17(2),107-122.
26. Hans Mikkelsen. (1990).Quality of project work and project management.International Journal of Project Management,8(3),138-143.

Received 17/04/2018
Approved 10/06/2018

27. Heeks, R.B. (2010). Design—Reality Gap Analysis. eGov4Dev, IDPM, University of Manchester, UK. Availableat: http://www.egov4dev.org/success/techniques/idfailure_drg.shtml
28. Holland.B. Light. (1999). A critical success factors model for ERP implementation.IEEE Computer Society, 16(3), 30-36.
29. Hong, K.K. and Kim, Y. G. (2002) The critical success factors for ERP implementation: an organizational fit perspective. Information and Management, 40(1), 25–40.
30. Hooshang M. Beheshti. (2006). What managers should know about ERP/ERP II. Management Research News, 29(4), 184 – 193.
31. I-Chiu Chang and Hsin-Ginn Hwang. (2008). A neural network evaluation model for ERP performance from SCM perspective to enhance enterprise competitive advantage. Expert Systems with Applications, 35(4), 1809-1816.
32. Jan Bröchner and Ulrika Badenfelt. (2011). Changes and change management in construction and IT projects. Automation in Construction, 20(7), 676-775.
33. JayanthaRajapakse and Peter B Seddon. (2009) ERP Adoption in Developing Countries in Asia : A Cultural Misfit. Presented at the 2[8t]h Information Systems Seminar in Scandinavia, 6-9 August, Kirstiansand, Norway, available at: http://www.hia.no/iris28/Docs/IRIS2028-1028.pdf
34. John Wanna. (2007) Improving implementation: 936rganizationall change and project management, ANU E Press, ISBN: 9781921313011, ISBN13: 9781921313028, section 2, Chapter 4.
35. Kamhawi, E.M. (2000). Enterprise resource-planning systems adoption in Bahrain: motives, benefits, and barriers. Journal of Enterprise Information Management, 21(3), 310-334.
36. Kamhawi, E.M. (2007). Critical success factors for implementation success of ERP systems: an empirical investigation from Bahrain. International Journal of Enterprise Information Systems, 3(2), 34-49.
37. Kyung-Kwon Hong and Young-Gul Kim. (2002). The critical success factors for ERP implementation: an organizational fit perspective. Information and Management, 40(1), 25-40.

Received 17/04/2018
Approved 10/06/2018

38. Lucien Dnckstein. (1983). Evaluation of the Performance of a Distribution System by Q-Analysis, APPLIED MATHEMATICS AND COMPUTATION, 13(1), 173-185.
39. Lucien Duckstein, Steven A. Nobe. (1997). Q-analysis for modeling and decision making, European Journal of Operational Research. 103(3), 411-425.
40. M. Al-Mashari and SK Ghani. (2006). A study of the Critical Success Factors of ERP implementation in developing countries. International Journal of Internet and Enterprise Management, 4(1), 68-95.
41. Molla. A. and Bhalla. A. (2002). Business transformation through ERP: a case study of an Asian company. Journal of Information Technology Case and Application Research, 8(1), 34-54.
42. Monahan. G, Management Decision Making. (2000). Cambridge University Press. ISBN: 0521781183, 33-40.
43. Muscatello, J.R. and Parente, D.H. (2001). Enterprise resource planning (ERP): a postimplementation cross-case analysis. Information Resources Management Journal, 19(3), 61-80.
44. Nah. F. H and, Islam. Z and Tan. M. (2007). Empirical assessment of factors influencing success of enterprise resource planning implementations. Journal of Database Management, 18(4), 26-50.
45. Nelson. R. R. and P. H. Cheney. (1987). Training End Users: An Exploratory Study. Datamation, 15(1), 121-122.
46. Paul Hawking. (2007). Implementing ERP Systems Globally : Challenges and Lessons Learned for Asian Countries. Journal of Business, 2(1), 21-32.
47. Ping Chen and David Partington. (2006). Three conceptual levels of construction project management work. International Journal of Project Management, 24(5), 412-421.
48. PiotrSoja. (2004). Difficulties in enterprise system implementation in emerging economies. Information Technology and Development, 14(1), 31-51.
49. R. Kouki, R. Pellerin, D. Poulin. (2008). An Exploratory Study of ERP Assimilation in Developing Countries: The Case of Three Tunisian Companies, International Conference of Software Engineering. ICSEA 08, 523-529.
50. Rajapakse. J and Seddon. P. (2010). Why ERP May Not Be Suitable For Organizations In

