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A master plan for the implementation of sustainable enterprise resource planning systems (part I): concept and methodology

Abdoulmohammad Gholamzadeh Chofreh ^{a, b, *}, Feybi Ariani Goni ^c, Syuhaida Ismail ^d,
Awaluddin Mohamed Shaharoun ^d, Jiří Jaromír Klemeš ^e, Masoomeh Zeinalnezhad ^f

^a Department of Industrial Engineering, Buein Zahra Technical University, Buein Zahra, Qazvin, Iran

^b Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia

^c Faculty of Information Science and Technology, Universiti Kebangsaan Malaysia, Bangi, Malaysia

^d UTM Razak School of Engineering & Advanced Technology, International Campus, Kuala Lumpur, Malaysia

^e Faculty of Information Technology and Bionics Pázmány Péter Catholic University, Práter u. 50/a, 1083 Budapest, Hungary

^f Department of Industrial Engineering, Faculty of Engineering, Islamic Azad University, West Tehran Branch, Tehran, Iran

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ABSTRACT

Sustainability has become a business imperative and every organization needs to respond to it. In practicing sustainable organizations, practitioners require to implement Sustainable Enterprise Resource Planning (S-ERP) systems in order to aid them in solving a segregation problem over extended value chain. The concept of the S-ERP system can be adopted from an Enterprise Resource Planning (ERP) system, however, they have distinction in terms of philosophical perspective. S-ERP system adds new dimensions of complexity, including new data types, new sources of data, and new stakeholders. It is more challenging to be implemented successfully than ERP system. Although various software vendors have developed S-ERP software applications, however, the organizations still have a difficulty to implement it due to lack of master plan that provides a holistic approach to implement the system. This problem motivates the researchers to introduce a concept of the S-ERP master plan in this study. Generally, the design of the master plan is developed based on the concept of project management as it can handle complex and complicated projects. The structure of the master plan contains of three essential components: roadmap, framework, and guidelines. These three components are closely interrelated and each of them has its own role in the S-ERP system implementation. An introduction of the S-ERP master plan concept in this paper perhaps would give a bird's eye view to the practitioners about the imperative of the master plan in order to mitigate problems that occur during the S-ERP implementation projects.

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1. Introduction

The transformation from traditional production into modern production happened since the turn of the 20th century in the majority of industries. This phenomenon affected by the emergence of social, environmental, and economic issues (Wilkie and Moore, 2003). To fulfil customers' demand, industries produce their products via new methods such as mass production. However, this enforcement gradually resulted in resource scarcity, pollution and waste, climate change, loss of biodiversity, poverty and famine, economic inflation, human rights, social justice and equality, health

and well-being, and other issues related to the social, environmental, and economic aspects (Lubin and Esty, 2010). These issues causing the future of human beings becoming more perilous (Elliot, 2011).

Since the 1960s, awareness within public and community concerning these global issues was progressively improved. It can be seen from numerous efforts from the government level and public community through international conferences and institutions, such as Intergovernmental Conference for Rational Use and Conservation of Biosphere in 1968, International Institute for Environment and Development (IIED) in 1971, and United Nations Conference on Human Environment (UNEP) in 1972 (IISD, 2012). These efforts are the root to the emergence of sustainability term.

Sustainability practice is imperative to resolving social and environmental issues (Dentchev et al., 2015). A formal inception began in the 1980's with the publication of a new policy includes

* Corresponding author. Department of Industrial Engineering, Buein Zahra Technical University, Buein Zahra, Qazvin, Iran.

E-mail address: mohammad_apmie@yahoo.com (A. Gholamzadeh Chofreh).

World Conversation Strategy (IUCN, 1980) and the Brundtland report in World Commission on Environment and Development of the United Nations (Brundtland, 1987). However, sustainability scholars often point the Brundtland report as a critical point of sustainability embedded into various disciplines (Chofreh et al., 2014a).

The sustainability issue is becoming a critical business aspect and it turns into a global business megatrend (Lubin and Esty, 2010). It enables the creation of a new opportunity through innovation to achieve competitive advantage and drive cost reduction programs (Accenture, 2011). Beyond the obvious cost saving derived from using less energy, additional benefits include changing behaviours leading to increased productivity, improved morale, streamlined business processes, creative innovations and better use of technology (Hutchins, 2009). Organizations that acknowledge and embrace the key drivers for sustainability will obtain the ultimate benefits of market opportunities, efficient business operations and enhanced competitive advantages (Dao et al., 2011). Therefore, numerous organizations integrate sustainability into their business strategies and operations (Almeida et al., 2015). They realize that they have a responsibility to contribute to solving the critical sustainability issues. In addition, their customers expect them to provide sustainable products and services (Chofreh et al., 2015).

