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Framework for implementation of Enterprise Resource Planning (ERP) Systems in Small and Medium Enterprises (SMEs): A Case Study.

O. Alaskari^{a,*}, R. Pinedo-Cuenca^b, M. M. Ahmad^c

^a School of Computing, Engineering & Digital Technologies, Teesside University, Middlesbrough, UK

^b School of Computing, Engineering & Digital Technologies, Teesside University, Middlesbrough, UK

^c Islamia University Bahawalpur, Pakistan

* Corresponding author. Tel.: +447765008205. E-mail address: O.Alaskari@tees.ac.uk

Abstract

Today Small and Medium Enterprises (SMEs) face global challenges and continuous change in consumer demands, most recently COVID-19 and the prospect of a future Serious Acute Respiratory (SARS) pandemic generating further challenges, thus SMEs require to be more flexible to respond quickly to these changes. This can be achieved by transformation into the digital economy, use of Artificial Intelligence (AI) techniques, integrating business processes and to have real-time information which will enable senior management to make better, quicker informed decisions. Enterprise Resource Planning (ERP) is one of the solutions for the SMEs to overcome these challenges and to obtain a competitive advantage. Subanidja, and Broto, 2019 stated that ERP systems are still not widely implemented by SMEs compared to their introduction in large businesses. However, the SME have a justifiable reputation for being proactive, open, willing and receptive to the adoption of new technologies, concepts and improvements. Also, SMEs differ in several inherent characteristics which are likely to impact on the ERP system implementations, hence it does not make sense to use the same frameworks that have been developed for large companies to implement ERP system within SMEs. One of the main risks of adopting ERP in SMEs is that SMEs have limited resources, so they cannot afford to fail to implement ERP system. Therefore, the purpose of this study is to explore ERP implementation process in SME context. The developed framework has been used to implement an ERP system in a SME. It highlighted the issues that need to be addressed while implementing ERP system in SMEs such as clearly defined scope of implementation procedure, suitable project planning and minimal customisation of the system selected for implementation. This study contributed to both research and practice and the research findings could aid practitioners and SMEs when embarking on ERP projects, as well as, to suggest future research avenues.

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Keywords: ERP system; SMEs; ERP implementation

1. Introduction

SMEs are considered to be the backbone of many economies. Over 99% of businesses in the United Kingdom (UK) and the European Union (EU) are SMEs according to the EU definition, which states that they employ between 1 and 249 staff, along with an annual turnover, which does not exceed €50 million (Schoenherr et al. 2010). While SMEs are an integral part of these economies, they also face numerous challenges due to the increasing competition globally thus; the complexity of the processes in the organisation has increased. Therefore, in order for SMEs to be competitive and responsive to continuously changing of the

market, they need to integrate all of the units within company at information level to have the correct information in real time to make quick and appropriate decision. This can only occur by adopting the most appropriate information systems relating to the business strategy of a company. Consequently, ERP systems can be regarded as the backbone of the information systems in organisations (Yang et al., 2007). Kilic et al., 2015 stated that different and diverse pieces of information coming from different processes can be unified by ERP systems for better support of managerial decision-makers. ERP systems are information systems that enable organisations to improve their business processes, minimise information redundancy and improve information integrity

