



ASSESSING THE APPLICATION OF AN EXTENDED FRAMEWORK OF ERP IMPLEMENTATION IN SMES

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ABSTRACT

Enterprise Resource Planning (ERP) has been used to integrate the information and to support decision making in business improvement and competition globally. Many frameworks, models and methods were proposed and applied clearly intended for large companies. Many Small and Medium Enterprises (SMEs) have difficulties when implementing and adopting the ERP systems that resulted in failures. The objective of this research is to formulate an extended comprehensive framework for ERP implementation in SMEs with a view of highlighting the enterprise architecture and Critical Success Factors (CSFs) as the foundation for ERP systems for substantial improvement in success rate of projects. The proposed framework was evaluated in five case studies from SMEs in Iran. Feedback from the case studies was used to revise the framework which addressed the requirements of the ERP system implementation. The implementation cycle would consist of four phases, namely, planning, selection and design, implementation and control, and evaluation and improvement. The framework consists of relevant elements to guide the managers and implementers in attaining the success rate of ERP projects in SMEs.

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INTRODUCTION

SMEs constitute the majority of businesses, and as a proportion of all business, it accounts for a large percentage of both employment and turnover [1-4]. Due to the inherent differences between SMEs and large businesses, research findings based on large businesses cannot be generalized to small businesses [5-8].

As SMEs constitute over 90% of operating businesses in many countries, there is a great need for more rigorous research that is relevant to this important sector of the economy [9-11]. Small businesses tend to have simple and highly centralized structures with the chief executive officers (CEOs), who are also the owners, making most of the critical decisions [12, 13]. These CEOs have a great influence on the technology adoption decision [14].

SMEs tend to employ generalists rather than specialists [15-19]. Other distinctive characteristics include reliance on short-term planning rather than long-term strategic plans, fewer bureaucratic procedures, less complex interpersonal and political relations, and less organizational inertia [12, 20].

With this background, it is necessary that SMEs also adopt ERP to support large businesses' information systems initiatives. Smaller companies cannot just imitate, in total,

the methodologies, models and approaches adopted by their large counterparts. They need to be developed, modified, adapted, or revised, to SMEs' needs and characteristics. Small and medium businesses are usually constrained by their size, their lack of technical expertise, of managerial time, and of financial resources and their human resource limitation [14].

In SMEs often decisions are made without full awareness of information and with risk to the overall survival of the company [21]. In brief, the SMEs differ from larger enterprises in various aspects, including their workflow, decision-making processes, levels of hierarchy, resources, and corporate culture [4]. Due to their distinctive differences from large businesses, there is a need to study these enterprises separately rather than dealing SMEs as large enterprises [5, 8, 22, 23].

Existing frameworks are large firms oriented and do not reflect the conditions and the characteristics of small ones. The purpose of this study is proposing of the framework for implementing of ERP for small and medium sized enterprises. The authors believe that this framework fits the SMEs' characteristics by, for example, stressing the need to consider enterprise architecture, project management, stakeholders, etc. It also helps SMEs to have a much better implementing of ERP systems and improve their success rate.

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ERP implementation frameworks

In the case of implementing ERP, one can start by trying to analyze the range of available approaches such as developing a project plan management, implementing methodology, enterprise architecture and including the stakeholders, standards, internal and external environment. Regardless of the size of the firms, implementing an ERP system is one of the most challenging projects of any company. Success does not come easily, and its benefits and return on investment is not immediately for it. It is clear that most companies need to implement ERP systems just to stay competitive [24].

By comparison to information systems (ISs) research and other academic fields, theories on ERP systems implementation have been given less attention. Most published articles on the field of ERP systems implementation unavoidably lack theoretical support [25].

Furthermore, the SMEs differ from larger enterprises in various aspects, including their workflow, decision-making processes, levels of hierarchy, resources and corporate culture [4].

strategy, systems, resources and flexibility. Because of these distinguishing characteristics, management knowledge, such as that pertaining to IT investments, that has been developed in relation to large enterprises often is not applicable to SMEs [8, 26, 27].