The business functions throughout the extended value chain face specific problems, defiance, and opportunities when responding to sustainability strategies (Seuring and Müller, 2008). They need to engage in the sustainability transformation to deliver truly sustainable products and services to a marketplace (Niesten and Lozano, 2015). On the way to this transformation, organizations that have a comprehensive vision, mission, and ability to respond sustainability strategies will be in the forefront (Lubin and Esty, 2010).

In achieving sustainable organizations, organizations require to perform life cycle assessment (LCA) and to report the results to their stakeholders (Chofreh, 2015). However, a segregation problem between business functions emerged during the transformation towards sustainable organization (Chofreh et al., 2014a). Organizations are unable to access and manage sustainable data, information, and processes. This problem is an indication of misalignment between sustainability and information systems (Goni et al., 2013b). Information systems play an important role in transforming sustainable data, information, and processes (Melville, 2010). It has an important role in globalizing the world over the past decades (Malhotra et al., 2013). S-ERP system is one of the integrated information systems that can aid organizations to solve the segregation problem in sustainability practices (Chofreh et al., 2014a).

Numerous software vendors contribute to the development of S-ERP system application (Chofreh et al., 2014a). Nevertheless, in real practice, the organizations still face a difficulty in implementing the system as it needs multidisciplinary skills and knowledge (Chofreh et al., 2014a). Practitioners need an ability to conceive the S-ERP system holistically from such perspectives like managerial and technical. They need a comprehensive plan that provides mechanisms to implement the system. In this paper, the authors introduce the concept of S-ERP master plan and portray about its imperative in the implementation of S-ERP systems. A general discussion of project management as a method to develop the master plan is provided. As future works, the authors identify various research areas concerning a development and evaluation of the master plan.

2. S-ERP systems concept

A new class of information systems, namely S-ERP system, has emerged to address the integration issues in sustainability implementation. An S-ERP system is important as a holistic solution to

support sustainability initiatives. It enables to integrate sustainable business functions, processes, and data into a single platform (Klemeš, 2015). Chofreh et al. (2014a) defined an S-ERP system as “an information system driven by sustainability consideration that covers all aspects of the value chain”. It is a holistic, integrative, and comprehensive solution for solving a segregation issue that emerges in sustainability practices. The concept of S-ERP system can be adopted from its prior generation, namely ERP system. The term of this system was initiated by Gartner Group in the early 1990s and it was swiftly implemented by numerous organizations in 2000s (Jacobs and Weston Jr., 2007).

According to Melville and Whisnant (2012), the S-ERP system has similar features with an ERP system in providing a centralized system for data analysis and report generation. The role of the ERP system is to integrate all resources, information, and activities needed to improve business processes to be more efficient and effective (Goni et al., 2013a). However, there are several distinctions between the S-ERP and ERP systems that can be seen from their philosophical perspective. The philosophy of the ERP system is based on profit as the core objective of ERP implementation is to integrate all business functions, bring the data into a platform, and integration over the value chain (Goni et al., 2012).

The philosophy of the S-ERP system is based on Triple Bottom Line (TBL), which includes profit, people, and the planet. Elkington (1997) stated that “profit” refers to the economic value created by the organization. “People” refers to equitable and valuable business practices toward labours, communities, and regions in which an organization conducts its business. “Planet” refers to issues related to the environment. The main goal of the S-ERP system is to integrate all sustainable data, processes, and business functions over the extended value chain in an organization (Chofreh et al., 2014a). The advantages of implementing this system are to streamline the sustainable business processes, cost reductions, and quality improvements that lead to securing economic improvement, social equity and justice, and environmental protection. As a conclusion, the aim of S-ERP system is wider than ERP system as it needs to be aligned with the TBL. Fig. 1 provides an illustration concerning the philosophy of ERP and S-ERP systems.

