



ERP Implementation Road Map for Small and Medium Size Enterprises (SMEs)

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Abstract

The definitions of small and medium enterprises (SMEs), vary from country to country and industry to industry, each country or region have their own definition which depends on who define it and where is utilized. SMEs play an essential role in most economies, particularly in developing countries. Many large enterprises depend on SMEs (Startups) for their supply chain; thus, SMEs need to adopt Enterprise Resources Planning (ERP) systems more and more. Since ERP system adoption is a challenge project in SMEs, the main purpose of this article is to propose an ERP implementation roadmap for SMEs. This work proposes a road map for ERP implementation in SMEs. It consists of three major stages and eight phases. The paper concludes that even though ERP is important to SMEs, its implementation is challenging, and organizations must prepare adequately to get it right.

Keywords: Enterprise Resource Planning, ERP life cycle, Small-and-Medium-Sized Enterprises, ERP implementation roadmap.

1. Introduction

The growing of e-business represents obstacles that might be faced by SMEs. ERP system provides several advantages to SMEs to overcome operational difficulties and enhances cooperation among various functions results in lower cost production, higher quality of product and service, higher customer satisfaction and increase market share. Although there are several advantages in implementing ERP systems, some of the ERP systems failed to deliver the required results. These failures are due to poor implementation of ERP systems or the organization is not ready for implementing it yet.

This work aims to propose an ERP implementation road map that can serve as a guideline for SME's to assess their ERP implementation readiness and to help in choosing the appropriate ERP technology and vendors. The reminder of the paper is structured as follows. First, it provides an overview of SMEs and its definition followed by the literature of ERP: models, criteria for selection and implementation aspects.

The proposed road map is outlined next, with details of each stage and phase and how each phase can be used. The next section is the possible deployment of ERP implementation from SMEs perspective and discussion. Finally, the paper concludes with findings and future directions.

2. Small and Medium Enterprises (SMEs)

There is no universal definition for small and medium enterprises (SMEs), The European Commission categorized SMEs based on number of employees as follows: small size (less than 50) and medium size (less than

250) [1]. [2], stated that the official and nonofficial SMEs contribute by 60–70% of Gross Domestic Product. SMEs offer new job opportunities to form middle class of society preserving the social and politic stabilization in a country [3]. SMEs playing an essential role in the world economy, they participate substantially to the native economy and investment [4].

Although the vital participation of SME, they meet several obstacles that prevent them from working with entire efficiency. Amongst these obstacles [4]–[10]:

- Difficulties in accessing finance,
- Imperfect use of Information Technology,
- Poor attitudes towards customers,
- Inadequate requirements definition,
- Risks in ERP project implementation,
- Their lines of communication are shorter.
- Limited access to external sources of advice and support,
- lack of business Research & Development,
- Barrier to adopt e-applications,
- Lack of institutional quality,
- Competency and capability,
- Non-availability of a logistics chain,
- lack formal documentation, and

3. Enterprise Resource Planning (ERP)

In recent years, ERP systems are the most effective computer application in manufacturing industry, it enables an organization to integrate all the primary business processes to enhance efficiency and maintain a competitive position. Successes and failures of ERP implementations have been widely cited in the literature as follows:

3.1 ERP Implementation Models

There is a considerable number of researches that proposed models for ERP implementation. [11], developed theoretical model with four critical characteristics that effect ERP implementation in Taiwan’s SMEs: CEO characteristics, innovative technology characteristics, organizational characteristics, and environmental characteristics. [12], proposed an ERP implementation model for SMEs based on three categories: Technology, Organization and People domains. Also, [13] proposed an integrated decision-making model for ERP implementation using “analytical regression model, a simulation model and a nonlinear programming model”. Recently, [14] suggested an incorporated model to select specific ERP systems for SME- in China using “the modified Delphi technique, analytic hierarchy process, fuzzy comprehensive evaluation and grey relational analysis”. Also, [15], proposed an integrated model for implementing of ERP based on the stage-gate method, which has been extended by incorporating both pre-implementation and post-implementation activities. More recently, [16] proposed an enterprise resource planning (ERP) implementation model based on the agency theory and the Delone and McLean information systems (IS) success model.