Figure 1 shows the schematic diagram of the conceptual framework was proposed by Aarabi *et al* [28]. The researchers are aimed to assess the application of this proposed framework in SMEs.

Table 1 shows the background and general operation of the Five SMEs that used as case study companies individually.

Evaluation of the framework as a particular aspect was a tedious task and proved difficult at times. It was especially difficult because of the lack of SMEs implementing the ERP systems and the fact that companies would not agree to provide their confidential information. However, despite these difficulties the case study survey was successfully completed with the cooperation of the researchers and Iranian SMEs managers.

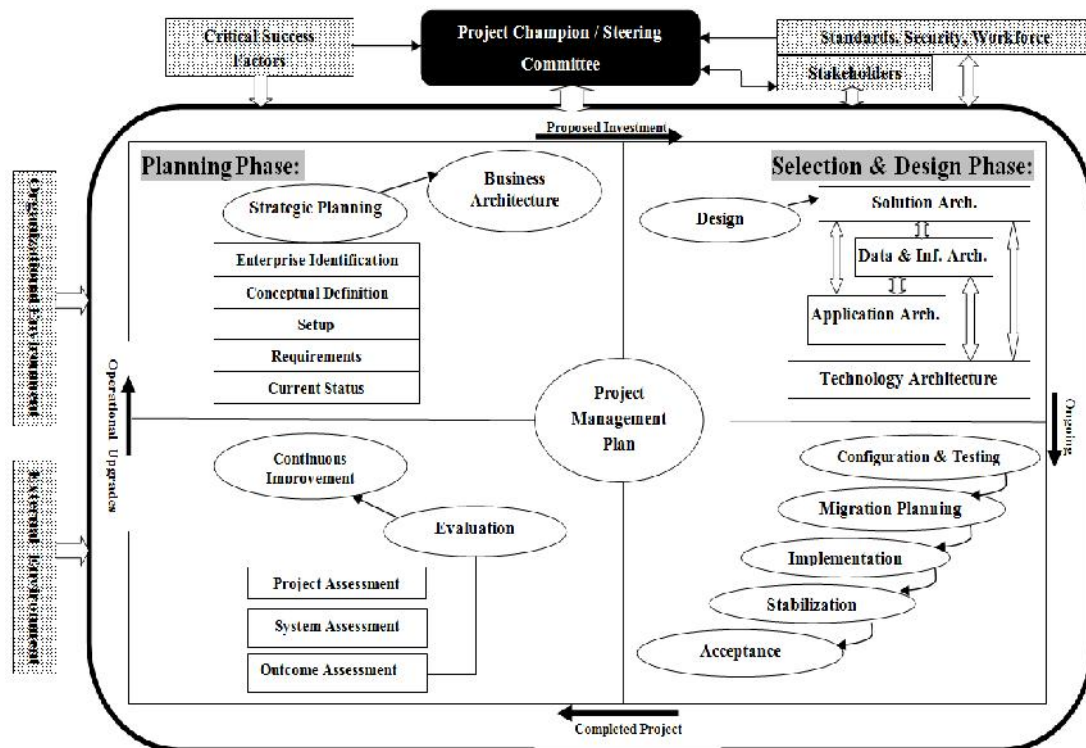


Figure Error! No text of specified style in document.1 Conceptual framework for ERP implementation in SME [28]

Table 1 Overview of company and respondents backgrounds

Specification title	Pars Refractories Co.	Aien Talash Co.	Nabi Akram College	Azar Foolad Amin Co.	Laleh Tabriz Hotel
Field of industry	Producing of refractory materials	Oil and Gas project construction	Education	Steel	Tourism and hotel
No. of employees	230	20	70	121	230
Size of company	Medium	Small	Medium	Medium	Medium
Year of establishment	1986	1996	1995	2009	2008
When was the system implemented?	2005	2007	2001	2009	2008
When was the systems updated?	2011	2012	2010	2011	2011
Period of time for system implementing/upgrading (days)	90	30	20	90	90
Experience of respondent (Year)	11	10	12	33	17

SMEs vary with large firms in terms of environmental uncertainty, dependency, centralization, specialization,

Cross Case Discussion of ERP Systems Implementation Current Practices

Cross case comparison of ERP systems implementation practices among the five case study companies are summarized in Table 2. The findings have been confirmed the lacking of comprehensive methodology for ERP implementation in case study SMEs.

according to the respondents' claims as implementation rate of the elements in their project.

