Evaluation of the Sustainable Enterprise Resource Planning Implementation Steps

Abdoulmohammad Gholamzadeh Chofreh[a,*], Feybi Ariani Goni[b], Muhammad Noman Malik[c], Huma Hayat Khan[c], Jiří Jaromír Klemeš[a]

[a]Sustainable Process Integration Laboratory – SPIL, NETME Centre, Faculty of Mechanical Engineering, Brno University of Technology - VUT Brno, Technická 2896/2, 616 69 Brno, Czech Republic
[b]Faculty of Information Science and Technology, Universiti Kebangsaan Malaysia, Bangi, Malaysia
[c]Faculty of Engineering, and Computer Science, National University of Modern Languages (NUML), Islamabad Campus, Pakistan
 chofreh@fme.vutbr.cz

Sustainable Enterprise Resource Planning (S-ERP) system is an integrated system enabling decision makers to integrate and manage business process within organisation in a sustainable manner. The S-ERP implementation is huge, which requires an integration of all business units in value chain. Practitioners need guidelines that show important steps to implement the S-ERP systems. A development of S-ERP guidelines has been highlighted in the previous work. However, the reliability of the steps needs to be evaluated by a number of experts. The aim of the present study is to evaluate the S-ERP guidelines using expert review methods. Twelve experts have been involved to contribute in this study through in-depth interviews. The results of the interview are recorded and transcripted for the analysis process. In this regard, a qualitative analysis technique consisting three main activities including data reduction, data display, and representing/validating conclusions is applied to get the final S-ERP guidelines. The validated S-ERP guidelines are important and beneficial for practitioners as its accuracy and reliability have been assessed by the experts. The S-ERP guidelines will assist them to effectively implement the S-ERP systems in their organisations.

1. Introduction

Sustainable Enterprise Resource Planning (S-ERP) systems are a new type of enterprise systems facilitating integration process between sustainable business units in the organisation (Chofreh et al. 2016b). This information system assists organisations to provide relevant and reliable data and information related to sustainability impacts on business. Traditional Enterprise Resource Planning (ERP) systems have significantly advanced the business processes and management across business units, ranging from manufacturing, inventory management, distribution, purchasing, finance, human resources, customer relationship management, and sales. However, this system is unable to measure sustainability indicators, such as the amount of resources used during production and ecological footprint. To overcome this limitation, Systems, Applications and Products in Data Processing (SAP) has introduced S-ERP systems.

The ERP implementation is complex and challenging requiring a large time and cost constraints as well as business process re-engineering (Sadrzadehrafiei et al., 2013). Numerous studies have underscored its implementation failure and attempts to avoid this. For example, Leu and Lee (2017) proposed a conceptual framework that was developed based on value engineering to analyse potential problems and avoid system implementation defects. Chofreh et al. (2016) stated that the implementation of S-ERP systems would be more difficult rather than ERP systems as it should consider three sustainability aspects (environmental, economic, and social) in the business process, which influence on new data types, new business process, and new stakeholders. Therefore, the S-ERP systems implementation cannot be underestimated. The role of the S-ERP is important to support the effective sustainability implementation in the organisations. The capability of integrating the sustainable business units within the organisation will accelerate the sustainable business

operations and reporting activities and reduce the ecological footprint during the business processes up to 40% (Chofreh et al., 2018).

To reap an effective system implementation, organisations need to have guidelines that provide step-by-step to implement the S-ERP systems. However, there is a few numbers of guidelines that provide a holistic implementation feature. The present study aimed to overcome this limitation by proposing and evaluating S-ERP systems implementation guidelines that integrate three main components: implementation steps, levels, and activities. The developed guidelines are then evaluated by twelve experts from academics and practices through an in-depth interview to validate the structure and usability of the guidelines. The collected data from the interviews are then analysed using the qualitative technique.

The evaluation results reveal that the guidelines consist of two main segments: sustainability implementation steps and system implementation steps. In this case, the practitioners require to initially move towards sustainable business, then the S-ERP systems can be applied as a tool to assist the sustainability practices.

