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THE INFLUENCE OF KEY USERS' SKILLS ON ERP SUCCESS

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ABSTRACT

Enterprise resources planning systems are considered a powerful means of acquiring competitive advantage in the organizations. However, the implementing of these systems suffers from high failure rates, which has resulted in a stream of research about the predictors of ERP success. This study also mainly aims to fulfill this issue by investigating the effect of skills of the key users of ERP system on the success of ERP implementation. Although prior research has speculated about the importance of skills and competency of project team members, there is limited knowledge of what skills make individuals effective team members in ERP implementation projects. This study is the first to provide empirical support for skills in predicting ERP success through two models: one for measuring key users' skills, including technical, human and conceptual skills, and the other for measuring the amount of ERP success. Then by means of a field study and data collection from 6 Iranian Organizations, the relation between key users' skills and the ERP implementation success is investigated. The results demonstrate that the greatest impacts on ERP success result from technical and human skills, in that order. Moreover, the most important skill items for the key users are team skills, organizing, change management, decision making and problem solving skills, risk management, business processes knowledge, strategic planning, communication skills, analytical skills, leadership skills, personal skills, crisis management, and system skills. Finally, via conducting interviews, some qualitative data about the importance of these introduced skills for key users are provided.

Keywords: knowledge, skills, and abilities (KSA), technical skills, human skills, conceptual skills, key users, Enterprise Resource Planning, implementation success, information technology professionals

INTRODUCTION

Enterprise resource planning (ERP) systems are widely implemented as the backbone of many manufacturing and service firms [54], with the goal of obtaining benefits in the form of improved communications and increased efficiency through the standardization of information technology (IT) across functional business areas [7]. ERP systems are designed to achieve integration and streamlining of internal processes [33] by providing a suite of software modules that cover all the functional areas of a business [79]. Although the implementation of ERP systems provides many advantages for the compa-

nies involved [34], the implementation of such systems is not always successful [45], and many companies are not able to use these systems properly. Due to this high rate of failure in ERP system implementation ([9], [16]), in recent years, numerous studies have been conducted on the topic of factors that affect ERP implementation, which has resulted in the identification of critical success factors (CSFs) and failure factors. However, most of this literature has only focused on identifying these critical elements, and there are few studies which have deeply investigated the impact of these factors on success of ERP implementation quantitatively. Since project team competence has been consistently identified as a critical requirement for the enhancement of outcomes in ERP implementation projects ([3], [19], [36], [56], [61], [70], [71], [73], [78], [79]), this study focuses attention on implementation skills as an important part of the competency of key users, who play a role in ERP implementation team. In addition, studying the skills is critical for addressing other issues such as training of system implementers that is a significant issue in successfully accomplishing ERP implementation.

Much research on the topic of ERP implementation has identified lack of, insufficient, or ineffective training as a key barrier to success ([7], [34]). In order to provide a suitable training program, however, it is important to understand the skills and knowledge that are necessary for people involved in these projects. Previous research has focused mostly on the technical aspects of ERP and very little the types of skills that are necessary to implement ERP. Since this emphasis on technical issues of IS has been mentioned in other studies [1], it is of both practical and theoretical interest to know whether technical skills alone are sufficient in ERP implementation projects, or should human and conceptual skills also be considered as important components of ERP implementation teams. Therefore, the motivation of this research is to investigate the skills and competencies of implementation teams which affect the success of ERP implementation projects.

Therefore, the main objective of this research is to provide insights about which ERP implementation skills affect ERP project success. Specifically, this research seeks to develop a conceptual framework that articulates the relationship between technical, human, and conceptual skills of key users and successful system implementation. A field study methodology is adopted to survey the skills of key users, and the effects of implementation skills on ERP implementation success. The survey determines the relative priorities and importance of technical, human, and conceptual skills for key users. Interviews are also conducted to enrich the findings of the quantitative survey of skills for key users in ERP implementation projects. Accordingly, our research questions are:

RQ1: Do technical skills of key users affect ERP project success?

RQ2: Do human skills of key users affect ERP project success?

RQ3: Do conceptual skills of key users affect ERP project success?

LITERATURE REVIEW

Team Competency in ERP Implementation Projects

More than ever, organizations are using teams to increase organizational efficiency and effectiveness [68]. However, effective project teams require effective team members, and therefore it is important to have clear definitions of competency, skill, team, and team members. A popular definition of competence is that it consists of knowledge, skills and abilities possessed by individuals [27]. It is important to note that many researchers use the terms competencies and skills interchangeably [42]. However, some others consider distinctions between them. A skill is a combination of ability, knowledge and experience that enable a person to do something well [11].

A team is a small group of people with complementary skills who are equally committed to a common purpose, goals, and working approach for which they hold themselves mutually accountable [31]. Team members are people who have complementary technical, problem solving, and interpersonal skills, are committed to a meaningful purpose and specific, understandable performance goals, maintain a high degree of mutual accountability, and can achieve high levels of performance [31]. High-performance teams are those that meet all the conditions of teams, and have members who are also deeply committed to each other's personal growth and success [49]. High-performance teams significantly outperform average teams [49]. High-performance teams have interchangeable and complementary skills, a deeper sense of purpose, more ambitious performance goals, more complete approaches to problem solving, and fuller mutual accountability than most teams [31]. Successful teams have critical skills in order to understand and communicate team goals, roles, and norms to other members clearly.