Comparative Summary of Case Companies

The author met the respondents in order to complete the

Table 2 Cross case comparison of information systems implementation

No.	Current Status	Companies				
		A	B	C	D	E
1	Structured and formal implementation approach	-	-	-	-	-
2	Utilization of enterprise architecture approach	-	-	-	-	-
3	Utilization of design of the system approach	x	-	-	-	-
4	Utilization of implementation approach	x	x	x	x	x
5	Utilization of evaluation approach	-	-	-	-	-
6	Utilization of upgrading / maintenance	x	x	x	x	x
7	Use of project management plan	x	-	x	-	-
8	Including of critical success factors	-	-	-	-	-
9	Relationship with users, managers and consultants	x	-	-	-	-
10	Considering the organizational structure	x	x	x	x	x
11	Considering the external environment	x	-	x	x	-
12	Considering the standards	x	x	-	x	-
13	Utilization of workforce plan	-	-	-	x	-
14	Considering the project championship	x	x	x	x	x
15	Documented methodology processes	x	-	x	-	-
16	Detailed roadmap to provide guidelines	-	-	-	-	-

Legend:

X: Considered in current practiced methodology

-: Not considered in current practiced methodology

None of the companies has a comprehensive framework with detailed guidelines as the roadmap for implementation of the ERP system. Only companies A and B have documented their implemented system and used it for upgrading and maintenance. None of the companies plan the workforce, their roles and duties for staffs at different levels of organization.

interview report in several rounds. Telephone conversations and online chats were also conducted to confirm the answer and get vigorous data. The respondents had tested the application and validity of the framework for approximately 4 months.

All companies responded very positively to the proposed

Table 3 Cross-case evaluation of the approaches and elements

Specification	Companies				
	A	B	C	D	E
Project champion / Steering committee	80%	95%	70%	50%	70%
	The steering committee established	The steering committee established	Top manager is project champion	Managing director as project committee	The steering committee established
Project management plan	100%	95%	80%	50%	55%
	Considered completely	Designed well	Designed by internal experts	Not complete because of lacking technical employee	Designed by internal experts
Critical success factors	35%	65%	60%	30%	35%
	Considered (not completely)	Considered (not completely)	Considered (not completely)	Considered (not completely)	Considered (not completely)
Organizational environment	80%	90%	95%	60%	60%
	Considered	Considered	Considered	Considered (not completely)	Considered (not completely)
External environment	About 100%	90%	75%	75%	70%
	Regarding strategic planning all items are considered	Considered	As possible as regarding the top management authority	Considered (not completely)	Considered (not completely)
Workforce plan	90%	90%	75%	50%	55%
	Done	Done	As possible as regarding the working laws	Done (not completely)	Done (not completely)
Standards	90%	80%	85%	--	--
	As needed as especially in information security	ISO9002, quality and productivity standards	ISO9002, quality and productivity standards	Not done	Not done

Table 3 shows the summary of the comparison for operational examination of the approaches and elements in the proposed framework. The percentage values are

framework and agreed that the framework is adequate and feasible to be implemented and generic into operational form. All the respondents except Company D believe that the framework is clear and easy to understand and

implement. They also claimed that it does not need crucial technical knowledge and tools.

revision of the framework. Table 6 shows the revision actions taken for this purpose.

Table 4 Cross-case evaluation of the approaches and elements (continued)

Specification	Companies				
	A	B	C	D	E
Security plan	90%	30%	50%	--	--
	Done in proper level	Done (not completely)	Physical security is considered	Not done	Not Done

Companies B and E stated that the framework should be simpler to be understood by everybody (technical and non-technical) involved in the project implementation and operation. Company D feels that the framework is more usable by the managers and system analysts and if it is broken down to separate frameworks specified for different groups of stakeholders with different duties and experiences, it can be more suitable for them. Companies D and E suggested including continuous training and education for improving under standability and usability of the framework in real operations. All companies agreed that there are no missing elements and links in the framework.