Received 17/04/2018
Approved 10/06/2018

Developing Countries In Asia. Working paper no.121. Department of Information Systems, University of Melbourn e. Available at: http://www.pacis-net.org/file/2005/121.pdf

51. Rasmy.M.Tharwat and Ashraf.S. (2010). Enterprise resource planning (ERP) implementation in the Egyptian organizational context. paper presented at the European Mediterranean Conference on Information Systems, Cairo. Available at: http://www.iseing.org/emcis/EMCIS2005/pdfs/21.pdf (accessed 14 May).
52. Ravi Kalakota, Andrew B. Whinston. (1997). Electronic Commerce – A Manager's Guide(book), Pearson, ISBN-10: 0201880679, ISBN-13: 978-0201880670.
53. Rockwell. W. P. (1968). MIS: A View from the Top. Duns Review, 92(4), 20-22.
54. Rüdiger Buck-Emden. (1999). The SAP R/3 System: An Introduction to ERP and Business Software Technology. BookZombie (Vallejo, CA, U.S.A.). ISBN: 0201596172, ISBN 13: 9780201596175.
55. Shang and Seddon. (1996). A comprehensive framework for classifying the benefits of ERP Systems. Paper presented at the 2000 Americas Conference on Information Systems, Long Beach, CA.
56. Shin-Guang Chen and Yi-Kuei Lin. (2009). On performance evaluation of ERP systems with fuzzy mathematics. Expert Systems with Applications, 36(3), 6362-6367.
57. Skok. W. and Döringer. H. (2001). Potential impact of cultural differences on enterprise resource planning (ERP) projects. Electronic Journal of Information Systems in Developing Countries, 7(5), 1-8.
58. Somers, T. M., Nelson, K., and Ragowsky, (2000). A. Enterprise Resource Planning (ERP)for e next millennium: Development of an ntegrative framework and implications for research, Proceedings of the Americas Conference on Information Systems, Long Beach, CA, 998–1004.
59. Stephen P. Laughlin. S. (1999). An ERP Game Plan. Journal of Business Strategy, 20(1), 32-37.
60. Sumner. M. (2000). Risk factors in enterprise-wide/ERP projects. Journal of Information Technology, 15(1), 317-327.
61. Themistocleous. m and andIrani. Z. Benchmarking the benefits and barriers of application. International Journal of Benchmarking, 8(4), 317-319.

Received 17/04/2018
Approved 10/06/2018

62. Umble. E and Umble. M. (2000) Avoiding ERP implementation failure. Industrial Management, 44(1), 25-34.
63. Viviana Ñañez Silva, M & Lucas Valdez, G.R (2017). Nivel de redacción de textos académicos de estudiantes ingresantes a la universidad . Opción, Año 33, No. 84 (2017): 791-817
64. Wang, E.T.G., Lin, C.C.-L., Jiang, J.J. and Klein, G. (2001). Improving enterprise resource planning (ERP) fit to organizational process through knowledge transfer. International Journal of Information Management, 27(3), 200-212.
65. WenhongLuo and Diane M Strong. (2004). A Framework for Evaluating ERP Implementation Choices. IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT, 51(3), 323-333.
66. Xue, Y., Liang, H., Boulton, W.R. and Snyder, C.A. (2003). ERP implementation failures in China: case studies with implications for ERP vendors. International Journal of Production Economics, 97(3), 279-295.
67. Yen, H.R., Sheu, C. (2004). Aligning ERP implementation with competitive priorities of manufacturing firms: an exploratory study. International Journal of Production Economics 92(3), 207–220.
68. Yi-fen Su and Chyan Yang. (2010). A structural equation model for analyzing the impact of ERP on SCM. Expert Systems with Applications, 37(1), 456-649.
69. Yuzhu Li, Ming-Hsien Yang, Gary Klein and Houn-Gee Chen. (2011). the role of team problem solving competency in information system development projects. International Journal of Project Management, 29(7), 911-922.
70. Z. Huang and P. Palvia. (2002). ERP implementation issues in advanced and developing countries. Business Process Management Journal, 7(3), 276-284.
71. Zhe Zhang and Matthew K.O. Lee. (2005). A framework of ERP systems implementation success in China: An empirical study. International Journal of Production Economics, 98(1), 56-80.