A novel of the study is the S-ERP guidelines that integrate various important concepts in sustainability and ERP systems implementation. The S-ERP guidelines consist of three main components including implementation steps, levels, and activities. It can be considered as a general technique for practitioners to implement the S-ERP systems.

2. Review of the guidelines development

S-ERP system guidelines are developed using conceptual research methods that emphasise an extensive review of the literature. Two areas of study, namely sustainability implementation guidelines and ERP implementation guidelines, are examined to get an idea in developing the guidelines. Association of Professional Engineers and Geoscientists of British Columbia- APEGB (2013) proposed steps for stakeholders to deliver sustainable solutions. Global Reporting Initiative (2015) released steps for sustainability reporting comprising an idea of the report content and quality. The GRI guidelines are the most frequently used as reporting standard for sustainability.

Sahran et al. (2010) developed ERP guidelines that integrate a number of critical success factors, ERP implementation process, and implementation methodology for successful ERP implementation in small and medium enterprises. Sun et al. (2015) proposed performance evaluation and improvement guidelines for ERP implementation. These guidelines integrate a number of stages, critical success factors, and key performance indicators to assess the ERP implementation and apply them in several manufacturing companies.

Based on the review results, the majority of the studies applied various concepts including sustainability paradigm (environmental, economic, and social), levels of decision-making (strategic, tactical, and operational), project management, and strategic management. However, these concepts are not simultaneously considered as a form of guidelines. Table 1 shows an outline of the prior studies following with the applied concept.

Table 1: Overview of prior sustainability and ERP implementation guidelines

Reference	Research field		Sustainability paradigm			Levels of decision-making			Project management	Strategic management
	Sust	ERP	Env	Eco	Soc	Str	Tac	Opr		
Lambrechts et al. (2009)	√		√	√	√	√	√	√		√
Malik (2009)		√		√		√	√	√	√	
Sahran et al. (2010)		√		√		√	√	√	√	√
APEGB (2013)	√		√	√	√	√	√	√		√
Welfering et al. (2014)	√		√	√	√	√				√
Global Reporting Initiative (2015)	√		√	√	√	√				
Sun et al. (2015)		√		√					√	
Johannsdottir and McInerney (2018)	√		√	√	√	√				√

Sust: sustainability	Str: strategic
Env: environmental	Tac: tactical
Eco: economic	Opr: operational
Soc: social	

The S-ERP guidelines are intended to acquire an effective implementation of S-ERP systems. It should streamline the implementation process and integrate the implementation activities into a cohesive form. Based on these ideas, the S-ERP guidelines are developed by adapting the project management concept, in which the project management processes are mapped to the process groups and knowledge areas. The S-ERP system

guidelines integrate three main components including implementation steps, levels, and activities. The implementation activities are mapped on the implementation steps and decision-making levels of an organisation. The implementation steps are adopted from process groups in project management concept, the implementation levels are adopted from decision-making levels, and implementation activities are adapted from strategic management and project management concepts. An overview of the developed S-ERP guidelines is illustrated in Figure 1.

Figure 1: Preliminary S-ERP guidelines

3. Research methodology

The development of the guidelines uses a conceptual research method that counts on the examination of the literature. Prior studies on sustainability implementation guidelines and ERP implementation guidelines are reviewed to get an overview of the applied concept to develop the S-ERP guidelines. The developed guidelines are then evaluated using expert review involving a number of experts to confirm its reliability.

The evaluation process consists of two main activities including data collection and data analysis. Data collection is conducted through a semi-structured interview with twelve experts from academics and practices. The selection of the experts is based on several criteria including experience in teaching related topics, experience in handling projects related to the topic and having publications related to the subject. The experts evaluate the components of the guidelines, their relationships, and the structure of the guidelines. The interviews are recorded and transcribed into text for further analysis.
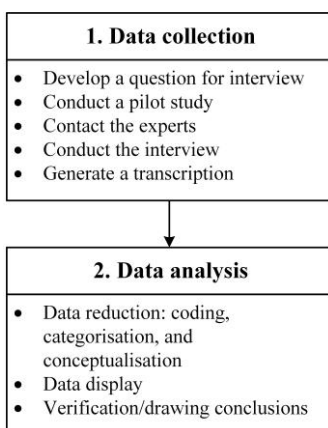