The success of any project is critically affected by the choice of the right team members, who have proper knowledge and skills. Specifically, an ERP project requires a cross-functional and multi-skilled implementation team, both because of the integrative nature of ERP systems, and its complicated implementation. ERP system design assumes the existence of "a balanced multi-

functional team" drawing skills and knowledge from a variety of areas, including competencies for both implementation and use of the system [65].

During recent years, research has identified project team competencies and team composition as critical factors for successful implementation of ERP systems ([3], [19], [36], [56], [61], [70], [71], [73], [78], [79]). Likewise, poor project team skills and unavailability of skilled people are one the most critical barriers in ERP implementation ([4], [9], [24], [39], [74]), and therefore it becomes necessary to address these areas.

Key Users

According to the above-mentioned studies, the required skills and knowledge of the project team members should be considered. In ERP implementation projects, people play different roles such as project sponsor, project manager, consultant, IT expert, key user, and end user. Since key users are among the most significant individuals in an ERP implementation project, they will be the focus of the present study. Wu and Wang [85] recognize two primary participants in the ERP implementation process: the internal project team who know the organization and defines the needs of the business, and the external consultant that presents a system in accordance with the needs of the organization. The internal project team consists of top management, MIS staff, and key users. Key users are the connection bridge between consultants and the organization, as well as between end users and the project team. Key users, sometimes called "super users", play a key role in the business application support infrastructure. In addition to being on the front line with users, they serve as liaisons between the business and IT organizations, enabling IT to focus on the technical aspects of system support [83]. Key users, who are selected from the various functional areas of the business, generally know business processes very well and have domain knowledge of their areas [85].

According to Maditinos et al.'s findings [45], an extremely significant factor for ERP system success is knowledge transfer, which is relevant to the present study since key users play a significant role in knowledge transfer ([8], [80]). The implementation consultants and key users each possess their own critical ERP knowledge and business process knowledge, which they must exchange with each other in order to achieve implementation success. In other words, consultants gain business process knowledge from key users, and key users learn ERP knowledge from consultants [86]. Afterwards, it is the responsibility of key users to share their knowledge with other users based on what they learn during the implementation process ([85], [80], [41]. Because key users develop the requirements for the system, they ultimately act as trainers, help-desk resources, educators, advisors, and change agents for end users [85].

Job tasks for different stages of ERP system implementation have also been identified in previous research [43], and key users are engaged in almost all stages for a variety of different tasks. Thus, key-users play a major role in success of the system [85]. After implementation, as resident ES experts, they return to their departments [80] and continue to transfer their knowledge in the organization.

MODELS USED IN THIS RESEARCH

Given the purpose of this research, 'skills' is modeled as an independent variable, and 'success of ERP implementation' as the dependent variable. The models that will be used to represent the variables are described as follows.

Skill Measurement Model

Skill measurement and classification has been the topic of much previous research *(*[10], [15], [22], [23], [26], [29], [30], [35], [53], [63], [64], [69], [72], [77], [82], [87]), however, most of the research traces its roots back to the relatively simple classification of the Katz model [29], for instance, as in Peterson, et al. [59], which reconceptualised Katz[29]. Katz suggested that effective administration rests on three basic developable skills: human skills, conceptual skills and technical skills. These skill sets are interrelated, and at the same time may be developed independently [20]. The Katz (1955) model provides a clean, simple classification that supports the goals of this research, and therefore was adopted as an operational means to classify ERP implementation skills. The definitions and descriptions of Katz's skill categories are:

Technical skills are defined as the understanding of specific activities that require the use of specialized tools, methods, processes, procedures, techniques, or knowledge. Generally, technical skills are thought of as the specific skills an individual needs to perform some specialized task [59].

Human skills are defined as the ability to work cooperatively with others, to communicate effectively, to resolve conflict, and to be a team player [59]. Analoui ([5], [6]) has labelled these as people-related skills. However, the cluster consists of teamwork, dealing with conflict, communications, and creating organizational climate. According to Mann [47], human skills include an

understanding of behavioural principles, interpersonal relations, motivation, and communication [59].

Conceptual skills are defined as the ability to see the organization as a whole or to have a systemic viewpoint (Peterson et al., 2004). Terms such as entrepreneurial [51], futuring [44], visioning [13], and systems thinking [67], have been used to describe the conceptual skill category [59].

In general, while technical skills focus on things and human skills focus on people, conceptual skills focus on ideas and concepts [87]. Some other studies have developed indices for three main categories of Katz's model. For example, El-Sabaa [20] used open-ended questions to determine a set of 18 skills of the best project managers, and then classified them into three main categories, technical skills, human skills, and conceptual and organizational skills. Technical skills include: special knowledge in the use of tools and techniques, project knowledge, understanding methods, processes, and procedures, technology required, and skills in the use of computer. Human skills include: mobilizing, communication, coping with situations, delegating authority, political sensitivity, high self-esteem, and enthusiasm. Conceptual and organizational skills include: planning, organizing, strong goal orientation, ability to see the project as a whole, ability to visualize the relationship of the project to the industry and the community, and strong problem orientation.

Zhiwen et al. [89] in their article also classify skills in technical, human, and conceptual categories. In Zhiwen, et al [89], technical skills include: business knowledge, learning ability, computing/IT skills, and foreign language. Human skills include: communication skills, action orientation, open personality, values, and morality. Conceptual skills include: problem thinking, judgment ability, acuteness/ foresight, and self motivation.

