

ERP Implementation Success in Iran: Examining the Role of System Environment Factors

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Abstract—The aim of this paper is to examine factors related to system environment (namely, system quality and vendor support) that influences ERP implementation success in Iranian companies. Implementation success is identified using user satisfaction and organizational impact perspective. The study adopts the survey questionnaire approach to collect empirical data. The questionnaire was distributed to ERP users and a total of 384 responses were used for analysis. The results illustrated that both system quality and vendor support have significant effect on ERP implementation success. This implies that companies must ensure they source for the best available system and a vendor that is dependable, reliable and trustworthy.

Keywords—Enterprise resource planning (ERP), Iran, System quality, Vendor support.

I. INTRODUCTION

ENTERPRISE resource planning (ERP) is a commodity, a product in the form of computer software and a key element of an infrastructure that delivers a solution to business [1]. ERP is not only an information technology (IT) solution, but also a strategic business solution. As an IT solution, ERP system, if implemented fully across an entire enterprise, connects various components of the enterprise through a logical transmission and sharing of data. When customers and suppliers request information that have been fully integrated throughout the value chain or when executives require integrated strategies and tactics in areas such as manufacturing, inventory, procurement and accounting, ERP systems collect the data for analysis and transform the data into useful information that companies can use to support business decision-making. They allow companies to focus on core and truly value-added activities. These activities cover up accounting and financial management, human resources management, manufacturing and logistics, sales and marketing, and customer relationship management.

As a strategic business solution, it will greatly improve integration across functional departments, emphasize on core business processes, and enhance overall competitiveness. In implementing an ERP solution, an organization can quickly

upgrade its business processes to industry standards, taking advantage of the many years of business systems reengineering and integration experience of the major ERP vendors [2]. ERP systems are important tools to help organizations change business and gain sustained competitive advantages via their opponents.

Consequently, ERP systems differ from other information systems (IS) in many ways, such as scale, scope, complexity, organizational changes, project costs, and need for business process re-engineering [1]. ERP implementation includes technological, operational, managerial, strategic, and organizational related components [3]. ERP implementation should be viewed as organizational transformation, not as a large IT project with a need to devote significant resources and energy to change management [4]. Implementing ERP system is a complex and time consuming project. Since ERP systems are meant to integrate all business processes it will cause major changes in the organization. Al-Mudimigh [5] stated ERP implementation is a process that involves macro-implementation at the strategic level, and micro-implementation at the operational level.

Considering the amount of time, effort and budget involved in implementing ERP, organizations implementing it would want to ensure the implementation is a success. However, it was revealed that ERP projects were on average, 178% over budget, took 2.5 times as long as projected and delivered only 30% of promised benefits [6]. Thus, there is a need to be understood why it is not successful and to provide suggestions to ensure its success. This has been emphasized by many researchers [6]-[7]-[8]-[9]. Subsequently, this research is undertaken to examine critical factors related to ERP system environment that affect the ERP implementation success in the context of Iran.

This study is significant because international ERP vendors are aggressively marketing their products to developing countries [10]. In addition, according to Sawah [8], many developing countries are now implementing ERP systems; nevertheless there has not been much research on the success or failure factors of ERP projects in these regions/countries. It has been said that additional effort should be directed to ERP projects in developing regions/countries as they represent a vast potential ERP market [7]. Despite the introduction of ERP systems since last decade, there is no similar study in Iran in this domain. Consequently, the findings of this study not only can be valuable for Iranian

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organizations intending to implement ERP systems and also international ERP vendor companies that plan to extend their market to Iran, but also it will be supportive for potential ERP adopters and vendors in the Middle-East and North Africa region and other developing countries. ERP adopting companies could gain an understanding of the complexities inherent in ERP systems to overcome obstacles and ERP system vendors would be able to rethink their products and possibly aid them to increase their market shares in a different market of Iran.

In the following sections, the related literature is reviewed. Then, research framework and hypotheses are presented followed by the research methodology chosen to conduct the study. Next, data collection and analysis are described and findings are discussed. Finally, conclusions and implications for future research are highlighted.