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(Shin 2006; Supyuenyong et al., 2009). Over the past two decades, ERP systems have become one of the most important and expensive implementations in the corporate use of Information Technology (IT). The benefits and importance of ERP systems have been recently accentuated with the continuous development of technology to support the implementation of Industry 4.0 concepts. Concepts such as Internet of Things, visualisation and data analytics have contributed to the development of the next generation of ERP systems characterised by being intelligent and autonomous systems. Such technology has contributed to enhance performance of ERP systems in the areas of planning and scheduling, machine monitoring, maintenance and Salesforce Dot Com (SFDC) (Vidosav and Slavenko 2020). ERP 4.0 technology has been successfully deployed in organisations highly automated enabling the deployment of SMART factories, including digital twin models of factories, production lines and processes. The ERP implementation phase is critical, as it requires a global reconsideration of the business procedures (Quiescent et al., 2006) as well as being the most resource consuming phase. The implementation of an ERP system is a costly and risky endeavour, Subanidja, and Broto, 2019 mentioned that implementation of ERP system needs higher investment and there are associated failures. Thus, following the structure to implement ERP system steps is a critical and difficult exercise for any organisation especially for SMEs, always restrained by limited resources both human and financial to support such initiatives. There are several frameworks proposed by various researchers to implement ERP system in SMEs, such as that developed by (Jagoda and Samaranayake, 2017; Sahran et al., 2010; Metaxiotis et al., 2005). These found that the majority of developed frameworks to implement ERP system use similar methodology of pre-implementation, implementation cycle and post-implementation phases or framework proposed using Critical Success Factors (CSFs). However, they did not consider how the phases of implementation could link together and moving from one phase to another. This gap motivates the current study to develop structure framework by linking all phases of implementation of ERP system and use of the output of a phase as input to other phase. Therefore, this research building on previous research, and contributing to the existing body of knowledge developed an implementation framework that can be utilised by practitioners in SMEs looking to implement ERP systems. The rest of the paper is organised as follows, Methodology is provided in Section 2; the Company Background and Developed Framework are provided in Sections 3 and 4, respectively; the Discussion, Conclusions and the Limitation are given in Section 5, 6 and 7.

2. Methodology

A qualitative approach was adopted in this research, Silverman (2001) argued that qualitative, rather than quantitative, data provides a deeper understanding of certain phenomena. Yin (2009) mentioned that case studies collect rich data and are appropriate to study a contemporary phenomenon within its natural setting. According to Schoenherr et al. 2010 and Galster and Avgeriou 2015, case

study methodology has frequently used in research studying of ERP implementation, believing that this approach is an appropriate one to explore the knowledge dimensions in ERP applications and factors. Therefore, a single case study was selected as the research method, with the analysis of documentation being the main data collection approach. Data collection methods used in this research were literature review, semi-structured interviews nature and document sampling. The literature review was used as secondary source of data by reviewing journal articles and conference papers obtained from various reputed able databases such as IEEE, Google Scholar, Elsevier, Springer, Emerald and Scopus, primarily of literature of ERP implementation in SMEs, certain key words were used to search for articles these include “ERP in SMEs” and “ERP implementation in SMEs”. The data that was collected from the company by the Facilitator, the author, who as the Facilitator was a key member of the ERP system implementation team, who was given access to the company shared drive and samples of documents from different function areas were taken and used as supporting material for this research. Also, the Facilitator was observing and recording company activities by observing different project activities in different project stages, especially during the initial ones. The interviews were of semi-structured nature conducted with the key staff. A team was formed from each department with the correct skill set such as good IT skills. Team members were cross-functional, which added difficulty to the company with no culture of working across functional areas and no experience of such large projects. It consisted of the managers of: Marketing, Procurement, Operations and Finance. All team members were senior with long-term experience in that business. Overall, the team was responsible to plan, execute and control the project as well as the supporting the staff who were stakeholders in the project.

3. Company Background

This was a small-sized company, according to the EU Commission definition of a SME, was located in the North-East of England. The ethical constraint was total company anonymity, entirely understandable in the socio-economic and political situation in which this company was operating, and continues to operate, therefore, the name of the company will remain anonymous. This company provides an accurate perception from SMEs, where ERP systems are not well-known, compare with large companies. This particular company operates in a highly competitive sector, included Automotive, Industrial, Infrastructure, Marine, Nuclear, Oil & Gas, Petrochemical and Renewables, and thus, the need to improve their performance particularly with regard to quality, delivery, flexibility and minimum cost of production was paramount to the company serving a wide range of mainly larger companies across multiple sectors that offer different types of services and products and was aiming to be a world class player by exploring local and international opportunities through the improvement of its flexibly. The main processes of the company were: seeking opportunities, receiving enquiries, producing quotations, sales order and negotiation, order acknowledgement, executing the contracted jobs,