3.2 ERP Implementation Factors

There are many factors affecting ERP implementations, most researchers focusing on the following factors [17], [18], [27], [19]–[26]:

- Organizational factors,
- Changing management,
- Supply chain copartner and network pressure,
- Human factors (training & skills of workforce),
- Hardware and software,
- Complexity of ERP System,
- Security Policies and Administration,
- Business complication,
- Project management,
- Management support,
- Technological factors,
- ERP Readiness,
- ERP team,
- ERP Customization.

Whereas, the factors might affect ERP implementation in SME can be summarized in the following ([5], [19], [27]–[34]):

- Human resources management,
- Production rate,
- Limited budget and resources
- ERP Readiness,
- Training and education,
- Project management,
- Legal and regulatory issues
- Cost management,
- Quality,
- Lack of experiences,
- Supply chain management,
- The level of existing technology,
- Cultural Factors, and

3.3 ERP Readiness Framework

The ERP implementation Failures could due to various factors. [35]stated that ERP Readiness Assessment (ERA) should be presented as a separate phase for ERP projects before kicking-off the project to avert the possibility risks in next phases. There are many researchers proposed numerous ERP implementation readiness assessment framework. [36]proposed the BEST (Better Enterprise SysTEM implementation) Framework to assess CEO (cause–event–action–outcome) chain. The BEST framework has three dimensions namely” permanent business, project management, and Enterprise system”.

Moreover, there are six aspects in the framework, namely “strategy and goals, management, structure, process, knowledge and skills, and social dynamics”. [37]proposed framework to evaluate the ERP readiness level for adoption in manufacturing SMEs. This framework has 4 dimensions namely” organizational context”,” external forces”,” perception of ERP”, and “business processes” with 13 related factors. [38]suggested organizational framework of readiness assessment for ERP by using Analytic Hierarchy Process (AHP). Their framework divided into four parts, namely; “technoware, humanware, inforware, and orgaware “with 37 sub-factors. [39]constructed “practical framework for ERP readiness assessment by using Fuzzy Analytical Network Process (Fuzzy ANP)”. Their framework grouped into three categories, namely, “organizational, project management, and change management readiness with five factors, are project, vision and goals, systems and processes, culture and structures, and human resources” with 15 sub-factors.

3.4 ERP System Selection Criteria

There are different approaches, factors, and corresponding criteria to select a suitable ERP project. These factors can be summarized in the following criteria: [40]–[45]

- Flexibility,
- Business functionality,
- Technology,
- Vendor credentials,
- Cost (purchasing and consulting costs),
- Affordability,
- Business domain knowledge,
- Financial analyses,
- General characteristics,
- Data and knowledge properties
- Reputation (vendor’s ability and condition).
- Strategy fit,
- Business processes,
- Risk,
- Implementation capability,
- Local support,
- Suppliers,
- Production planning,
- System control,
- Software design,
- Quality, and

3.5 ERP Selection Methods

There are varies researchers have suggested different methods to solve the problem of ERP selection, each method differs from the others depending on their used tools and complexity. Some of these methods are rely on ranking and scoring techniques as [43], [46]–[49]:

- Utility Ranking Methods (URM),
- Analytic Hierarchy Process (AHP),
- Analytic Network Process (ANP),
- Hierarchical Analysis Process (HAP)

- Attribute Decision Making (MADM),
- Data envelopment analysis (DEA),
- Systematic Help ERP Acquisition (SHERPA),
- Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and
- Fuzzy Logic (FL),
- Priority Matrix (PM),

Although many research articles covering various topics and issues related to ERP systems adoptions, ERP implementation in SMEs is still at the infancy stage especially in developing countries. Therefore, Investment in ERP systems is an important strategy that enables SMEs to achieve competitive advantages and provide good quality of service.