Donelly [18] in his study introduced five specific conceptual skills and five human skills as critical skills for bank managers. Human skills include: decision-making skills, confronting the role of manager-leader, communication skills, team-building skills, and leadership skills. Conceptual Skills include: organization design skills, inter organizational analysis skills, environmental analysis skills, strategic analysis skills, and change management skills.

Kumpikaitė, et al. [40] synthesized the works of Katz and other related research to determine 16 management skills, classified into four groups. Technical skills include: subject knowledge, specialty experience, and application experience. Personal skills include: responsibility sense, creativeness, activity, and criticism tolerance. Human or interpersonal skills include: self-presentation, ability to contact, ability to show own opinion, communicability, ability to work in teams, and self-reliance. Conceptual skills include: ability to solve problems, analytic thinking, goal understanding, ability to plan, and analyze results.

Another model based on Katz' classification, was introduced by Mahdavian, et al. [46]. Based on related research about information systems, ERP, IT, and managerial skills, Mahdavian, et al. [46] selected 22 items to represent the technical, human, and conceptual categories. A panel of experts associated each skill item with any of the three categories of technical, human, and conceptual skills which applied to that skill, and the expert ratings were confirmed by factor analysis. The results are reported in Table 1 (T: technical skills, H: human skills, C: conceptual skills).

This research adopts the Mahdavian, et al. [46] framework for several reasons. First, this research is an extension of the same research stream as Mahdavian, et al., [46], and therefore the adoption of the same skills and classifications will ensure the consistency and continuity of this research with the previous research in the same stream. Secondly, the Mahdavian, et al. skill framework is the only skill framework that is developed specifically for ERP implementations. Thirdly, the adoption of Mahdavian, et al. will allow the direct comparability of results between the two studies.

ERP Success Measurement Model

Generally speaking, ERP success has been treated as a subset of IS success by the research literature. The principal characteristic that differentiates ERPs from generic information systems is the integrated nature of the ERP, particularly as it pertains to its effects on business processes ([81], [84]). Consequently, the more general IS success evaluation models may not be appropriate for ERP systems [52].

Table 1: Classification of skills by Mahdavian, et al. [46]

No.	Item	Category(s)	No.	Item	Category(s)
1	Change Management	H, C	12	ERP Technical Knowledge	T
2	Stress Management	H	13	General Skills	T
3	Technology Management Knowledge	T	14	Business Processes Knowledge	C, T
4	Project Management	T	15	Analytical Skills	C
5	Information Literacy	C, T	16	Team Skills	H
6	Negotiation and Conflict Management	H	17	Personal Skills	H
7	Risk Management	C	18	Strategic Planning	C
8	Teaching and Training Skills	H, T	19	System Skills	C
9	Crisis Management	C	20	Communication Skills	H
10	Organizing	C, T, H	21	Time Management	C, T
11	Leadership Skills	H	22	Decision Making and Problem Solving Skills	C

This has led several researchers to propose different models to evaluate ERP implementation success. According to Markus and Tanis [48], there are different phases that are indicated by key players, typical activities, characteristic problems, appropriate performance metrics and a range of possible outcomes [38]. The first phase, known as the project phase, is associated with the capability of the organization to install and implement the system successfully. In the second phase, the shakedown phase, the primary activities focus on the measurement of the extent and duration of the organizational impact caused by the ERP system. In the third phase, the onward and upward phase, Markus and Tanis [48] propose that success is related to the organization's capacity to gain ERP benefits [52]. Tan and Pan [75], motivated by Markus and Tanis' neglect to account for the softer side of ERP success, proposed a new model that defines ERP success as infrastructure success, information structure success, and knowledge success, and combined technical and strategic values in the assessment of ERP implementation success.

Research has also been conducted to extend the Delone and McLean [17] model to ERP systems [21]. Specifically, Gable et al. [21] argued that several measures in the Delone and McLean model were not suitable to measure ERP systems' success. Additionally, Gable, et al. [21] theorized that user satisfaction was not a distinct surrogate for ERP success, and therefore omitted user satisfaction in their final model. Gable, et al. (2003) also suggested that Delone and McLean's measures of organizational impacts focus primarily on financial factors, and do not account for business process improvement and organizational change [52]. The inadequacies of Delone and McLean [17] led Gable et al. [21] to propose a model that included the following dimensions of ERP systems' success: System Quality (SQ), Information Quality (IQ), Individual Impact (II) and Organizational Impact (OI).

Subsequently, Zhang et al. [88] proposed a conceptual framework to explore the relationship among the organizational environment, user environment, ERP system environment, ERP vendor environment, and ERP implementation success, developed a conceptual framework. Zhang et al.'s model drew less attention than Gable et al.'s model, because it is primarily a guidance framework for successful implementation of ERP systems, rather than as a practical model to measure ERP implementation success [52].

Ifinedo [28], extending Gable, et al., developed a more comprehensive model to measure ERP success. Having reviewed the literature and conducted interviews with several companies, Ifinedo discovered two other vitally important dimensions that were not included in the Gable, et al. Framework, Vendor/Consultant Quality (VQ), and Workgroup Impact (WI). Table 2 reports the ERP system success dimensions, their sources, and their description, based on Gable, et al. [21] and Ifinedo [28], which are adopted to support the goals of this research.