invoicing and lessons learnt. The problem for this company, as with SMEs in general, was operating in dynamic and rapidly changing environment and the use of a variety of Microsoft Excel based templates, a Customer Relationship Management (CRM) system and other systems for the preparation and management of its account, sales, purchases and inventory; however, these systems were stand-alone, not integrated; thus, a lot of work and cost was wasted due to data re-entry, which caused difficulties for the company to manage the complexity of production schedules, maximising equipment and labour use; increasing challenges for the managers and decision-makers to make quick decisions in confidence to respond to the daily changing of the global marketplace due to the company's lack of total visibility and accessibility to real time information. That situation that was the causation of the decision to re-engineer and automate current process of the company and implement an ERP system project to replace all these systems with a single “best-of-breed” integrated solution to improve performance and to produce timely, accurate information relevant and thus strengthen the company's position in the market.

4. Developed Framework

This section presents the theory of the developed framework and discusses the actual ERP installation, customisation, Business Process Re-engineering (BPR), and all other activities that align the system with the company requirements in nine phases, each of which was divided into three steps, namely: Input, Process and Output. The aim of developed framework is to assist SMEs to implement ERP system by undertaking these suggested phases and steps. The steps of the process were developed as a basis for providing a step-by-step, and easy-to-follow, procedure. Indeed, the procedure of the developed framework can be considered as a feedback loop, in which the actions of one step are based on the result of another step; moreover; the whole framework of phases should work in a simple flow form. Some of the criteria were considered when the framework was developed such as to be: simple in structure; systematic and easily to understand; clear between the phases and steps outlined; general enough to suit different contexts; and represent a “road map” and planning tools for implementation.

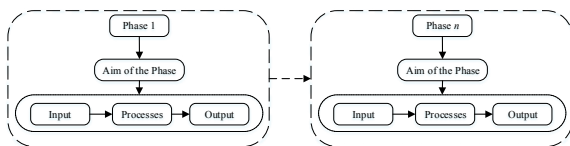


Fig.1. Basic conceptual structure of the framework

4.1. Phase 1: Process Analysis

The aim of this phase was to map out the current workflows of the company. Thus, the input of this phase was the review and examination of the documents and reports currently in use; and the key users were involved in specified business processes with which they were familiar. In the process step discussions were conducted with key users to understand how current processes were performed within the existing system, and assessment of key issues associated with current work

practices. Following conducting these activities, the output of this phase assisted the map out of the current company work processes and workflows, which helped to define any additional requirements or modifications needed to the selected ERP system to characterise the desired business processes with reference to existing business practices.

4.2. Phase 2: Preparing the Scope of Work (SOW)

The aim of this phase was to define the SOW of the processes within the company from the standpoints were the ERP system to be implemented. Thus, the output of Phase 1 an understanding of the existing workflows of the company, was used as input step of this phase. The process step of this phase was a number of meetings between the key staff and the software provider to discuss and understand “As Is” implemented module as well as the need for the customisation of a module to fit the company work processes, and some optional considerations for future phases. The company tried to avoid and to minimised any customisation required to the selected ERP system, as this is time and financial consuming and might affect the core of the selected ERP system, thus little tweaks were needed to current workflow to ensure that the ERP system full configuration and to meet the company needs and, thus, avoid any a conflict between the logic of the ERP system and the logic of the business. The outputs of this phase were a structured document, including milestones and deliverables that were expected to be provided by the Software Provider; thus a clear list of all required data and data load sequences were identified, to adopt in an organised manner, for example, preparing a comprehensive list of: customers, suppliers, contained in a part catalogue in a predefined file format determined by the Software Provider; also, a list of required software customisations, plus an estimate of customisation costs. The output of SOW phase was included in the deliverables agreed upon by the company and Software Provider approved by the company.