4. Proposed ERP Implementation Roadmap for SMEs

There are several researches tried to propose a successful procedure for ERP systems implementation ([50], [51], [49] and [52]). Most of them concentrated on the implementation stage and applied the proposed models on multinationals or large companies not on small and medium-sized enterprises (SMEs).

4.1 Research Methodology

In accordance with the models proposed by previous researches, a roadmap for ERP implementation in SMEs was proposed to help organizations to assess its ERP implementation readiness level and to find out which specific area should be focus on and improved. The research methodology is based on the review of literature on ERP implementation in SMEs, also, it is based on articles collected from many sources in given range of publication years (2010-2020).

4.2 Proposed Roadmap Components

The proposed roadmap consists of three major stages and eight phases as shown in Figure 1:

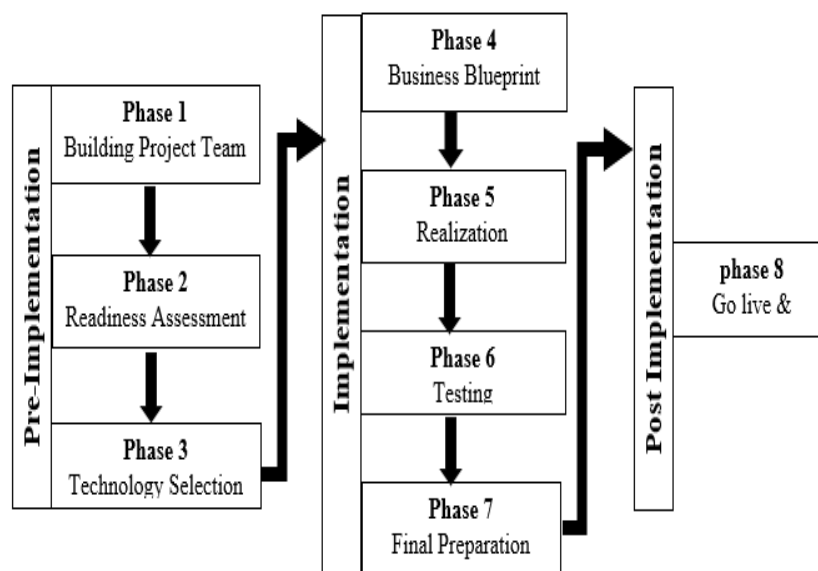


Figure 1: The proposed framework for ERP implementation in SMEs

4.2.1 Stage 1: Pre-Implementation

The first stage in the proposed roadmap is the pre-implementation stage which consists of three phases as follows:

4.2.1.1 Phase 1: Building Project Team

The first step in this phase, is to establish the project team based on their competence and knowledge. Team building is the process of turning a group of employees into a cohesive team to work together to meet the predefined purpose and goals.

4.2.1.2 Phase 2: Readiness Assessment

In this phase, three implementation drivers, six factors and 18 criteria for assessing organization's readiness for implementing ERP were selected based on pervious researches as shown in Table 1.

Table 1: The proposed readiness assessment criteria

Drivers	Factor	Criteria
Technology	Infrastructure	IT Infrastructure, Business processes & Communication
	Competence	Management's skills, Staff's skills & Reputation
Environment	Regulations	Formalization, Strategic IT plans & Legal and regulatory issues
	Pressure	Top management support, Company-wide commitment & Organizational culture
Organization	Strategy	Vision and mission, Goals/ objectives & Organizational structure
	Employee's engagement	Shared beliefs, Human resource management & Training and education

4.2.1.3 Phase 3: Technology Selection

Based on the results of assessment ERP readiness, the project team should specify the evaluation criteria for selecting the appropriate ERP Technology. The criteria were selected based on [41]–[44], [53] and [45] works. These criteria were divided into two main groups:

- ERP product selection group which consists of three drivers: Quality, Investment, and Business Process Reengineering (BPR) as shown in Table 2.
- Stakeholder selection group which consists of three drivers: vendor, consultants, and client as shown in Table 3.