Suggestions for Revision and Improvement

After analyzing the feedbacks of the respondents and discussion with them to clarify their opinions, a number of suggestions were obtained that require revision and improvement of the framework. Table 5 shows a summary of the suggestions. The suggestions were addressed as much as possible in new version of the revised framework. Finally, the suggestions were included in the framework and some parts of the framework were revised.

Table 5 Summary of suggestions from the case study companies

No.	Suggestion	Companies				
		A	B	C	D	E
1	Simpler methodology process	x	x	x	x	
2	Including of training				x	x
3	Including of qualitative and quantitative assessment in each stage	x				x
4	Including CSFs in the framework scheme	x	x	x		
5	Stronger relevance for some CSF and implementation stage	x		x		x
6	Specify the stakeholders clearly		x			

Table 3 Actions of revision as response of suggestions

No.	Suggestion from case companies	Action of revision as response
1	Simpler methodology process	Framework and methodology were revised and simplified- with detailing of the implementation procedures (Figures 6.8 to 6.12)
2	Including of training	Including the CSFs with the framework and methodology stage processes
3	Including of qualitative and quantitative assessment in each stage	Detailing of the sub-stages in each phases of implementation (Figure 6...)
4	Including CSFs in the framework scheme	Including the training and education factor in the methodology
5	Stronger relevance for some CSF and implementation stage	Including the evaluation for each stages of implementation
6	Specify the stakeholders clearly	Included in methodology process flowchart
		Revision of the relevance rate of CSFs with implementation stages
		Stakeholders and their duties are specified using the CSFs in implementation methodology stages

Development of Revised Framework

After combining the suggestions of the case companies (Table 5), the author responded to the suggestions with

In response to suggestions for simplifying and detailing the methodology of the framework, the revised form was more detailed including the CSFs with each stage in the processes flowchart.

Figure 7 shows the revised framework with the relevant CSFs in the stages of implementation. The sequence of the critical success factors in the boxes under each stage in the life cycle shows the importance and relevance rate of each factor in the implementation stage. In addition, to enhance user friendly rate for the proposed framework, the detailed stages of implementation phases are described in Figure 8 to Figure 12.

The specifications and full name of the CSFs in Figure 6.7 are:

- F1) Culture and Resource Management
- F2) Project Management and Evaluation
- F3) ERP Project Team and Training
- F4) Process Reengineering and Change Management
- F5) Technology Management and Control
- F6) Upper Management Support, Commitment and Communication
- F7) Consultant and Vendor Services

Validation of Revised Framework

Once the framework was revised, for the validation of the revised framework, interviews were held and 21 questions were asked from the same respondents at the five case companies. Appendix E shows the protocol of the revised framework validation. The interview was done using the open-ended questionnaire. All the companies agreed that the framework was suitable, generic, understandable, implementable and adequate for ERP implementation in SMEs. They also mentioned that this framework prepares a structural and comprehensive guideline for implementation of ERP systems in SMEs.

They believed that the framework is easily understood and used. Furthermore, they agreed that there is not any wrong link and elements in the framework.