4.3. Phase 3: Creating a Project Plan

The aim of this phase was to create a Project Plan for the Software Implantation. The input step in this phase was that proposed by the SOW, namely the output of Phase 2. The process step of this phase was a meeting between the company key staff and the Software Provider to discuss the SOW with the aim to prepare a detailed software modification document, by determining the functionality specified in the SOW, and which functions are not immediately available in the standard software packages. The output of this phase was that of a project work plan, covering project activities and milestones, for implementation, planning training sessions, and testing modifications of the software. After finalising the SOW and delivery project plan the approval of both parties, namely that of the company and the software provider was obtained.

4.4. Phase 4: Build the System

The aim of this phase was the building of the system based on SOW, the input step in this phase was the gathering of the current forms and reports in use. In the process step, the forms templates which were already available in the system were

customised and document layouts, reports were designed, the computer screens and menus were customised by hiding certain tabs to provide that end user with a computer screen devoid of tabs which that user does not use, thus avoiding any confusion, and easing the training of the end users to the software that is specific and user friendly. The selected ERP system has a Business Process Management (BPM) tool, which was used to configure the system by determine appropriate relationship, rules and procedures of the workflow of the business processes in accordance with the company needs. Such a configuration concerns all of the business processes that the system should or should not support. The output of this phase was the finalisation of the forms, reports, customised screens and access authorisation/approval points throughout the processes flow for the end user.

4.5. Phase 5: Preparing the Standard Operating Procedures (SOP)

The aim of this phase was the preparation of SOP documents for all the processes that are covered in the SOW as approved by the company. The inputs in this phase were the SOW and project plan. The process step was the development of SOP and the engagement of the key users by asking them to review the document based on their area of responsibility, and then the validated procedures, with modifications if necessary, the document was signed off by the respective users. The output of this phase was the very specific SOP, step-by-step instructions for users in every role, stipulating how to perform their specific work processes when using the ERP software, this ensures the understanding and consistency in performance of duties and roles for the users.

4.6. Phase 6: Creating a Data Migration Plan

The aim of this phase was to plan for data migration. Data migration is the critical element of the whole project; therefore, it is vital to plan this correctly. Thus, in the input step of this phase the collection of the available data from different departments and the consideration of the standards of existing data, as the departments had different patterns of data classification. In the process step, the current source of data was compared with the system target data (mapped data), in a predefined file format determined by the provider of the software and then, the setting up of certain translation rules; and the review of all data as to its viability, thus the reducing and/or eliminating redundancy; and the cleaning of the data by removing incorrect, corrupt data or outdated from records, tables, and databases prior to the migration to the software. These activities were performed manually, Microsoft Excel templates in Comma-Separated Values (CSV) format, to avoid corrupting were used in this task, and small amount of data (gold sample) was developed and uploaded into the software to test the data, any errors that transpired were rectified, then the data was validated and any corrections applied to ensure that the data was mapped to the correct fields of the software. The output of this phase was the enhanced data loaded into the software. As this phase was time consuming and does not have effect on other phases the work in this phase was undertaken concurrent with other phases.

4.7. Phase 7: User Acceptance Tests

The aim of this phase was to test the SOPs by key users after the data was uploaded into the software. The input step of this phase was the translation from the SOW into SOP documentation in accordance with the system modules. Thus the process step was the involvement of the key user to perform acceptance tests by executing the different work flows and processes according to the SOPs and ensuring that the SOPs reflect the actual steps that users have to carry out, also the modifications were tested and approved by the provided software development team as well as key users from the project team. The output of this phase was the provision of very clear operation procedure documents to be used by users to operate the software.