Table 2: Dimensions of ERP Success [28]

Dimension	Sources	Description/meaning
Systems Quality (SQ)	[21] ,[66] , [17]	Performance characteristics of the ERP system with regard to ease of use, accuracy, reliability, efficiency.
Information Quality (IQ)	[21] ,[66] , [17]	Characteristics of the output provided by the ERP system with respect to timeliness, relevance, availability, and understandability.
Vendor/ Consultant Quality (SerVQ)	[76] , [60], [37]	Support that the organization receives from the ERP provider, often operationalized by reliability, dependability, quality of expertise.
Individual Impact (II)	[21] ,[66] , [17]	Concerned with the effect of ERP on the individual, often assessed through increased individual's productivity, improved decision-making capability.
Workgroup Impact (WI)	[55]	The impact of the ERP system on sub-units or departments within the organization often assessed through improved inter-departmental coordination, communication, and productivity.
Organizational Impact (OI)	[21] ,[66] , [17]	The benefits that the organization gets from its ERP system, often measured by the extent to which customer service, decision-making processes, and so forth have been enhanced.

RESEARCH HYPOTHESES

The main hypotheses of this research are related to the effect of the key users' skills on ERP implementation success.

Hypothesis (a): skills of key users of the ERP system affect ERP implementation success, i.e., for the model $y= \alpha + \beta x$, (y is the amount of success and x is the amount of skills), the following hypothesis is tested:

$H0: \beta = 0 \quad H1: \beta \neq 0 \quad (a)$

The following hypotheses of this research are related to the investigation of the effect of technical skills, human skills, and conceptual skills of key users on ERP implementation success. The hypotheses will be presented separately, though a judgment will be made subsequently as to whether or not they may all be tested at once in a single multiple regression model. These hypotheses are:

Hypothesis (b1): Technical skills of key users of ERP system affect the ERP implementation success, i.e., for the model $y= \alpha + \beta 1x1$, (y is the amount of success and x1 is the amount of technical skills), the following hypothesis is tested:

$H0: \beta 1 = 0 \quad H1: \beta 1 \neq 0 \quad (b1)$

Hypothesis (b2): Human skills of key users of ERP system affect the ERP implementation success, i.e., for the model $y= \alpha + \beta 2x2$, (y is the amount of success and x2 is the amount of human skills), the following hypothesis is tested:

$H0: \beta 2 = 0 \quad H1: \beta 2 \neq 0 \quad (b2)$

Hypothesis (b3): conceptual skills of key users of ERP system affect the ERP implementation success, i.e., for the model $y= \alpha + \beta 3x3$, (y is the amount of success and x3 is the amount of conceptual skills), the following hypothesis has been tested:

$H0: \beta 3 = 0 \quad H1: \beta 3 \neq 0 \quad (b3)$

Another question of this article seeks to determine which skill items shown in Table 1 are related to ERP success. So, the following hypotheses are tested:

Hypothesis (c): skill item *i* of key users affects the ERP implementation success. r_i is correlation coefficient of skill item *i* and ERP implementation success.

$H0: r_i = 0 \quad H1: r_i \neq 0 \quad i=1, 2, \ldots, 22 \quad (c)$

The conceptual model of the research is shown in Figure 1.

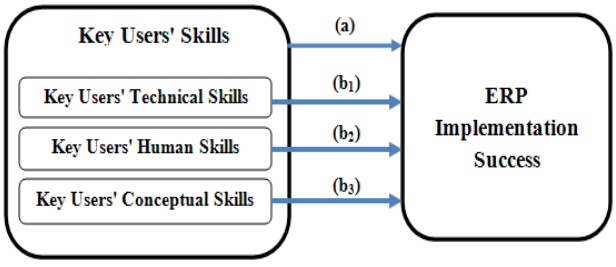

Figure 1: Conceptual model of the research

RESEARCH METHOLOGY

Sample

Respondents were among the project managers, key users, ERP experts and other individuals involved in ERP implementation projects. Overall, n = 66 responses were obtained for analysis, which was judged to be satisfactory for the purposes of performing simple regressions with one dependent, and one independent variable [57]. Primary data was collected by distributing this questionnaire to 6 Iranian companies that have implemented an ERP, including steel, printing, and energy, chemical and mining industries. It is notable that all these companies used non-integrated systems before implementing ERP. Although the sample drawn is not random, an inspection of its demographical composition indicates that the sample resembles what may be expected of a cross-section of the population, and therefore poses a minimal threat to generalizability.

Instrumentation

To measure dependent and independent variables, based on two models explained in the previous section, a two-part questionnaire was designed, which is reported in the Appendix. The first part of the survey, adapted from Mahdavian et al. [47], operationalizes both the degree of key users' skills, and the importance of each skill, for 22 items, which will be used to create a weighted score for each skill. The second part of the questionnaire, adapted from Ifinedo [28], operationalizes ERP implementation success.

CONVERGENT AND DISCRIMINANT VALIDITY

Factor analyses were performed for both the ERP skills, and ERP Success instrumentation. The goals of the factor analyses were to purify the instrumentation from items that exhibited either significant cross-loadings, or did not load significantly on any factor, so that the remaining variables could be used to form new summated variables to operationalize the hypotheses. The analysis adopted a rule-of-thumb that any loading greater than 0.60 would be acceptable [57].