II. IRANIAN ERP MARKET

An analysis of the Iranian ERP market indicated that there are two different types of ERP vendors in Iran. One, international ERP vendors who act as agents. They are Epicore Software Corporation, IFS Applications, Logo Business Solutions, Mincom, Netsis Software, Oracle, SAGE, SAP, and 3i Infotech. Two, local Iranian IS companies. These companies developed their own ERP software. At the point of this research, there were more than 10 Iranian IS companies who claimed that their ERP systems in operates in the local language i.e. Persian. However, care should be taken when discussing ERP system developed by Iranian IS companies as it may not fulfill the criteria of an ERP system. In general, Iranian developed ERP systems are designed based on the current status of organizations and not based on best practices in the industry or improved processes. Moreover, a majority of the ERP systems do not support operations and production management processes in manufacturing companies. In addition, most of the Iranian ERP systems merely support the inter-organizational processes and not intra-organizational interactions with customers and suppliers. The ERP systems also do not contain modules such as customer relationship management and supply chain management. Furthermore, they have a number of limitations like inability to support the multi-languages and multi- currencies which are critical for the multinational and international companies in Iran.

At the point when this research was carried out, there were no existing single source of information that one can refer, to identify Iranian organizations that have implemented or are in the process of implementing an ERP system. Since there was no particular source, various sources was used to compile a listing. The websites of top international ERP vendors companies and top local IS vendors companies, as well as Iranian governmental and non-governmental organizations in charge of IT were searched. In addition, the Annual Reports of public listed companies published by Tehran Stock Exchange was also examined. A list was then compiled and follow ups to the companies were made for verification

purpose. Finally a list of 31 organizations that were categorized as ERP User Company was identified.

III. CRITICAL SUCCESS FACTORS OF ERP IMPLEMENTATION

A key research question in examining the deployment of ERP systems is centered on determining the critical success factors (CSFs) that lie behind successful implementation. As to ERP implementation, CSFs can be understood as the few key areas where 'things must go right' for the implementation to be successful. Loh [11] found that the discovery and management of critical elements and their respective constituents at each phase of the ERP implementation project leads to a successful implementation. The literature varies regarding what factors are required for implementation success or responsible for failure [6].

CSF for ERP systems have been studied from a number of different perspectives. Holland [12] focused on strategic factors that span over the whole project and tactical factors that can be applied to particular parts of the project while Esteves-Sousa [13] concluded that the CSFs model should have four perspectives: strategic, tactical, organizational and technical. On the other hand, Al-Mashari [14] presented a categorization of 12 factors which were divided into three dimensions related to the stages of ERP project while Dezdard [15] identified 17 factors which is subsequently divided into two main categories, i.e. "ERP adopting organization environment" and "ERP system environment". This research focuses on two factors relating to ERP system environment, namely, ERP system quality and ERP vendor support.

A. ERP System Quality

DeLone [16] considered system quality to exist at the technical level, where accuracy and efficiency of the system producing information were paramount. These were object-based attitudes and reflected users' perceptions. To be useful to organizations, ERP systems must provide data and information that is accurate, consistent, dependent, and sufficient to meet users' needs. In addition, the ERP system should be easy to use for users and could exchange data with other systems servicing diverse functional departments [2]-[17]-[18]-[19]. Without this interface between users and ERP systems, frustration and resistance to the systems by the users can become a constant problem which consequently affects the ERP implementation failure. These qualities can be confirmed through ERP software selection and through ERP implementation, including system configuration [20]. Consequently, the following hypothesis was developed.

H1: ERP system quality is positively related with ERP user satisfaction.

B. ERP Vendor Support

ERP systems require continual investment in new modules and upgrades to add functionality, achieve better fits between business and system, and realize their strategic value.

Consequently, vendor support, in the form of extended technical assistance, emergency maintenance, updates, and special user training, is an important factor with ERP packaged software during the implementation stages. The need for vendor's support in ERP implementation is stronger than in another IS project because ERP implementation project requires a wide range of skills and technical implementation knowledge [21]. It is not often that the ERP implementing organization possesses all knowledge about the system. Therefore it is vital that the ERP vendor support the implementing organization during and after the implementation. Zhang [6] classified three dimensions of vendor support as service response time of the software vendor; qualified consultants with knowledge ability in both enterprises' business processes and information technology including vendors' ERP systems; and participation of vendor in ERP implementation. Accordingly, following hypothesis was defined:

H2: ERP vendor support is positively related with ERP user satisfaction.

IV. ERP IMPLEMENTATION SUCCESS

ERP implementation success can also be viewed from many perspectives, however the more common ones are based on two variables namely, user satisfaction and organizational impact [6]-[18]-[22]. As a surrogate measure of IS success in computing environments, user satisfaction measures the success of an information system. DeLone [23] identified three reasons why user satisfaction has been widely used as a measure of IS success: high degree of face validity, development of reliable tools for measure, and conceptual weakness and unavailability of other measures. An IS that meets the needs of the users reinforces their satisfaction with the system. User satisfaction is the sum of one's feelings and attitudes toward a variety factors related to the delivery of information products and services [16]. User satisfaction refers to the extent to which users perceive that the IS available to them meets their requirements [24]. A system without user satisfaction is less likely to be used and to produce beneficial results to a user community and the organization [19].