4.8. Phase 8: User Training

The aim of this phase was for the key users to receive training from the software provider, so the said key users were able to operate the new software and train the other staff within the same department. The input of this phase was to scheduled training practice sessions of key users for each work process. In the process step of this phase, key users were trained on the new application to be carried out on live data in a test system, and the training followed the SOP, including the entering and/or manipulation of documents and other information that is part of the traditional work assignments of the end-users.

The output of the phase was that the key users were trained and corrective issues raised during training sessions were taken into account.

4.9. Phase 9: Go - Live

The aim of this phase was that the project becomes operational, to Go - Live. In the input phase, data was updated and uploaded to the software. In the process phase, key users had the opportunity to input on final questions on the operation of the software in the live environment. In the output phase the system culminated in going live. Finally, IT infrastructure within the company was updated to ensure that all the hardware and server are available to accommodate the new ERP system.

Table 1. Guidelines for the implementation procedure of the developed framework

No	Input	Process	Output
Phase 1	<ul style="list-style-type: none"> Review and examination of current documents and reports 	<ul style="list-style-type: none"> Key users' discussions and assessment to understand current processes 	<ul style="list-style-type: none"> Map current company work processes and workflows. Define additional requirements / modifications to selected ERP system
Phase 2	<ul style="list-style-type: none"> Utilise Phase 1 output - the company's existing workflows 	<ul style="list-style-type: none"> Key staff and software provider meetings to understand "As Is" implemented module. Understand module customisation to fit the company's current & future needs 	<ul style="list-style-type: none"> Documentation milestones, and deliverables to be provided by the software provider. Identify a data and data load sequences Required software customisations, and estimated costs. Agreed SOW and deliverables by company and software provider.
Phase 3	<ul style="list-style-type: none"> Output of Phase 2 proposed by the SOW 	<ul style="list-style-type: none"> Meeting between the company key staff and the software provider to discuss the SOW. Prepare a detailed software modification document, by determining the functionality specified in the SOW Determine which functions are not immediately available in the standard software packages. 	<ul style="list-style-type: none"> Project work plan and implementation milestones Training sessions, and software modification testing
Phase 4	<ul style="list-style-type: none"> Gathering of the current forms and reports in use. 	<ul style="list-style-type: none"> Customise current forms templates document layouts and reports Customise the screens and menus of the system Determine relationship, rules and procedures of business processes 	<ul style="list-style-type: none"> Finalisation of forms, reports, customise the screens, authorisation/approval points
Phase 5	<ul style="list-style-type: none"> SOW and project plan 	<ul style="list-style-type: none"> Develop and validating of SOP's 	<ul style="list-style-type: none"> Step-by-step instructions for all users
Phase 6	<ul style="list-style-type: none"> Collection of all data from all departments and evaluate their standards 	<ul style="list-style-type: none"> Compare current / mapped data Translation rules; review viability of all data Reducing/eliminate redundancy from all records Develop gold sample. uploaded into the software, test data Error rectification Data validation and any corrections ensuring data assigned to correct software fields 	<ul style="list-style-type: none"> Load the enhance data into the software
Phase 7	<ul style="list-style-type: none"> Translation from SOW into SOP documentation 	<ul style="list-style-type: none"> Testing acceptance by according to the SOP's Ensuring the SOP's reflect company requirements 	<ul style="list-style-type: none"> Provision of SOP's for all users
Phase 8	<ul style="list-style-type: none"> Key user training sessions 	<ul style="list-style-type: none"> Key user live data training in a test system 	<ul style="list-style-type: none"> Key user training Corrective issues
Phase 9	<ul style="list-style-type: none"> Uploaded to the software. 	<ul style="list-style-type: none"> Key users check final questions on live environment 	<ul style="list-style-type: none"> Going live