The factor analysis revealed that there were three factors for ERP skills, as may have been anticipated, and one for ERP success. Previous research (Mahdavian and Mostajeran, [46]) indicated that several items may be associated with more than one factor, so the factor structure was examined with the goal of determining which items are associated with the human, technical, and conceptual factors of ERP skills. The three factors produced by this analysis were mostly in agreement with the results of previous research, though a few items either associated with no factor, or a factor different than the one proposed by previous research. Four ERP skills items did not load on any factor (Leadership Skills, ERP Technical Knowledge, General Skills, Decision Making and Problem Solving Skills), and there were no items with cross-loadings. The factors also exhibited moderate-to-high correlations between themselves, thus raising the possibility that variance inflation may confound any attempt to test all hypotheses at once, in the same multiple regression model. Therefore, a judgment was made to test the hypotheses as separate simple regression models, rather than a single multiple regression model.

The human dimension of ERP skills is represented by: change management, stress management, negotiation and conflict management, teaching and training skills, organizing, communication skills, and time management. The technical dimension is represented by: business processes knowledge, analytical skills, team skills, personal skills, and system skills. The conceptual dimension is represented by: technology management knowledge, project management, information literacy, risk management, crisis management, and strategic planning. Leadership skills, ERP technical knowledge, general skills, and decision making and problem solving skills failed to load significantly on any factor. The items were summated into three separate variables for human ERP skills, conceptual ERP skills, and technical ERP skills.

The factor analysis revealed that ERP success is comprised of six dimensions: Systems Quality, information quality, vendor/ consultant quality, individual impact, workgroup impact, and organizational impact. The System Quality dimension is represented by items 5, 6, 7, and 9, as reported in the Appendix. The Information Quality dimension is represented by items 1, 2, 3, 5, 6, and 7, as reported in the Appendix. The Service Quality dimension is represented by items 4, 5, 6, and 7, as reported in the appendix. The Individual Impact dimension is represented by items 1 – 6, as reported in the Appendix. The Workgroup Impact dimension is represented by items 1 – 7, as reported in the Appendix. The Organizational Impact dimension is represented by items 1 – 8, as reported in the Appendix. Items for each dimension were summated to form new variables, to be used to test the hypotheses. The Cronbach's alpha values, technical skills= 0.90, human skills= 0.90, conceptual skills= 0.94 and ERP success= 0.96 indicate that the survey has adequate internal consistency.

OPERATIONAL DEFINITIONS

Each ERP skills item is operationalized as the amount of availability of that skill during ERP implementation, multiplied by the reported importance of that skill. The result is a weighted index for the presence of each skill during ERP implementation. To operationalize hypothesis a, the skills variable is the sum of the all skill items as they are determined by the factor analysis. For hypothesis b1, the technical skills variable is the sum of all items that are categorized in the technical skills class. For hypothesis b2, the human skills variable is the sum of all items that are categorized in the human skills class. For hypothesis b3, the conceptual skills variable is the sum of all the items that are categorized in the conceptual skills class. For all hypotheses, the amount of ERP success (y) is operationalized as the sum of the six dimensions: System Quality, Information Quality, Vendor/ Consultant Quality, Individual Impact, Workgroup Impact, and Organizational Impact, as explained in previous section.

DATA ANALYSIS

To test Hypothesis (a), a regression model was specified with skills as the independent variable and ERP success as the dependent variable. To test Hypotheses (b1), (b2), and (b3), technical, human, and conceptual skills were entered as the independent variables, and ERP success as the dependent variable. Tests revealed that the assumptions of normality, linearity, and homogeneity are satisfied. In the table 3, the results of the regression procedure for hypothesis (a) are presented.

Table3: Regression analysis for hypothesis (a)

	β	Adj. R^2	Sig.
Skills	0.03	0.131	0.0049

At the $p < 0.01$ level, there is a significant relation between the key users' skills and ERP success. The value of adjusted R2 = 0.131 indicates that approximately 13% of the variance in ERP success is explained by the combined ERP skills variable. The relatively low value for R2 may be due to the fact that implementation success of the system depends on numerous factors ([3], [36], [56], [61], [70], [78]) which were not taken into account in this study. The $\beta = 0.03$ indicates that a one unit change in the measure of key user skills results in a 0.03 increase in ERP success.

Table 4 reports the results of the regression analyses for technical, human and conceptual skills, for hypotheses b1, b2, and b3, respectively.

Table 4: Results of regression analysis of technical, human and conceptual skills, hypotheses b1, b2, and b3

	β	Adj. R^2	Sig.
Technical skills	0.10	0.19	< 0.0001
Human	0.054	0.059	0.038
Conceptual skills	0.041	0.01	0.20

According to table 4, both technical skills ($p < 0.0001$) and human skills ($p = 0.038$) are significantly related to ERP Success, but conceptual skills are not. Technical skills explain 19% of the variation in ERP Success, and human skills explain 6% of the variation in ERP Success. The regression coefficients indicate that a one unit change in technical skills results in a 0.10 change in ERP Success, and a one unit change in human skills results in a 0.054 unit change in ERP Success.