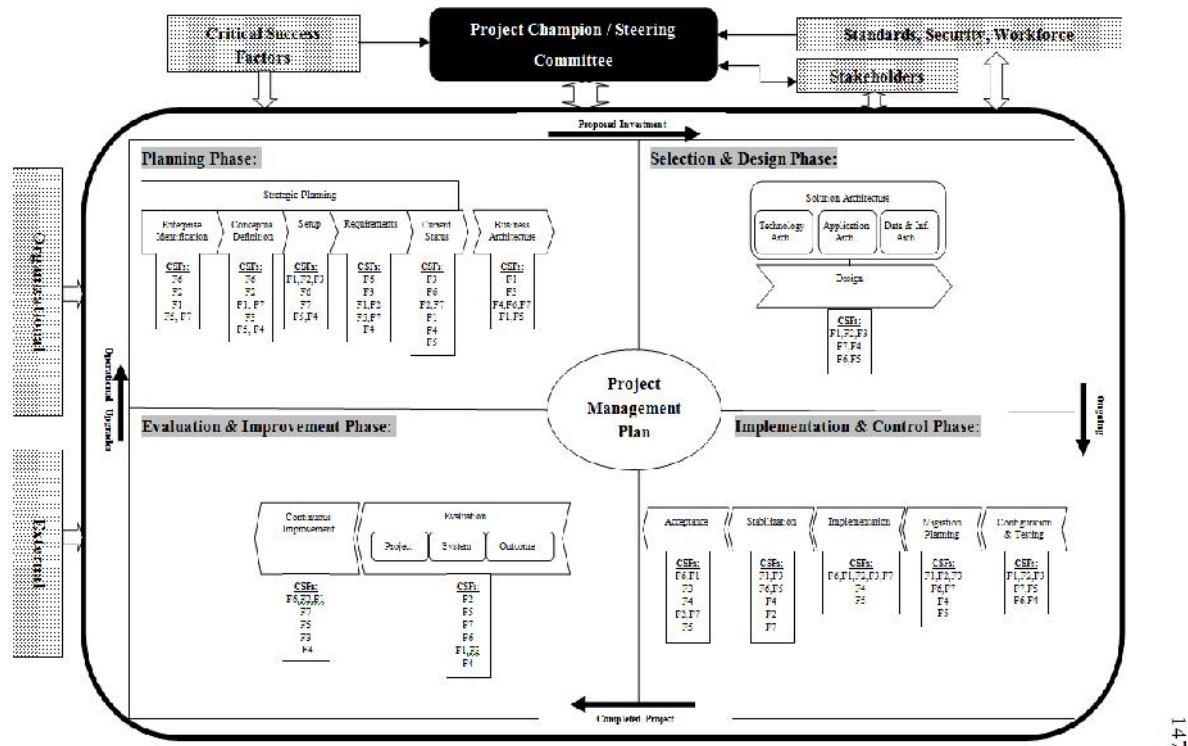


Figure 7 Revised framework of ERP Implementation for SMEs

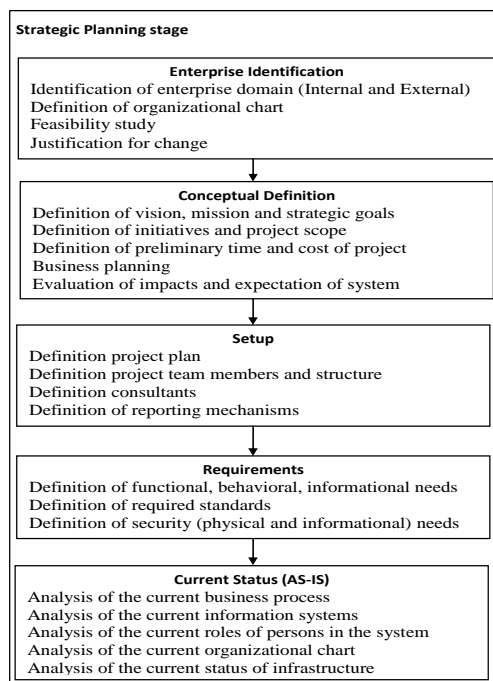


Figure 2 Detailed Phase one - Strategic Planning stage

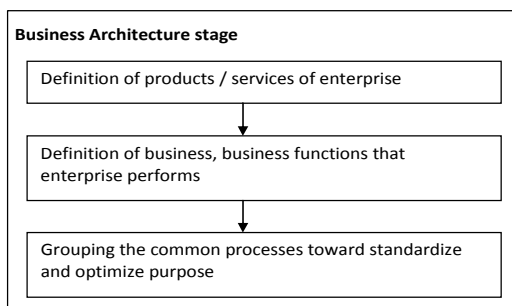


Figure 3 Detailed Phase one – Business Architecture stage

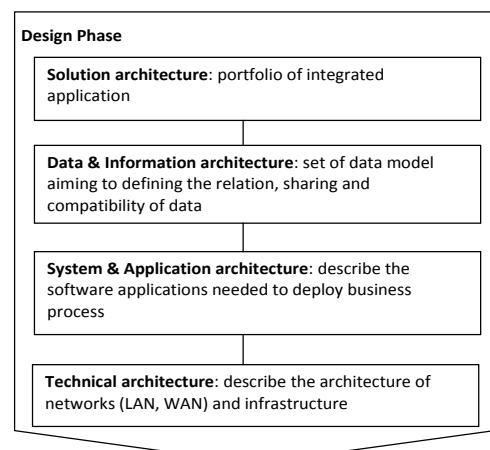


Figure 4 Detailed Phase two (Design) stages

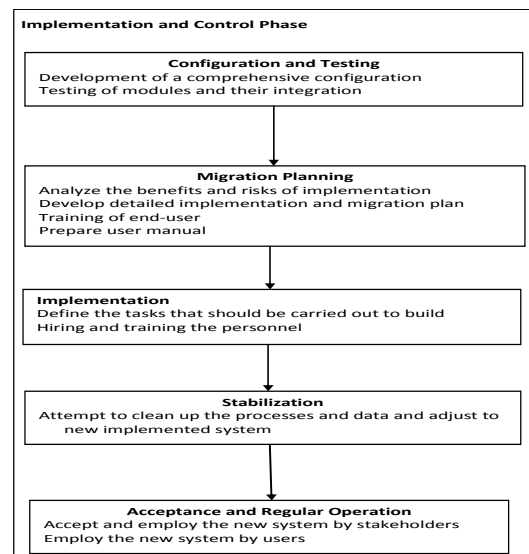


Figure Error! No text of specified style in document..5 Detailed Phase three of the implementation

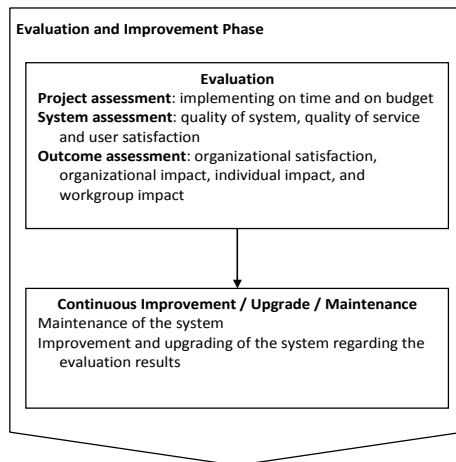


Figure Error! No text of specified style in document..6 Detailed Phase Four of the implementation

They also mentioned that the CSFs relevance are included and shown well in the proposed framework. The summary results of these interviews are shown in Table 7.

approaches such as the workforce, champion of the project, standards and security (informational and physical) are neglected in their framework but are included in the proposed framework.

The proposed framework in this study is also far more detailed and simpler and comprehensive than Markus and Tanis [30] framework. Their framework does not include operational life cycle to implement the system in SMEs. The life cycle and detailed implementation methodology is considered in the proposed framework.

The recent frameworks are either descriptive which only specify what article and views are there or prescriptive which show the actions and processes that should be undertaken to implement some task. The proposed framework in this study follows a combined approach incorporating both specifications for identifying the articles and views are required and also representing of the methodology and lifecycle to implement of ERP systems.

The framework of Somers *et al.* [31] can be considered as

Table 4 Validation results of the revised framework