3. Significance of a master plan for the S-ERP systems implementation

The emergence of S-ERP system can be seen from the ERP system background. The implementation of ERP system is complex and challenging than anticipated and it often leads to failures. There are various issues related to ERP systems implementation failure, such as lack of top management supports, lack of project management, poor leverage of partner vendor, and data quality (Sahran et al., 2010). If organizations desire to successfully implement the ERP system, they need to tackle these issues by having

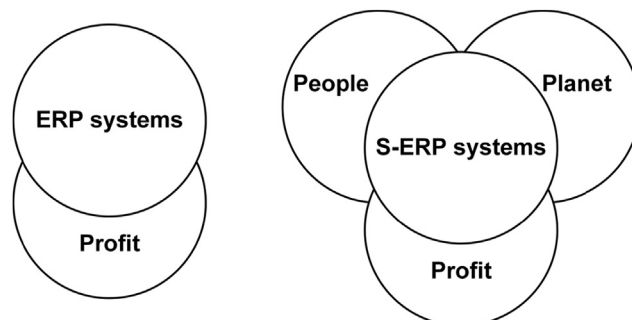


Fig. 1. Philosophy of ERP and S-ERP systems.

four capabilities including functional capability, managerial capability, implementation capability, and technological capability (Goni et al., 2012).

This phenomenon also applies to the implementation of the S-ERP systems. S-ERP system adds new dimensions of complexity since it needs to consider TBL. The implementation of the S-ERP system is more challenging than ERP system because the S-ERP system needs new data types, new sources of data, and new stakeholders (Melville and Whisnant, 2012). The result could be unsuccessful, which would hinder the attainment of sustainability goals and objectives.

According to Chofreh et al. (2014a), the literature indicates very little evidence of any work that outlines a comprehensive plan to direct practitioners in implementing an S-ERP system. The work done by Melville and Whisnant (2012) showed part of the whole process only. Melville and Whisnant (2012) conducted a case study of environmental ERP systems implementation at SunGard Data Systems. They found that S-ERP system needs to be driven by corporate sustainability strategy and it is required a strategy to be implemented. However, their study only focused on phenomena that are observed to lead successful implementation of S-ERP system without looking into detail on how to implement this integrated system. This lack of comprehensive plan and direction to guide practitioners in implementing S-ERP system might result in increased sustainability implementation cost and time. Therefore, an effort should be devoted to providing a comprehensive master plan for implementing an S-ERP system.

A study concerning the development of a master plan for the implementation of S-ERP systems has substantial research and practical implications. The structure of the master plan can be used to generate various research areas in S-ERP system implementation thus proving that it can be an important research instrument. Through this newly formed concept, it is currently possible to systematically implement the S-ERP system in an organization. The research value of the master plan structure concept cannot be underestimated.

From the practical standpoint, organizations can use the master plan as a reliable method to implement S-ERP system. Having the master plan can decrease time, costs, resources, risks of implementation, and it can improve the quality of a project. It is significant for practitioners in order to give them a holistic perspective and direction to manage the implementation of S-ERP system.

4. Concept of the master plan

An S-ERP system implementation needs to be managed via a coherent master plan. The S-ERP master plan can be defined as a detailed conception of the S-ERP system that contains a comprehensive plan of action to guide practitioners in implementing S-ERP systems. The master plan can build visibility to assure that the S-ERP implementation is orderly and predictable. An adoption of the master plan can help the organizations to diminish various problems, such as alleviate S-ERP implementation time, cost, resources, and risks. Further explanation related to the concept of the S-ERP master plan is presented in the following sub-sections.

4.1. Prior research on the development of the master plan

This study reviews back prior research on the development of a master plan in sustainability and ERP system fields to get an overview concept of the S-ERP master plan, as given in Table 1.

As shown in Table 1, there are various methods used to develop a master plan in these two fields. In sustainability field, Karamouz et al. (2007) developed a master plan for hospital solid waste management using a Multiple Criteria Decision Making (MCDM) technique, namely AHP. This method is one of the most popular and

powerful methods for group decision making used in project selection. It simplifies complex, ill-structured problems by arranging the decision factors in a hierarchical structure (Pirdashti et al., 2011).

De Benedetto and Klemeš (2009) introduced an environmental performance strategy map by using an integrated LCA approach as a tool for strategic decision-making. This new approach allows developing a new graphical representation that combines the main environmental indicators with the dimension of cost. It has been demonstrated with a specific case to find the balance between cost and environmental impacts.