To determine the most important skills (hypothesis c), the Pearson test was used. A more conservative $\alpha < 0.01$ criterion was adopted, because of the number of tests to be performed. Pearson correlations are included for the aggregate ERP Success variable, and each ERP Success dimension (SQ, IQ, SRVQ, II, WI, and OI) as they were operationalized for hypotheses a and b, and the aggregate human, technical, and conceptual dimensions of ERP Skills, as they were operationalized for hypothesis b1, b2, and b3, for each ERP Success dimension. The results are shown in Table 5**.**

These results show that at level of $\alpha < 0.01$, change management, risk management, organizing, business process knowledge, analytical skills, team skills, personal skills, strategic planning, systems skills, communication skills, and decision making and problem solving skills are correlated with at least one dimension of ERP Success. Stress management, technology management knowledge, project management, information literacy, negotiation and conflict management, teaching and training skills, crisis management, leadership skills, ERP technical knowledge, general skills, and time management were correlated with no dimension of ERP Success. It also is noteworthy that both team skills, and the technical dimension of ERP skills are highly correlated with all dimensions of ERP Success.

Table 5: Pearson correlations between ERP Skills and ERP Success

	SQ	IQ	SRVQ	II	WI	OI	Success
Change management	**0.317**	0.199	0.294	0.279	**0.402**	**0.334**	0.319
Stress management	0.177	0.057	0.132	0.216	0.306	0.239	0.200
Technology management knowledge	0.202	0.089	0.002	0.223	0.177	0.175	0.188
Project management	0.112	0.054	0.151	0.083	0.089	0.074	0.001
Information literacy	-0.033	0.027	-0.174	-0.012	-0.027	-0.050	-0.099
Negotiation and conflict management	0.243	0.110	0.141	0.148	0.233	0.146	0.128
Risk management	0.260	0.096	0.211	0.260	0.262	**0.351**	0.255
Teaching and training skills	0.211	0.065	0.079	0.213	0.225	0.158	0.133
Crisis management	0.195	0.082	0.170	0.271	0.271	0.291	0.209
Organizing	**0.385**	0.261	0.236	**0.389**	**0.378**	**0.380**	**0.383**
Leadership skills	0.287	0.238	0.183	0.308	0.263	0.204	0.240
ERP technical knowledge	0.245	0.020	0.147	0.216	0.199	0.257	0.254
General skills	0.188	0.010	0.059	0.219	0.170	0.052	0.101
Business process knowledge	**0.363**	**0.327**	0.275	0.248	0.281	**0.314**	**0.356**
Analytical skills	**0.339**	0.200	0.239	0.305	**0.332**	0.318	**0.315**
Team skills	**0.450**	**0.331**	**0.402**	**0.387**	**0.443**	**0.424**	**0.446**
Personal skills	0.308	0.123	0.148	0.299	0.293	**0.314**	0.241
Strategic planning	0.283	0.088	0.162	**0.343**	**0.331**	0.283	0.225
System skills	0.291	0.305	0.260	0.316	**0.360**	**0.328**	**0.376**
Communication skills	**0.346**	0.157	0.207	**0.361**	**0.380**	0.299	**0.320**
Time management	0.073	0.000	0.050	0.102	0.153	0.051	0.041
Decision making and problem solving skills	**0.352**	0.266	0.222	0.309	**0.377**	**0.339**	**0.339**
Human	0.314	0.153	0.204	0.305	**0.375**	0.287	0.276
Technical	**0.459**	**0.340**	**0.336**	**0.392**	**0.447**	**0.431**	**0.454**
Conceptual	0.195	0.064	0.081	0.228	0.217	0.240	0.172

DISCUSSION AND CONCLUSION

The skill sets required for success in the work place have changed dramatically in recent years [2], and will continue to do so for the foreseeable future as the global economy becomes even more competitive. Given the rapid and inevitable pace of technological change, some of the most critical skills and competencies are those related to implementing change itself. Information systems, especially enterprise systems, are a primary source of change in organizations; this is reflected by the surge in research on the topic of the people who implement technological systems, and their competencies. Kelegai [32] in his study identified "Management IS knowledge" and "Availability of IS professionals" as important factors influencing information systems success in organizations. A study conducted by Owei et al. [58] shows that developing countries are creative in their desire to recruit IT professionals, in order to keep up with the rapid pace of technological advancement in the developed world. However, their progress is constrained by the lack of trained, skilled and knowledgeable IS workers.

Therefore, it is necessary to assess the demand for skills and competencies, and to make training and education more relevant to the people who will need these skills and competencies in order to implement the systems of the future. In this regard, this study has considered one of the most important factors in the successful implementation of ERP - the competencies of project team. Although many studies have demonstrated the importance of knowledge, skills, abilities and experience of project team members in ERP implementation, there are few studies that have examined and focused on specific skills of individuals in ERP implementation. This study addresses the question, “Do the skills and knowledge of key users of ERP system affect ERP implementation success?” Subsequently, the following questions were proposed: Do the technical skills of key users affect ERP implementation

success? Do the human skills of key users affect ERP implementation success? Do the conceptual skills of key users affect ERP implementation success? Which skills are the most important predictors of ERP success?

To answer the above questions, two models were used. One for measuring the existing amount as well as the importance of each index of technical, human and conceptual skills of those individuals involved in ERP implementation project, such as key users. The first model is shown in Figure 2.

Figure 2: ERP Implementation Skills [46]

The second model for measuring ERP implementation success is shown in Figure 3.

Figure 3: ERP System Success Measurement Model [28]

The results show that technical and human skills are significantly related to ERP success, which indicates that key users should be multi-skill individuals. This also demonstrates the importance of attentive selection of key users with good team skills, since team skills were important for all dimensions of ERP Success.