No.	Question	Responses from Case Study Companies				
		A	B	C	D	E
1	Is the framework comprehensive/complete enough to implement of ERP in SMEs?	++	+	++	+	+
2	Is the framework simple enough to implement of ERP in SMEs?	+	+	+	+	-
3	Do you believe that the framework easy to be used and applied?	++	+	+	+	-
4	Do you believe that the framework easy to be understood?	+	+	+	+	-
5	Do you believe that all needed elements and articles are included in the framework?	++	++	+	+	+
6	Is there any wrong element in the framework?	-	-	-	-	-
7	Is there any wrong link in the framework?	-	-	-	-	-
8	Is the framework generic and nor prescriptive enough?	++	+	+	++	+
9	Does the framework address the enterprise-wide communication and facilitate it?	+	+	+	+	+
10	Does the framework include all needed stages of implementation process?	+	++	+	++	+
11	Does the framework include all needed elements of implementation process?	+	++	+	+	+
12	Can the framework integrate the needed activities of implementation process?	+	+	+	+	+
13	Does the framework include all related stakeholders?	+	+	+	++	+
14	Is the framework capable for operational usage?	++	+	++	+	+
15	Does the framework depend on special and technical tools and experts?	-	-	0	0	-
16	Does the framework use from technical tools enough?	+	++	+	+	+
17	Does the framework consider all critical success factors (CSFs) affect on ERP implementation?	++	++	+	+	++
18	Does the framework consider all relationship between the critical success factors (CSFs) and implementation stages?	++	+	+	+	++
19	Is there any not-need/miss-interrelationship between the critical success factors (CSFs) and implementation stages?	-	-	-	0	-
20	Is there any missing critical success factors (CSFs) in the framework?	-	-	-	-	-
21	Can the framework use as guideline for implementation and documentation of the system?	++	+	+	+	++