Received 17/04/2018
Approved 10/06/2018

Appendix 1

Key factors and their attributes in literature:

The major factors of the success or failure of ERP in organizations in developing countries in literature				
Factor	Frequency	References	Frequency (%)	Agreement with the results of case study
Project Management	14	Z. Huang & P. Palvia(2002) Molla. A. & Bhalla(2002) M. Al-Mashari and SK Ghani(2007) Rajapakse. J & Seddon(2010) Rajapakse, J. & Seddon, P(2009) Xue. Y et al(2003) Beeharry. A and Schneider(2005) Kamhawi, E.M(2000) Aladwani(2000) Rasmy.M.Tharwat and Ashraf.S(2010) Paul Hawking(2007) Skok, W. & Döringer(2001) Ala'a Hawari and Richard Heeks(2010)	87.5	✓

Received 17/04/2018
Approved 10/06/2018

		R. Kouki, R. Pellerin(2008) Kyung-Kwon Hong and Young-Gul Kim(2002)		
Top management support	12	ETG Wang and G Klein(2006) Aladwani(2000) R. Kouki, R. Pellerin(2008) M. Al-Mashari and SK Ghani(2007) Beeharry. A and Schneider(2005) Rasmy.M.Tharwat and Ashraf.S(2010) Xue. Y et al(2003) Rajapakse. J & Seddon(2010) Ala'a Hawari and Richard Heeks(2010) Kamhawi, E.M(2000) Skok, W. & Döringer(2001) Ala'a Hawari and Richard Heeks(2010)	75	✓
Organizational Calture	4	ETG Wang and G Klein(2006) Xue. Y et al(2003) Molla. A. & Bhalla(2002)	25	✓

Received 17/04/2018
Approved 10/06/2018

		Skok, W. & Döringer(2001)		
communication	10	Rasmy.M.Tharwat and Ashraf.S(2010) M. Al-Mashari and SK Ghani(2007) Molla. A. & Bhalla(2002) Kamhawi, E.M(2000) Rajapakse, J. & Seddon, P(2009) R. Kouki, R. Pellerin(2008) Beeharry. A and Schneider(2005) Kyung-Kwon Hong and Young-Gul Kim(2002) Xue. Y et al(2003) Paul Hawking(2007)	62.5	✓
Legacy Systems	9	Z. Huang & P. Palvia(2002) M. Al-Mashari and SK Ghani(2007) Beeharry. A and Schneider(2005) Rajapakse, J. & Seddon, P(2009) Paul Hawking(2007) Skok, W. & Döringer(2001)	56.25	✓

Received 17/04/2018
Approved 10/06/2018

		Beeharry. A and Schneider(2005) Kamhawi, E.M(2000) Kyung-Kwon Hong and Young-Gul Kim(2002)		
Development and troubleshooting	8	ETG Wang and G Klein(2006) Beeharry. A and Schneider(2005) M. Al-Mashari and SK Ghani(2007) Skok, W. & Döringer(2001) ETG Wang and G Klein(2006) Kamhawi, E.M(2000) Kyung-Kwon Hong and Young-Gul Kim(2002) Ala'a Hawari and Richard Heeks(2010)	50	✓
Effective Training	10	M. Al-Mashari and SK Ghani(2007) R. Kouki, R. Pellerin(2008) Ala'a Hawari and Richard Heeks(2010) Rajapakse. J & Seddon(2010)	62.5	✓