The results of the study also show that technical and human skills have the greatest effect on ERP system implementation success. With regard to human skills, this result is to be expected, given the role of key users and the nature of ERP systems. Key users are generally the middle managers of the organization, and hence, are considered as agents of change. Key users become communication bridges between the enterprise and implementation consultants, trainers, advisors, and educators of end users, and therefore they are required to be competent and able in their exercise of "soft skills". Human skills are necessary to enable a key user to work effectively as a group member and to build a cooperative effort within the team, since it involves an assessment of the perception and recognition of the attitudes of his superiors, equals, subordinates, and consultants, as a guide for the way he accordingly behaves. A key user with highly developed human skills is also sufficiently sensitive to the needs and motivations of others.

Technical skills, as represented by business processes knowledge, analytical skills, team skills, personal skills, and system skills, were the most influential with regard to ERP success. As mentioned previously, key users are selected from operating departments, generally know business processes very well, and have domain knowledge of their areas [85], as is typically expected of business analysts. Richards et al. [62] believed that the business analyst plays a key role in ensuring that technology is appropriately used to achieve the organisation's goals. Due to the mediating role of these people, and consequently, high demand for this role in organisations, Richards et al. [62] conducted a survey in the Information and Communication Technology industry in Australia to determine the educational and/or training needs of business analysts. The survey considered these four sets of skills: soft skills (e.g. Problem solving, Conflict resolution, Teamwork, Leadership, communication, Training others, Time Management, Organization Skills, Negotiation Skills), business skills (e.g. Domain/industry specific knowledge, General Business Skills, Finance, Marketing, Supply Chain Management), green skills (e.g. Sustainability Strategy, Sustainability Management of IT , Training for Sustainability Awareness, Sustainability Assessment, Sustainability Engineering), and technical skills (e.g. Testing, Data Warehousing, User-Interface Design, Programming, Security). These findings show that not only is there similarity between Richards et al.'s research and present study, but they also support the notion that key users should be multi-skilled business analysts.

As reported in Table 5, analyses of the data revealed several areas of skill to be effective for ERP implementation. To gain a richer understanding of those skills, the authors conducted interviews with some ERP project managers, the results of which are discussed in the following:

Change Management: Change management plans typically originate at the top organizational level, and therefore it is necessary for key users to cope with changes in the implementation phase. Experience shows that if there is not any plan for coping with change, and employees are not mobilized in this regard, there will be excessive project costs and disappointment in the new system. Senior users play an important role from the beginning of the implementation project and should have an organizational post to highlight the importance of their role in change management. Charismatic power (that is an inherent ability), and popularity of key users are both important because they both help overcome individuals' resistance. Choosing an unpopular person increases resistance of the individuals who are working with him/her, but if the key user is popular, those who are working under his/her supervision are more likely to cooperate.

Risk Management: As ERP implementation is accompanied by many changes, the issue of risk becomes considerable. Risk is unavoidable, and hence, an issue for key users is not whether or not to take risks, but which risks are worth taking and how to mitigate those risks. By definition, projects that add more value tend to be more complex, and since more complex projects tend to be more risky, it is therefore to be expected that the most value will be added to the organization by projects that assume more risk (successfully), rather than less. Therefore, key users should be encouraged to take risks. This may be problematic since risk management, change management, and crisis management skills are more typically performed by senior management. However, since supporting senior managers is one of the roles of key users, this may be accomplished if key users also function as advisors to risk decisions made by senior management.

Organizing: Organizing the people in the project in planning phase, specifying tasks, and limiting employee displacements during the implementation will be highly effective on successful ERP implementation. Displacement of employees who are involved in the project is a serious problems in ERP implementation, since not only are their skills lost, but it takes some time for new employees to become skilled-up to replace them. To mitigate this, key users should be able to choose and divide the tasks among the individuals under their supervision.

Business Processes Knowledge: Key users are selected based on their knowledge and mastery of business processes. Experience shows that employees who are knowledgeable with regard to business processes have better interaction with the implementation consultants, which results in acceleration of the implementation time, ease of change, and better perception of the improved processes.

Cooperation with the implementation consultant to recognize current business processes (AS IS) is one of the most important tasks of key users. They should not only know the processes in their own scope properly, but they also should be familiar with related processes in other areas. In other words, they should have a holistic viewpoint and know all relevant processes. This entails a recognition of business needs and how to transfer them to the implementation consultant.

Analytical Skills: One of the most important skills required for key users is the ability to analyse the current status of the implementation and then evaluate the ensuing changes and modifications. Users should have an analytical power to propose solutions and specify a plan to move the project forward. Hence, they can play an important role in offering solutions to the implementation consultant.

Generally, key users or process owners who have high analytical skills will assist the implementation consultant to analyse the processes, eliminate the current problems, cover future needs of the organization and propose integrated strategies.

Team Skills: Team work is an inherent feature of ERP projects, because of the level of integration and comprehensiveness of ERP systems. Thus, team skills will have a direct effect on implementation quality of the system. In order to moderate team conflicts, a common language, "team culture", and cooperation should be created among team members.

Strategic Planning: Although this skill is not typically for most key users, key users should nonetheless have a an appreciation of the strategic value of the ERP system. Such an appreciation would most probably come from clear communications with the leadership of the organization.