ERP organizational impact refers to the realization of business goals and improved enterprise operating capabilities as a result of the ERP implementation. Implementing an ERP system help organizations with improved management decision making, improved customer service and retention, and standardized data formats [21]. Al-Mashari [14] stated that the overall goal of ERP is essentially to improve business performance through supporting the integration of various business processes across the different functional areas and beyond organizational boundaries. Moreover, implementing an ERP system can lead to improvement in business performance, by reducing costs, improving decision performance, improving process efficiency, and being more responsive to customer requirements [24]. According to Fan

[25], ERP systems integrate a firm's value system in handling its inventory, logistics, orders, billing, shipping, sales, customer service, and many other aspects. Standardizing and integrating these activities shall deliver positive impact on employees and organization in increasing efficiency and effectiveness. Thus, next hypothesis was defined:

H3: ERP user satisfaction is positively related with organizational impact of ERP system.

V. RESEARCH METHODOLOGY

Based on the aim of this study and the review of the literature discussed in the earlier section, the following research framework was developed (Fig. 1).

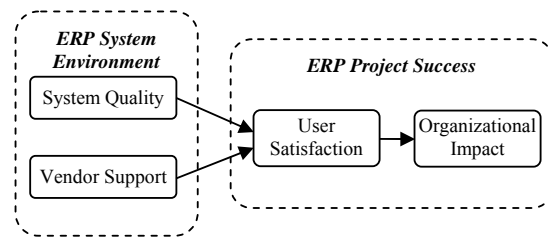


Fig. 1 ERP implementation success model

The target population of this research is Iranian ERP user companies. An ERP user company was defined as one that has installed at least three basic modules of the ERP system. In addition, the companies must have installed the systems for not more than 3 years to ensure that the personnel would not have difficulties in recalling the past implementation process.

A survey questionnaire was utilized to collect data for this study. Items used in the operationalization of the constructs were adapted from prior researches [2]-[17]-[18]-[19]-[20]. All items were measured using a seven-point Likert-type scale with anchors ranging from 'strongly disagree' to 'strongly agree'. The questionnaire was translated to Persian language using the back-to-back technique to ensure the meanings are the same as the original. The questionnaire consisted of four sections. In section one, there was an introduction that revealed the identity of the researcher and expressed the rationale of the survey. It guaranteed the secrecy of the information presented by respondents and a note, thanking the participant for taking time to respond to the survey. In section two, a range of demographic data such as age, gender, level of education, ERP usage period and frequency was required. In section three, questions were provided to tap the elements of the constructs.

To ensure the reliability of the questionnaire, a pilot study was conducted. The questionnaire was distributed to 54 operational managers and 37 completed questionnaires were collected. The data were tested using the SPSS software 16.0. It was found that all the variables' cronbach alpha values were above 0.7 hence the questionnaire was considered to be reliable as suggested by Hair [26].

In data collection phase, all the ERP user companies were contacted and were required to identify a person to liaise with the researcher. The liaison person then was required to distribute the questionnaires to all their operational/functional/unit managers who use ERP systems. Operational/functional/unit managers were chosen as respondents because they are among the most knowledgeable informants regarding ERP implementation projects in organizations as suggested by Bradford [27]. After constant reminder, 411 completed questionnaires were collected. The questionnaires were reviewed and 27 questionnaires were omitted as they were incomplete. Therefore, only 384 questionnaires were used for analysis.

VI. DATA ANALYSIS

The first part of analysis involves the use of descriptive statistics showing the frequencies and percentages of the demographic variables. The second part of the analysis examines the effect of CSFs on ERP implementation success, using structural equation modeling (SEM). The SEM analysis was carried out in accordance with a two-step methodology proposed by Hair [26]. According to this procedure, after the model has been modified to create the best measurement model, the structural equation model can be analyzed.

A. Sample Characteristics

Table I illustrates there were more males than females and more than two-thirds of the respondents were between 31-50 years old. In addition, more than three-fourths of the respondents hold university degree and have been working for more than 6 years in their respective companies. The Table also illustrates that a majority of the respondents are involved fully or partially in the ERP implementation project. These statistics show that the respondents are experienced and highly educated. They also know the company's business processes and ERP implementation projects as well. Thus, they are the best people to answer the survey.