Received 17/04/2018
Approved 10/06/2018

		Beeharry. A and Schneider(2005) Xue. Y et al(2003) Kamhawi, E.M(2000) Kyung-Kwon Hong and Young-Gul Kim(2002) Paul Hawking(2007) ETG Wang and G Klein(2006)		
Organizational resistant	5	Aladwani(2000) R. Kouki, R. Pellerin(2008) Xue. Y et al(2003) Ala'a Hawari and Richard Heeks(2010) Rasmy.M.Tharwat and Ashraf.S(2010)	31.25	✓
Effective Decision Making	9	Xue. Y et al(2003) ETG Wang and G Klein(2006) M. Al-Mashari and SK Ghani(2007) R. Kouki, R. Pellerin(2008) Rajapakse. J & Seddon(2010) Rasmy.M.Tharwat and Ashraf.S(2010) Kamhawi, E.M(2000)	56.25	✓

Received 17/04/2018
Approved 10/06/2018

		Ala'a Hawari and Richard Heeks(2010) Kyung-Kwon Hong and Young-Gul Kim(2002)		
Teamwork and composition	11	Rasmy.M.Tharwat and Ashraf.S(2010) Molla. A. & Bhalla(2002) M. Al-Mashari and SK Ghani(2007) Z. Huang & P. Palvia(2002) R. Kouki, R. Pellerin(2008) Ala'a Hawari and Richard Heeks(2010) Xue. Y et al(2003) Kamhawi, E.M(2000) Kyung-Kwon Hong and Young-Gul Kim(2002) Ala'a Hawari and Richard Heeks(2010) Paul Hawking(2007)	68.75	✓
learned lessons	9	Paul Hawking(2007) M. Al-Mashari and SK Ghani(2007) ETG Wang and G Klein(2006) Aladwani(2000) Z. Huang & P. Palvia(2002)	56.25	✓

Received 17/04/2018
Approved 10/06/2018

Revista Publicando, 5 No 15. (2). 2018, 917-952. ISSN 1390-9304

		Kamhawi, E.M(2000) Kyung-Kwon Hong and Young-Gul Kim(2002) Ala'a Hawari and Richard Heeks(2010) R. Kouki, R. Pellerin(2008)		
Business plan and vision	9	M. Al-Mashari and SK Ghani(2007) Rasmy.M.Tharwat and Ashraf.S(2010) Paul Hawking(2007) Z. Huang & P. Palvia(2002) Xue. Y et al(2003) R. Kouki, R. Pellerin(2008) Ala'a Hawari and Richard Heeks(2010) Kyung-Kwon Hong and Young-Gul Kim(2002) ETG Wang and G Klein(2006)	56.25	✓
Change Management	4	Rajapakse, J. & Seddon, P(2009) Molla. A. & Bhalla(2002) Z. Huang & P. Palvia(2002) Kyung-Kwon Hong and Young-Gul Kim(2002)	25	✓

Received 17/04/2018
Approved 10/06/2018

Independent Cultural Factor	4	Z. Huang & P. Palvia(2002) Rajapakse, J. & Seddon, P(2009) Molla. A. & Bhalla(2002) Xue. Y et al(2003)	25	

Attributes of the major factors of the success or failure of ERP in organizations in developing countries in literature			
Attribute	Main factor	Reference	Agreement with case study
Plan ability	Project management	Ping Chen and David Partington 2006, Al’'aHawariand Richard Heeks 2010	✓
Making confidence between project members		Alfred Simms 1984,	✓
Change management	Project management	J. Bröchner and U. Badenfel 2011	✓
Effective communication	Project management	P.Chen 2006 D. Pington and	✓
Risk analysis	Project management	Armin Franke 1984	✓