System Skills: People who are familiar with all processes of the organization will help the advancement of the project through their understanding of the process integration throughout various parts of system. Mapping of process among different modules is a very important aid for key users to resolve conflicts and differences between the various ERP modules. Analysts with good system skills have a holistic approach that encompasses the entire system scope, not just the scope of their own tasks or work. When key users lack system skills, their work becomes more task oriented rather than process oriented, which will become a source of implementation problems.

Communication Skills: Since most of the skills under consideration assume that key users are able to communicate with each other, key users with communication skills will have a direct effect on project success. "Soft skills" have been the topic of prior research, and include behavioral factors, such as "friendliness" and ability to relate to others.

Decision Making and Problem Solving Skills: ERP implementation projects are complex, both from a technical and organizational perspective, and therefore benefit from decision making and problem-solving skills. Inability, or lack of authority to make decisions, will naturally affect the project outcomes. Decision skills and problem-solving skills may be taught and learned over time, so there are opportunities for unskilled team members to improve their abilities in these areas. When key users become dependent on the implementation consultant, this often reflects a lack of decision and problem-solving skills.

Personal Skills: Some of the most important personal skills for key users are flexibility and adaptability, positive attitude towards the new changes, and preparation to confront uncertain conditions due to execution of the new system.

IMPLICATIONS, FUTURE RESEARCH AND LIMITATIONS

The data from this study reveals that key users' skills play a significant role in ERP implementation success. So, in order to increase the ERP implementation success, individuals tasked with selecting and developing key users should pay more attention to appropriate selection of key users as well as holding educational courses to enhance key users' skills. They should take all three main categories into account. Moreover, special consideration should be given to human skills. The focus of most education in the context of universities and organizations has been on the technical skills deemed essential to achieve project success [2]. Technical skills are easier to teach than soft skills [12]. However, some researchers ([50], [14], [25]) have argued that human skills are those which managers lack the most, and therefore could benefit the most from developing their soft skills. So, universities and organizations should make more effort in improving all required skills including hard and soft ones.

This study is limited in that has included only Iranian companies. Furthermore, there are only a small number of companies that have implemented ERP in Iran, and therefore the analysis is based on a small number of cases. By considering a wider study and analyzing more cases, the results may be improved, and become more generalizable to the population of ERP implementations.

There are some recommendations for future studies. According to models used in this study, the effect of skills of other individuals who are dealing with ERP system such as those of project managers, end users, and consultants on ERP success can be investigated. The study regarding the effect of other CSFs such as top management support, change management, and project management on ERP success can be helpful. Moreover, how to develop the skills required by members of ERP implementation project team is another worthwhile topic for future studies.

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APPENDIX: INSTRUMENTATION

These items were used to measure ERP implementation skills. For each item, respondents were asked to provide both the importance, and existing amount of that skill in the ERP implementation.

1. Change Management
2. Stress Management
3. Technology Management Knowledge
4. Project Management
5. Information Literacy
6. Negotiation and Conflict Management
7. Risk Management
8. Teaching and Training Skills
9. Crisis Management
10. Organizing
11. Leadership Skills
12. ERP Technical Knowledge
13. General Skills
14. Business Processes Knowledge
15. Analytical Skills
16. Team Skills
17. Personal Skills
18. Strategic Planning
19. System Skills
20. Communication Skills
21. Time Management
22. Decision Making and Problem Solving Skills

These items were used to measure ERP Success. Items were measured on a 1 – 5 Likert scale.

System quality

1. Our ERP has accurate data
2. Our ERP is flexible
3. Our ERP is easy to use
4. Our ERP is easy to learn
5. Our ERP is reliable
6. Our ERP allows data integration
7. Our ERP is efficient
8. Our ERP allows for customization
9. Our ERP database content is good
10. Our ERP allows for integration with other IT systems
11. Our ERP meets users' requirements

Information quality

1. Our ERP provides timely information
2. The information on our ERP is understandable
3. The information on our ERP is important
4. The information on our ERP is brief/concise
5. The information on our ERP is relevant
6. The information on our ERP is usable
7. The information on our ERP is available
8. The information on our ERP is accurate

Service quality

1. Our ERP provides prompt information to users
2. Our ERP system has a good interface
3. Our ERP has visually appealing features
4. Our ERP provides the right solution to requests
5. Our ERP service provider is dependable
6. Our ERP service provider has up-to-date facilities
7. Our ERP service provider is experienced and provides quality training and services

Individual impact

1. Our ERP enhances individual creativity
2. Our ERP enhances organizational learning and recall for individual worker
3. Our ERP improves individual productivity
4. Our ERP is beneficial for individual's tasks
5. Our ERP enhances higher-quality of decision making
6. Our ERP saves time for individual tasks/duties

Workgroup impact

1. Our ERP helps to improve workers' participation in the organization
2. Our ERP improves organizational-wide communication
3. Our ERP improves inter-departmental coordination
4. Our ERP create a sense of responsibility
5. Our ERP improves the efficiency of sub-units in the organization
6. Our ERP improves work-groups productivity
7. Our ERP enhances solution effectiveness

Organizational impact

1. Our ERP reduces organizational costs
2. Our ERP improves overall productivity
3. Our ERP enables e-business/e-commerce
4. Our ERP provides us with competitive advantage
5. Our ERP increases customer service/satisfaction
6. Our ERP facilitates business process change
7. Our ERP supports decision making
8. Our ERP allows for better use of organizational data resource