B. Measurement Model

Convergent validity was assessed (Table II) using three measures: factor loading, composite construct reliability and average variance extracted [15]. First of all, the entire factor loadings of the items in the measurement model were greater than 0.70 and each item loaded significantly on its underlying construct. Second, the composite construct reliabilities were within the commonly accepted range greater than 0.70. Finally, the average variances extracted were all above the recommended level of 0.50. Therefore, all constructs had adequate convergent validity as recommended by Hair [26].

To confirm discriminant validity, the average variance shared between the construct and its indicators should be larger than the variance shared between the construct and other constructs.

TABLE I
CHARACTERISTICS OF THE RESPONDENTS

Measure	Categories	Frequency	Percent	Cumulative (%)
Gender	Male	328	85.4	85.4
	Female	56	14.6	100
Age	Below 30 years old	43	11.2	11.2
	31-40 years old	111	28.9	40.1
	41-50 years old	150	39.1	79.2
	Over 50 years old	80	20.8	100
Education	Undergraduate	88	22.9	22.9
	Graduate	184	47.9	70.8
	Postgraduate (MS)	97	25.3	96.1
	Postgraduate (PhD)	15	3.9	100
Employment with this company	Less than 3 years	36	9.4	9.4
	3-5 years	61	15.9	25.3
	6-10 years	112	29.2	54.4
	More than 10 years	175	45.6	100
Involvement in ERP project	Fully involved	139	36.2	36.2
	Partially involved	190	49.5	85.7
	Not involved	55	14.3	100

TABLE II
CONVERGENT VALIDITY TEST

Construct	Items	Factor Loading	Composite Reliability	Average Variance Extracted (AVE)
System Quality	SYQ1	0.816	0.943	0.736
	SYQ2	0.876		
	SYQ3	0.868		
	SYQ4	0.883		
	SYQ5	0.884		
	SYQ6	0.817		
Vendor Support	VES1	0.863	0.944	0.738
	VES2	0.842		
	VES3	0.860		
	VES4	0.855		
	VES5	0.868		
	VES6	0.867		
User Satisfaction	UST1	0.872	0.938	0.718
	UST2	0.828		
	UST3	0.839		
	UST4	0.823		
	UST5	0.865		
	UST6	0.855		
Organizational Impact	ORI1	0.863	0.948	0.751
	ORI2	0.883		
	ORI3	0.882		
	ORI4	0.857		
	ORI5	0.857		
	ORI6	0.857		

The outcomes of convergent validity test (Table III) indicate that constructs share more variances with their indicators than with other constructs.

TABLE III
DISCRIMINANT VALIDITY TEST

Construct	SYQ	VES	UST	ORI
System Quality (SYQ)	0.858			
Vendor Support (VES)	0.477	.860		
User Satisfaction (UST)	0.707	0.696	0.847	
Organizational Impact (ORI)	0.591	0.503	0.611	0.867

Note: Leading diagonals represent the square root of the average variance extracted between the constructs and their measures, while off diagonal entries are correlations among constructs.

C. Structural Model

The second stage of the SEM process involves testing the structural model prior to testing the hypotheses. The proposed structural model was examined using AMOS 16.0 software. The maximum likelihood method was employed to estimate all parameters and fit indices. SEM fit indices measure the extent to which the covariance matrix derived from the hypothesized model is different from the covariance matrix derived from the sample. Based on the results of the SEM fit indices, the proposed model provided a good fit. The normed χ^2 was 2.736, which is within the recommended level of 3.0. The RMSEA was 0.067 which is below the recommended cut off of 0.08. The CFI was 0.953 that is greater than threshold of 0.90. Overall, the hypothesized structural model provided an acceptable fit for the data. In addition, the SEM path results, standardized path coefficients and t-values of all relationships hypothesized in the model are shown in Fig. 2.

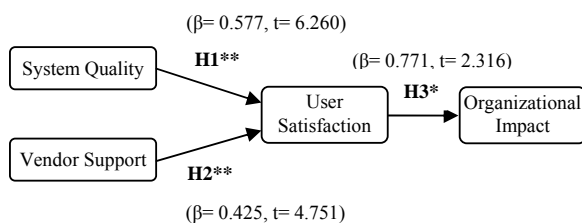


Fig. 2 Path Analysis Results

In Hypothesis (1), it was posited that ERP system quality would have a significant effect on ERP user satisfaction. The results of SEM analysis support this hypothesis ($\beta=0.577, p<0.001$). Hypothesis (2) proposed that the ERP vendor support will positively influence the ERP user satisfaction. The coefficient for this path is positive and significant ($\beta=0.425, p<0.001$) which supports hypothesis H2. Finally, hypothesis (3) recommended that ERP user satisfaction will positively influence ERP implementation success. The coefficient for this path is also significant ($\beta=0.771, p=0.021$) which support hypothesis H3.