Received 17/04/2018
Approved 10/06/2018

Problem solving	Project management	Yuzhu Li et al 2011	
Project quality control	Project management	Hans Mikkelsen 1990	
leadership	Top management support	Rockwell 1968	✓
Believe in project utility and being familiar with its attributes	Top management support	Ann Mooney et al 2008	✓
Top management communication with executives	Top management support	Ann Mooney et al 2008	✓
Financial support	Top management support	Holland 1999	✓
Analysis and evaluation	Top management support	Dinter 1971	✓
End user readiness	Effective training	Nelson and Cheney 1987	✓
Instructor readiness	Effective training	Nelson and Cheney 1987	✓
Training course quality	Effective training	Nelson and Cheney 1987	
Befit of educational equipment	Effective training	Nelson and Cheney 1987	✓
	Effective training	Senge 1990	✓

Received 17/04/2018
Approved 10/06/2018

Revista Publicando, 5 No 15. (2). 2018, 917-952. ISSN 1390-9304

Relying on systemic thinking			
Creative learning	Effective training	Senge 1990	
Organizing mental models	Effective training	Senge 1990	✓
Developing a common vision	Effective training	Senge 1990	✓
Group learning	Effective training	Senge 1990	
Definite objectives	Effective decision-making	Monahan, G 2000, Al''aHawariand Richard Heeks 2010	✓
Classification and prioritization of objectives	Effective decision-making	Monahan, G 2000	✓
Definite decision options	Effective decision-making	Monahan, G 2000	✓
Scientific evaluation of decision options	Effective decision-making	Monahan, G 2000	
Revisionability of decision-making	Effective decision-making	Monahan, G 2000, Majed Al-Mashari et al 2006	
		Umbleet al 2003	✓

Received 17/04/2018
Approved 10/06/2018

Adequate experience of executives	ERP teamwork and composition		
Adequate knowledge and skill of executives	ERP teamwork and composition	Sumner 2000, Umbleet al 2003	✓
Flexibility of executives	ERP teamwork and composition	Umbleet al 2003	
Proper configuration of executives	ERP teamwork and composition	Umbleet al 2003	✓
Organizational resistance	ERP teamwork and composition	Laughlin 1999	✓
Employees loyalty	ERP teamwork and composition	Bingi et al 1999	
Definite objectives	Business plan and vision	Umbleet al 2003, Al''aHawariand Richard Heeks 2010	✓
Comparison of current situation of the organization	Business plan and vision	Al-Mashari et al 2003	✓
Proper scheduling	Business plan and vision	Davenport1998	
Definite processes and implementation method	Business plan and vision	Davenport1998	✓
Proper cost evaluation	Business plan and vision	Schwalbe 2000	✓
Risk analysis and system provider evaluation	Business plan and vision	Amin Hakim.A and Hakim.H 2010	✓

Received 17/04/2018
Approved 10/06/2018

Reliable communication ways	Effective communication	Nah et al 2007, Al''aHawariand Richard Heeks 2010	✓
Fast communication ways	Effective communication	Nah et al 2007, Al''aHawariand Richard Heeks 2010	
Comprehensive communication	Effective communication	Nah et al 2007	
Covering all activities and changes	Effective communication	Nah et al 2007	✓
System monitoring and revision	Effective communication	Nah et al 2007, Al''aHawariand Richard Heeks 2010	✓
Providing software needs	Befit of legacy systems	Bennett 2000; almashari et al 2003; Beeharry.A and Schneider 2005	✓
Adequate software equipment	Befit of legacy systems	Bennett 2000; almashari et al 2003; Beeharry.A and Schneider 2005	✓
Adequate flexibility	Befit of legacy systems	Bennett 2000; almashari et al 2003; Beeharry.A and Schneider 2005	✓
Testing based on real conditions	Software development, testing and troubleshooting	Al-Mashari et al 2006	

Received 17/04/2018
Approved 10/06/2018

Introducing errors and solutions	Software development, testing and troubleshooting	Al-Mashari et al 2006	✓
Effectiveness of special group	Software development, testing and troubleshooting	Al-Mashari et al 2006	
Adequate knowledge and experience of expert analyzers	Software development, testing and troubleshooting	Al-Mashari et al 2006	✓

Appendix2:

Programmed Model in C++

```
#include <iostream>
#include <map>
#include <vector>
#include <set>
#include <algorithm>
#include <queue>
using namespace std;
```


Received 17/04/2018
Approved 10/06/2018