Table 2: The ERP product selection criteria

Group	Drivers	Criteria
ERP product selection	Quality	Portability, Maintainability, Efficiency, Usability, Reliability & Functionality.
	Investment	License fee, Consultant expenses, infrastructure, expenses, Maintenance and upgrading cost & Implementation time.
	Business Process Reengineering	Ability to achieve strategic goals, Ease of customization, Ease of implementation & Algin with business procedure

Table 3: Stakeholder selection criteria

Group	Drivers	Criteria
Stakeholder selection	Vendor	Experience in the SME industry, Reputation, Terms and period of guarantee, Technical capability, Training-support, Consulting performance, R&D capability, License Cost, Service and

		support Cost, & Implementation Time, latest trends in IT technology & Supplying ongoing support.
	Client	Organization size, Desired Business Processes, Organization budget & Technical Infrastructure.
	Consultant	ERP implementation experience, Implementation cost, Training cost, Development cost & Support after going live

4.2.2 Stage 2: Implementation

Implementation stage consists of four phases as follows:

4.2.2.1 Phase 4: Business blueprint

Based on the results of assessment ERP readiness, the project team should specify which area should be focus on to improve. Unfortunately, embarking on ERP initiative in SMEs may be a destroying and overwhelming experience. The Blueprint technique helps SMEs to minimize the risk associate with these initiatives and maximize ERP value. It helps also in understanding the business requirements, and how ERP can be customized.

4.2.2.2 Phase 5: Realization

In this phase, the project team prepare and configure the new technology by customizing the software/hardware to support the implementation processes.

4.2.2.3 Phase 6: Testing

ERP testing is the critical component of a successful ERP implementation and the last phase before the system goes live. Testing must be done at all stages and all levels of the organization. A system testing is a software tool or a document that outlines and prepares software testing in systematic way to discover bugs as quickly as possible and ensure that all the organization's business processes involved in the implementation of ERP happen in the correct way [54]

4.2.2.4 Phase7: Final preparation

This phase is the last phase before system goes live, this can be done through the following steps:

1. Create a help desk,
2. Fix the system's issues and bugs.
3. Terminate the data migration process.
4. Provide the end-users training.
5. Provide the end-users manual.
6. Determine the Go Live date.

4.2.3 Stage 3: Post Implementation

Post Implementation stage consists of one phase as follows:

4.2.3.1 Phase 8: Go live & support

The main purpose of this phase is to assist the users after live broadcast, manage new releases and maintain the evolution. In go-live, the system code moves from the test environment to the production environment. Continuous monitoring is very important in this stage to make the substantial modification as soon as possible if the system's performance disappointed specially in the first days after using the new system.

5. Proposed Roadmap Deployment

Unfortunately, there are many difficulties in implementing ERP systems in SMEs, especially, when ERP is used for the first time. The propose road map is an ERP implementation guideline to assist SMEs businesses to implement ERP applications successfully. In this section, a step-by-step implementation processes and research tools will be described starting from building project team to "Go live". This part describes

5.1 Phase 1: Building Project Team

For designing, developing and supporting cooperative and responsible team, follow the guidelines below:

1. Setting clear target for the results that the team will come out with to.
2. Setting clear objectives to measure the team's performance.
3. Define harmonic and regular communication mechanism between team members.
4. Assign the role of leader & the communicator.

5.2 Phase 2: Readiness Assessment

In this phase, a check list could be used to assess the level of applications for the proposed criteria as shown in Table 4. No. 5 represents the good/sufficient applications and No. 1 represents the bad/insufficient applications.