Che et al. (2014) developed an integral storm water management master plan to solve various problems, such as eutrophication, flood risk, water shortage, and high maintenance cost, during the beginning of the Oriental Sun City construction in China. This master plan was developed based on the concept of LID. They developed and applied a large number of LID and green storm water infrastructure (GSI) approaches in the community to replace traditional storm water drainage systems completely. As a result, the master plan solved the problems effectively and yielded economic and ecological advantages.

In another study, Kim et al. (2015) proposed a master plan, named Development Strategy Formulation and Evaluation Methodology (DSFEM), of sustainable large-scale developments by employing BIM-based decision supports methods. The master plan was designed to evaluate and visualize development scenarios and their metrics in sustainable large-scale developments. It integrated multiple attributes including WBS in project management in order to define the relationship among activities, sequence, and duration.

Lu and Zhang (2016) introduced a regenerative sustainability implementation framework for architecture engineering and construction organizations that includes three dimensions of sustainability and four elements' corporate essentials. They used an empirical research to review sustainable assessment systems in various industries and organizations. The framework was then developed based on their best practices in those industries and organizations.

AHP, LID, and BIM methods are commonly used for developing a master plan in the sustainability field, however, they are focused on more technical master plan without pertaining to the strategic part of the project implementation. Therefore, these methods are not appropriate to be adopted for designing the S-ERP master plan. Furthermore, the use of an empirical study method cannot be used in this study as the industries and organizations that implement the S-ERP system are still rare.

In ERP field, Systemanalyse und Programmentwicklung (SAP) introduced a master plan, namely Accelerated SAP, for efficiently implementing and continuously optimizing ERP systems (Asher, 2009). The master plan was aligned with industry standards and project management procedures. It has been widely used by organizations to implement ERP software application from SAP (SAP America, 2004).

Another work from Lee et al. (2015) proposed a VE-based framework that combines the SD method to support the implementation of ERP systems. Within the framework, VE is a systematic, functionally oriented method for generating decision alternatives, whereas SD can simulate the possible outcomes in terms of the generated decision alternatives so that a suitable strategic decision for the ERP implementation can be evaluated and selected. However, the VE and SD methods are commonly used for framing, understanding, and discussing complex issues and problems emerged during the system implementation by using mathematical modeling. Since S-ERP system has not been widely implemented in organizations, therefore, these methods are not appropriate to be used to initiate the S-ERP system implementation.

Shen et al. (2016) applied a non-additive fuzzy integral method to develop an ERP performance measurement framework. Similar

Table 1
Review research on development of a master plan.

Reference	Field	Research purpose	Methodology
1) Karamouz et al. (2007)	Sustainability	This study proposed a master plan for managing hospital solid wastes.	Analytical Hierarchy Structure (AHP)
2) De Benedetto and Klemeš (2009)	Sustainability	The purpose of this paper was to develop an environmental performance strategy map by using an integrated LCA approach. The authors introduced the strategy map as a new graphical representation that allows merging the main environmental indicators with the additional dimension of cost.	Integrated LCA approach
3) Che et al. (2014)	Sustainability	This work developed an integral storm water management master plan.	Low Impact Development (LID)
4) Kim et al. (2015)	Sustainability	This paper introduced a new methodology, which is tailored for the master plans for large-scale developments. Based on this new methodology, the authors developed the Development Strategy Simulator (DSS), an automated and integrated decision-support system.	Building Information Model (BIM)
5) Lu and Zhang (2016)	Sustainability	This study proposed a regenerative sustainability transition framework for architecture engineering and construction organizations.	Empirical study
6) Asher (2009)	ERP	This work aimed to explain a master plan, namely Accelerated SAP methodology from SAP, to implement ERP systems.	Project management
7) Lee et al. (2015)	ERP	This paper proposed a mixed method to successfully implement ERP systems.	Value Engineering (VE) and System Dynamics (SD)
8) Shen et al. (2016)	ERP	The researchers introduced an ERP performance measurement framework using quantitatively balanced scorecard approach.	Non-additive fuzzy integral

to VE and SD methods, the non-additive fuzzy integral is generally used for analysing the performance of a system implementation. Hence, this method is also not suitable for developing the S-ERP master plan.