VII. DISCUSSION

The findings of this study affirm that the ERP user satisfaction tends to be rated highly when a high-quality ERP system is implemented. This result is consistent with results of prior studies [25]-[12]-[28]-[5]. From an information systems perspective, the results of the study point to specific system features that ERP vendors can leverage to improve the likelihood of ERP user satisfaction and consequently ERP implementation success. These findings suggest that it is necessary for ERP implementation managers and also ERP vendors to spend time and effort to make sure that user are satisfied with system reliability, functionality, and flexibility and user friendliness. Selecting the poor quality ERP package

could result in an unwilling commitment to applications that do not fit the organization's strategic goals and users' needs. Moreover, it causes the organization to add modifications to their system which are difficult to manage and strongly discouraged by ERP vendors. ERP adopting firms must evaluate and select an ERP package carefully. Companies must have a detailed requirements specification before selecting ERP software. An organization must choose an appropriate vendor that able to provide a flexible ERP system. Another important principle for selecting an ERP system is the best fit, or compatibility with current business procedures. It is also important for the company to select those ERP systems that are easy to customize so that the cost and time consumed in the customization can be minimized.

This study also supported that there is a positive relationship between ERP vendor support and ERP user satisfaction and subsequently ERP organizational Impact. This result is consistent with findings of previous researches [17]-[25]-[22]. ERP implementing companies needs comprehensive vendor support because ERP implementation is an extremely complex project and it remains difficult for an adopting company to initiate such an endeavor without the benefit of external knowledge. ERP adoption is often a lifelong commitment for organizations. New modules and versions of ERP systems must continually be installed or updated to improve the fit between business and system. Vendor support activities should include user training, technical assistance, emergency maintenance, updates, service responsiveness and reliability. In addition, ERP vendors should be carefully selected since they play a crucial part in shaping the ultimate outcome of the ERP implementation projects. Factors that should be taken into account when choosing a provider should include the implementation support services they offer and the competence of their installers and trainers. It is important for the vendor's staffs to be knowledgeable in both business processes and ERP system functions.

VIII. CONCLUSIONS

This study resulted in important theoretical contributions. First, this study has contributed to academic research by producing the empirical evidence to support the theories of CSFs and ERP implementation success. This research confirmed that ERP system quality and ERP vendor are positively related with successful ERP implementation. Second, these findings are also important if the context of this research is taken into consideration. This research is probably the first to study ERP implementation projects in Iran from ERP system environment perspective. This research will thus add to the growing body of knowledge on ERP implementations in developing countries. Third, this study developed a research model which could be applied into other Asian, Muslim and developing countries to test its applicability or for those interested in cross cultural issues of ERP implementation success. Lastly, from a comprehensive

review of the literature, Finney [28] identified a major gap in the literature, which is the lack of research to examine ERP critical success factors and ERP implementation success from the perspectives of key stakeholders. Our study is one of the few that examine success of ERP implementation from the perspectives of key stakeholders (operational/unit/functional managers).

This research also found significant managerial implications. First, this study cautions about ERP and vendor selection. Before ERP adoption, thorough misfit analysis and resolution plan based on ERP knowledge will help organizations to select the best ERP system. Thus, when a firm is going to select an ERP package, it should pay special attention to whether its requirements in these areas can be satisfied or whether the package can be easily customized if needed. Second, the outcomes of this study are also useful to ERP vendors and consultants to prepare specific system features to improve the likelihood of ERP user satisfaction and consequently ERP implementation success in developing countries. Lastly, experiences revealed can be useful to other developing countries with similar environments, in the Middle-East, North Africa, Muslim and developing countries.

Although the findings of the current study contribute to a better understanding of the successful implementation of ERP systems, the types of ERP packages used by the participating firms were not controlled due to limited number of target companies. The study's sample comprised mixed ERP software, including top-brand names (e.g., SAP, Oracle, Sage, etc.). It is likely that the heterogeneous nature of the ERP systems used for the study might be problematic.

There are numerous paths for future research and extensions of this study. More studies can be conducted in developing countries in Middle-East, North Africa and other Moslem countries. At present, only a few studies can be found on the subject; thus, researchers have an opportunity to further explore the CSFs for these countries. Moreover, this study focused on those CSFs that relate with ERP system environment. Potential researchers could examine other group of CSFs relating to organization of ERP system and ERP project environment itself. Lastly, the target group of this survey was operational/functional/unit managers in ERP user companies. Future researchers could send out questionnaires to different groups of people involved in ERP implementation such as ERP project team members, consultants, chief information officers, and users.

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