Table 4: Rreadiness assessment check list

Drivers	Factor	Criterion	Measuring Scale				
			Bad	Applications			Good
			1	2	3	4	5
Technology	Infrastructure	IT Infrastructure					
		Business processes					
		Communication					
	Competence	Management's skills					
		Staff's skills					
		Reputation					
Environment	Regulations	Formalization					
		Strategic IT plans					
		Legal and regulatory issues					
	Pressure	Top management support					
		Company-wide commitment					
		Organizational culture					
Organization	Strategy	Vision and mission					
		Goals/ objectives					

	Employee's engagement	Organizational structure					
		Shared beliefs					
		Human resource management					
		Training and education					

5.3 Phase 3: Technology Selection

One of the problems may face the decision makers is how to select the appropriate ERP systems, two check lists can be used to simplify this decision. Table 5 shows ERP product selection check list, whereas Table 6 shows Stakeholder selection check list.

Table 5: The ERP product selection check list

Drivers	Criteria	Measuring Scale				
		Bad	Applications			Good
		1	2	3	4	5
Quality	Portability					
	Maintainability					
	Efficiency					
	Usability					
	Reliability					
	Functionality					
Investment	License fee					
	Consultant expenses					
	infrastructure expenses					
	Maintenance and upgrading cost					
	Implementation time					
Business Process Reengineering	Ability to achieve strategic goals					
	Ease of customization					
	Ease of implementation					
	Align with business procedure					

Figure 6: Stakeholder selection check list

Drivers	Criteria	Measuring Scale				
		Bad	Applications			Good
		1	2	3	4	5
Vendor	Experience in the SME industry					
	Reputation					
	Terms and period of guarantee.					
	Technical capability					
	Training-support					
	Consulting performance					
	R&D capability					
	License Cost					
	Service & support Cost					
	Implementation Time					
	latest trends in IT technology					
Client	Supplying ongoing support					
	Organization size					
	Desired Business Processes.					
	Organization budget					
	Technical Infrastructure.					

Consultant	ERP implementation experience					
	Implementation cost					
	Training cost					
	Development cost.					
	Support after going live					

5.4 Phase 4: Business blueprint

This can be done through the following steps:

1. **(AS IS) analysis:** AS IS analysis the process of collecting detailed data about the currently performed processes to identify weakness and assess potential improvements.
2. **(TO BE):** TO-BE is depend on the as-is analysis and on the weakness issues and determine the desired processes that will be expected to improve the shortage in current process.
3. **Gap analysis and action plan:** Gap Analysis is the process of comparing current state of business process to desired expected future state of business process that should be implemented by ERP, then creating possible actions to address the identified gap. The work team can exhibit the gap analysis to its ERP vendors or implementation partner and ask them to explain how ERP system can map the current process (AS IS) to desired process (TO BE) and identify potential solutions to bridge this gaps.

5.5 Phase 5: Realization

This can be done through the following steps

1. Developing integration with other existing business applications.
2. Build the hardware infrastructure.
3. Install the software and customizations.
4. Data migration from legacy systems to the new system.
5. Develop training materials to users
6. Integration tests
7. Drawing up end-user documentation
8. Conducting end-users training

5.6 Phase 6: Testing

There are different types of ERP Testing can be used:

1. Functional Testing
2. Business Process Testing
3. Data Conversion/Migration Testing
4. Application/Data Integration Testing
5. Performance Testing
6. Security Testing

5.7 Phase7: Final preparation

This phase is the last phase before system goes live, this can be done through the following steps:

1. Create a help desk,
2. Fix the system's issues and bugs.
3. Terminate the data migration process.

4. Provide the end-users training.
5. Provide the end-users manual.
6. Determine the Go Live date.

5.8 Phase 8: Go live & support

This can be done through the following steps:

1. The work team support the Help Desk,
2. Rework and fix the bugs
3. Monitor the functional performances,
4. Make necessary upgrade.

6. Conclusion

The implementation of ERP in SMEs have been found convenient when the SMEs have ready and have appropriate infrastructure systems to avail. It is understood from the literature that most of the ERP implementations are not successful. So, this paper provided good background pertaining to the principles and concepts of ERP implementation in SMEs. Although this research provides participation to the domain of ERP implementation in SMEs, the issues are insufficient at this stage, and it is expected that future practical and academic studies will be conducted from this emerging trend, especially in economic recession period due to COVID 19, where the survival of companies is critical and threatened.

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