The project management methodology is widely used in ERP system implementation areas. According to a number of research works, such as Ngai et al. (2008) and Goni et al. (2011), the use of project management concept becomes one of the best practices in ERP system implementation. Chofreh et al. (2011) stated that an adoption of the project management concept is stressed in the implementation of ERP systems. The application of the project management enables the ERP project team to define a comprehensive ERP project plan including integration, scope, time, cost, quality, human resource, communications, risk, procurement, and stakeholder (Chofreh et al., 2014b). Since an S-ERP system is an extension of ERP system, hence, a general design of the master plan is also developed based on the concept of project management.

Goffin and Mitchell (2005) stated that project management method is a recognized area of knowledge that is important for implementing projects as innovations. Successful implementation of an innovation starts with good project management (Brones et al., 2014). According to the Economist Intelligence Unit survey, ninety percent of global senior executives ranked project management method as important to deliver successful projects and remain competitive (PMI, 2010). It is a common method that can handle complex and complicated projects by breaking them into smaller, simpler, and clearer tasks. Organizations that use project management to monitoring and control processes and schedules can more effectively complete their projects on time and on the budget (PMI, 2010).

4.2. Application of a project management methodology for the development of the master plan

An organization needs to employ project management as the application of knowledge, skills, tools, and techniques to implement S-ERP systems. As given in Project Management Body of Knowledge (PMBOK® Guide), Project Management Institution (2013) integrates forty-eight project management processes within five process groups and ten knowledge areas. The process groups consist of initiating, planning, executing, monitoring/controlling, and closing. They are an iterative and ongoing process that have interdependence and are generally completed in the same sequence on each project. The ten major knowledge areas including integration, scope, time, cost, quality, human resource, communications, risk, procurement, and stakeholder. These knowledge areas contain processes that need to be accomplished in order to achieve effective project management.

The authors engage the three main components of the project management including process groups, knowledge areas, and project management processes to design the S-ERP master plan. In this regard, the process groups can be mapped into a roadmap, the knowledge areas can be mapped into a framework, and the project management processes can be mapped into guidelines. The detail of the mapping process between project management concept and the S-ERP master plan can be seen in Fig. 2.

In following the project management concept, the structure of the master plan is aligned with the project management structure. The S-ERP master plan contains three essential components: roadmap, framework, and guidelines. Fig. 3 gives an illustration of the master plan and the relationships between roadmap, framework, and guidelines.

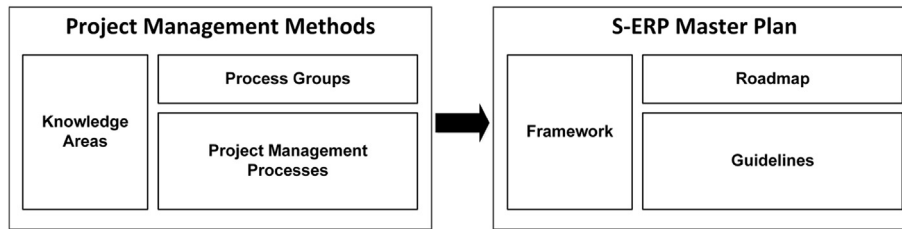


Fig. 2. Project management concept adoptions to S-ERP master plan.