++: Strongly positively, +: Positively, -: Negatively 0: None

Based on interview results in the case study companies, it is concluded that the proposed framework is adequate and there is no need for any further revision.

Comparison of Proposed Framework with Others

To approve the validation of the proposed framework, it was compared with other frameworks developed for implementation of ERP systems. Jenson and Jonson framework [29] proposed for large-scale systems and present only 6 steps to follow for implementation of ERP systems. The proposed framework aimed in this research is far more comprehensive and applicable for SMEs. The

a conceptual model and is not adequate to be used as an implementation framework for ERP systems of SMEs. The framework of Parr and Shank [32] showed only 3 stages of implementation whereas the proposed framework of this research has contributed adequately to answer all the requirements of SMEs for implementing their ERP systems.

The critical success factors of ERP implementation and their relevance and significance in different stages of implementation are not considered in Ehie and Madsen [33] framework. The proposed framework in this study

includes the CSFs and their relevance for the stages of implementation. This framework was evaluated in case study SMEs and have proved that is comprehensive and detailed in addition to being simple and usable toward answering to ERP systems implementation projects in SMEs.

CONCLUSION

This study was aimed to assess an extended framework for ERP implementation in SMEs. The researchers believe that the contributions of this research can be used as a comprehensive guideline for the users, consultants, managers and vendors of these projects.

The robustness of the framework has been tested and validated in Iranian SMEs as case studies. The framework is applicable to ERP system implementation in practice and provides guidelines and roadmap for study, implementation and management of the system with a potentially powerful decision aid. The cases claimed that they have not had any specific framework to implement or update their IS and ERP system and any other IT projects and the current frameworks are less suitable for SMEs. The case companies strongly believed that the proposed framework is a novel model that can assist SMEs in ERP implementation comprehensively.

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Appendix E

Validation of the Revised Framework for ERP Implementation in SMEs

The objective of this interview is to validate the final framework. It is to determine whether the proposed framework can be appropriately applied for ERP implementation in SMEs of developing countries. The framework derived from literature review and case studies and was examined in the operational approach. The results obtained from this exercise will be validated the framework.

Validation questions for the aforementioned purpose are in the following pages. Please give your feedback on these questions.

Note: The final revised framework and its implementation stages details are in the next page. Please study it before to answer the interview

Questions

1. Is the framework comprehensive/complete enough to implement of ERP in SMEs?
2. Is the framework simple enough to implement of ERP in SMEs?
3. Do you believe that the framework easy to be used and applied?
4. Do you believe that the framework easy to be understood?

5. Do you believe that all needed elements and articles are included in the framework?
6. Is there any wrong element in the framework?
7. Is there any wrong link in the framework?
8. Is the framework generic and nor prescriptive enough?
9. Does the framework address the enterprise-wide communication and facilitate it?
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16. Does the framework use from technical tools enough?
17. Does the framework consider all critical success factors (CSFs) affect on ERP implementation?
18. Does the framework consider all relationship between the critical success factors (CSFs) and implementation stages?
19. Is there any not-need/miss-interrelationship between the critical success factors (CSFs) and implementation stages?
20. Is there any missing critical success factors (CSFs) in the framework?
21. Can the framework use as guideline for implementation and documentation of the system?

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