5. Discussion

There is no doubt that the impact of globalisation on business is increasing the competitiveness, and companies need to be more quickly adapt to the changing environment around them, thus ERP system is one of the most important tools/enablers for a companies to meet and exceeds the information needs and requirements. ERP implementations in SMEs have been found to be important for SMEs to follow industry best practices. Although there has been a increase in recent years in the use of ERP system in SMEs, however, it is understood from the literature that most of the ERP implementations are not successful and the success percentage is relatively low, due to the complexity and difficulty associated with ERP system implementation process, the complexity of ERP implementation is different between companies, based on the size of the company and complexity of the system itself. Therefore, many SMEs consider the implementation of ERP system is a critical in their improvement strategy. As SMEs always has constraint on their resources thus, they need to think about how and when they utilise these resources, so they are not run out of these resources during the implementation of ERP system rather than being too ambiguities of what and when to do. It seems that it is important to have very clear steps of implement the ERP system in SMEs this will facilitate the implementation complexity of the system. In other words, instead of radical changes to the SMEs cause by implementing ERP system, an incremental systematic approach seems to be more appropriate. So structure framework to aid SMEs implement ERP system is required to overcome difficulties during implementation of ERP system was needed to allow SMEs achieve the benefits associated with ERP system. This study framework, which consists of several phases and steps in the context of SMEs, was developed, aiming to help industry practitioners implanting ERP system. There are various studies in the recent literature proposing different techniques to provide a solution to this complex and critical problem. With this study, different from the existing ones, a systematic and easily to understand framework that takes into account the phases and steps based on input, processes and output was proposed. In the first phase, process analysis was conducted to current process and workflow within the company. The SOW was prepared based on understand “*As Is*” workflows of the company and to determine milestones, and deliverables. The obtained information was used to create project plan for the software implantation. Then the system was build based on SOW, which assist to prepare SOP documents for all the processes. At this point it’s important to mention that the company tried to make any changes within the company processes to be able to align its processes with software not vice versa, to avoid any knock-on effect on the core of the system. Available data was migrated uploaded into the software using small amount of data (gold sample) to test the data, then the key users was test and acceptance after the data was uploaded into the software in order for the key user to receive training so they will be able to operate the new software and to train the other staff before go live. It is important that SMEs managers must carefully consider and plan the right steps of the successful implementation of the ERP System. This study is providing clear guidelines to SMEs who consider implementing ERP systems in future by using developed framework to decide

appropriate steps of ERP implementation also prioritising resources and efforts to manage key factors affecting ERP implementation success. The proposed framework assisted the company to reduce the implementation duration, minimise common problems of ERP implementation project and facilitate effectively implementation phases of ERP system, which is very important for SMEs to manage ERP system implementation.

6. Conclusion

The importance of ERP system for supporting SMEs has been widely recognised. Therefore, the main objective of this study was to develop a framework to assist SMEs to implement ERP system and to highlight issues that need to be addressed during implementing the ERP system in the SMEs. The developed framework in this paper consist of nine phases where each phase has input, processes, and output. The applicability of the framework was explained through a case study of a company that employed a phases of implementation of the framework. This study contributes to the on-going research on implementation of ERP systems in SMEs. SMEs considering the implementation of ERP systems in future, can use the developed framework in this study by following the appropriate steps and phases which have also been demonstrated in the case study. The business changes generated by COVID-19 dramatically alternate the individual and business relationship regarding employment, customer, retailer, supplies, and service provided, the World Health Organization (WHO) has indicated the probability of further SARS pandemic. This framework provides a methodology for SMEs to be ‘ahead of the game’

7. Limitation

The proposed framework was successfully applied in a single company, this suggested that the methodology could be expanded by implementing the develop framework in other SMEs. Further investigations are required for generalising the developed framework including IT infrastructure, adoption of digital economy concept in business processes which can also enhance the capability of the framework in service and government organisations.

8. CRediT authors statement

O Alaskari: Project administration, Methodology, Data curation, Original draft preparation, Writing. R Pinedo-Cuenca: Supervision, Methodology, Reviewing and Editing. M M Ahmad: Validation, Reviewing and Editing.

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