MASTER PLAN

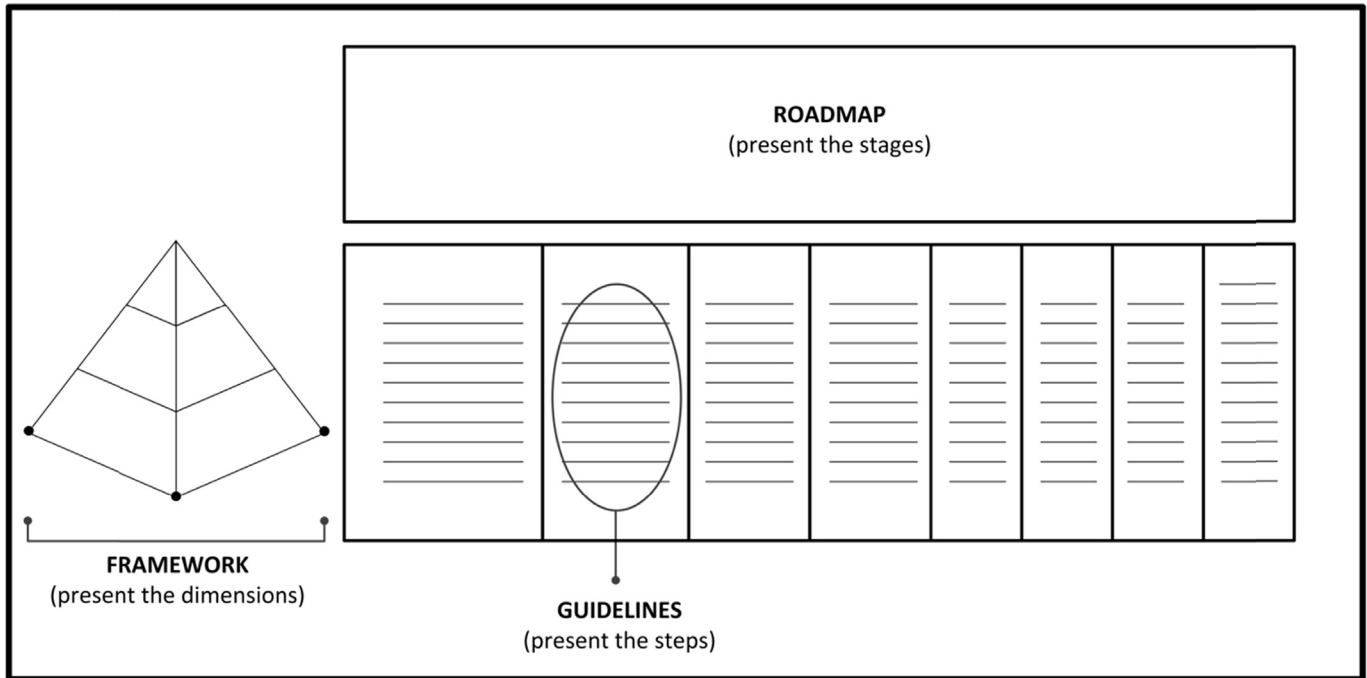


Fig. 3. General overview of the S-ERP master plan.

S-ERP implementation roadmap provides stages that involve effective processes that need to be completed throughout the life cycle of the project. The roadmap adapted five process groups in project management as stages in the roadmap. It requires overlapping stages throughout the project implementation life cycle. The outputs of one stage are generally the inputs to another stage. For instance, the output of planning stage would be the input to executing stage. For this reasons it is important to integrate complete process groups into the roadmap in order to ensure the continuity of process in S-ERP implementation project. The S-ERP implementation roadmap must serve the following objectives:

1. It should combine and relate the relevant stages into one cohesive form;
2. It should show overlapping activities that occur throughout the S-ERP system implementation;
3. The output of one stage generally should be an input to another stage; and
4. It should serve as a systematic and comprehensive map that will aid the user in implementing S-ERP system.

S-ERP implementation framework refers to an essential structure underlying the dimensions that demonstrate a perspective of

an issue that has to be considered in S-ERP system implementation. Since the S-ERP system is a type of information system to support sustainability initiatives, the framework should incorporate both aspects of the sustainability and system. The sustainability aspect includes sustainability paradigm whereas the system aspect includes decisional paradigm. The S-ERP implementation framework has to generally provide the following objectives. It should:

1. Combine and relate the relevant dimensions into one cohesive form;
2. Show a holistic perspective for S-ERP system implementation; and
3. Should show work breakdown of each dimension.

S-ERP implementation guidelines provide steps that determine a course of action for the completion of the S-ERP system implementation. The guidelines are an essential part of a master plan. The project management method on mapping the project management processes within the process groups and the knowledge areas was adapted in developing the guidelines. The steps of S-ERP system implementation were mapped within the stages in the roadmap and the dimensions in the framework. The S-ERP implementation guidelines must accomplish the following characteristics:

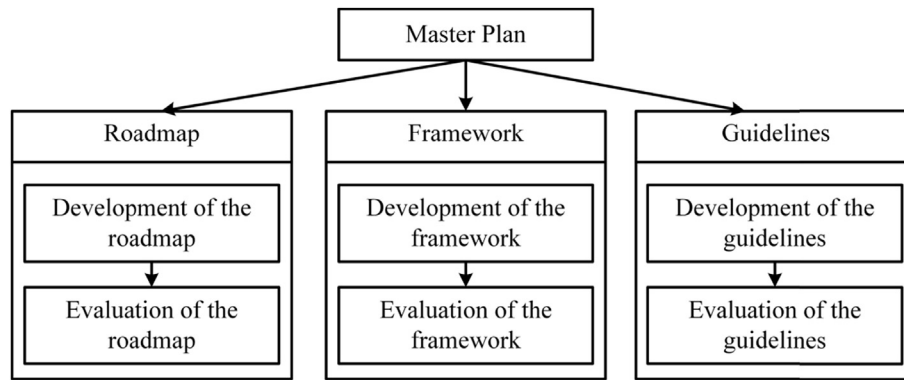


Fig. 4. Development of the S-ERP implementation master plan.

1. It should streamline the S-ERP system implementation process;
2. It should combine and relate the relevant steps into one cohesive implementation process; and
3. It should focus on important issues in order to implement S-ERP system.

The goal of having a master plan is to achieve successful S-ERP system implementation within estimated schedules and budget, and the important phase from the beginning of the implementation is a sufficient planning. The key to successfully implement the project lies in the method of planned execution (PMI, 2013). A proactive risk management planning can in addition assist the project team to avoid the potential problems during project implementation. This type of management planning represents a form of strategic planning (PMI, 2010). Consequently effective project management relies on the strategic planning to align S-ERP implementation strategies with the business strategies. This alignment is important for the successful S-ERP system implementation project.

5. Conclusions and future works

Sustainability has embedded into business strategies and operations in organizations. They need to integrate all business functions over the extended value chain. In this regard, the role of an S-ERP system is imperative to aid organizations in achieving the sustainability goals and objectives. However, the organizations have problems in implementing this complex system. There is a lack of a master plan that comprehensively provides a roadmap to show the stages, a framework to illustrate the perspective, and guidelines to show the steps for organizations to implement the S-ERP system. In this study has been introduced a concept of an S-ERP master plan that consists of three main components including roadmap, framework, and guidelines. This concept is adopted from a project management approach that has been generally used in project implementation.

The S-ERP master plan has substantial research implications. The identification of the stages in the roadmap, dimensions in the framework, and steps in the guidelines that made up the master plan structure is an important contribution to the theory on S-ERP system researches. Through this newly formed concept, it is currently possible to systematically implement the S-ERP system in an organization. The research value of the master plan structure concept cannot be underestimated. In addition, each stage, dimension, and step in the master plan can also be used to generate various research areas in S-ERP system implementation thus proving that it can be an important research instrument. Organizations could use the master plan as a reliable method to

implement S-ERP system. Furthermore, the master plan would give the practitioners a bird's eye view of the whole S-ERP system concept and its implementation process.

Further study needs to be carried out to explore further development of the master plan. The researchers defined various potential areas that might be explored including the development and evaluation of an S-ERP roadmap, the development and evaluation of an S-ERP framework, and the development and evaluation of S-ERP guidelines. Fig. 4 gives an illustration of the further studies in S-ERP implementation master plan.

A study on the development and evaluation of an S-ERP system implementation roadmap is imperative to complete the structure of the S-ERP master plan. The roadmap, which is identified as the first component in the master plan, refers to stages intended to implement S-ERP systems. Each stage presents a group of the steps in the master plan. The development of the roadmap had been approached by a variety of ways by various researchers. The use of conceptual research methods, which relies primarily on the literature, is necessary to acquire essential stages that culminate a formation of the roadmap. Although the roadmap has successfully captured and correlated the existing concepts that have been confirmed in the literature to provide a new approach to the S-ERP implementation, its usability needs to be evaluated by experts in order to improve the quality of the roadmap.

The second component of the S-ERP master plan that needs to be developed is an S-ERP framework. The framework refers to an essential structure underlying the dimensions of S-ERP system. These dimensions show a perspective of an issue that has to be considered in S-ERP system implementation. The developed framework then would be evaluated by using peer review methods. This method allows the experts to evaluate the content and category of the initial S-ERP framework, refine other necessary dimensions, and finally forming the final S-ERP framework.

The next potential area is the development of the third component of the S-ERP master plan, which is S-ERP guidelines. The guidelines refer to the steps that determine a course of action for the completion of S-ERP system implementation. This step is a part of the stages in the S-ERP roadmap. Similar to the previous studies, the initial S-ERP guidelines are then might be evaluated by using peer review methods. In this method, the experts can provide support and direction, challenge the research assumptions and findings, and assist the researcher in improving the research rigour or trustworthiness of the guidelines.

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