Figure 2: Evaluation process of S-ERP guidelines

Data analysis is performed using the qualitative technique, which involved three sequential steps: data reduction, data display, and conclusion drawing and verification. Morse and Richards (2012) defined data reduction as a process of simplifying and converting the data from the transcription into a simple form so that they can be understandable. This process includes three processes: coding, categorisation, and conceptualisation. Coding is a process of data analysis by arranging and integrating the data to facilitate analysis. The categorisation is a process of creating a theory. In this process, the identified coding should be

attached to the related quotations on the interview transcription. The conceptualisation is a process to generalise the categories into concepts, which involves three steps of writing initial notes, arranging notes, and analysing notes. Data display as a process of organising and displaying the data to facilitate understanding for drawing the conclusions. Conclusion drawing, and verification is a process of considering the meaning of the analysed data and evaluate their inferences. Figure 2 provides an overview of the evaluation process of S-ERP guidelines.

4. Results and discussions

The S-ERP guidelines are aimed to aid the practitioners to effectively implement S-ERP systems in their organisations. The final structure of the S-ERP guidelines consists of two main parts: sustainability implementation guidelines and system implementation guidelines. The experts argued that the organisations need to initially transform their business towards sustainability, then they can implement the S-ERP systems. The final results of the study are presented in Tables 2 and 3.

Table 2: Sustainability implementation guidelines

Implementation levels	Implementation steps				
	Initiating	Planning	Executing	Monitoring/ controlling	Closing
Strategic level	- Preparation of the enterprise profile - Identify the external & internal environment - Forecast the future environment - PESTLE analysis - Manage the stakeholders - SWOT analysis - Vision and mission development - Define the objectives	- Formulation of appropriate strategies by TOWS Matrix - Select the appropriate strategies	- Alignment of strategies with sustainability Balanced Score Card (SBSC) - Getting execution right	- Review and evaluate the performance	- Close the strategic level phase
Tactical level	- Define stakeholders' commitment to the project - Analyse required skills - Identify training requirements and materials - Analyse current business processes - Align S-ERP strategies with organisational strategies - Predict process and system changes	- Design the stakeholders' commitment management plan - Design the recruitment process of required experts - Design the training plan - Design the blueprint of integration processes - Identify the required hardware and software	- Assign the stakeholders - Recruit the experts - Select the project team members - Execute the strategic alignment process - Execute training	- Review and monitor the system implementation process - Evaluate the system performance	- Provide feedback - Create documentation for further improvement

Some modifications to the preliminary guidelines should be made to get practical S-ERP guidelines. For instance, the activities of the strategic level in the preliminary guidelines should be the activities of the strategic level in the sustainability implementation guidelines. The activities of the strategic level in the S-ERP implementation include identification of business case and S-ERP implementation strategies. The experts argued that the steps in the strategic level of the system implementation guidelines should consider business

case and system implementation strategies. Similar modification goes to the activities of the tactical level in the preliminary guidelines should be the activities of the tactical level in the sustainability implementation guidelines. Change management and technology should be added as a new element in the system implementation guidelines. The activities of the operational level in the preliminary guidelines should be the activities of the implementation level in the system implementation guidelines. Project deliverables need to be considered in the guidelines.

Table 3: System implementation guidelines

Implementation levels	Implementation steps				
	Initiating	Planning	Executing	Monitoring/ controlling	Closing
Strategic level	- Define the business case - Determine the implementation strategies		- Steering meetings		- S-ERP project sign-off
Implementation level	- Develop S-ERP project charter & obtain the management approval - Define the scope of the S-ERP implementation and departments involved - Design schedule management plan - Design cost management plan - Design quality management plan - Identify required experts and project team members - Design preliminary S-ERP training plan - Design communication management plan - Identify risks - Design procurement management plan - Identify the stakeholders - Change management - Identify required software and hardware	- Develop project management plan - Correct requirements - Develop schedule - Determine budget - Identify the quality that has to be attained - Experts recruitment as project team members - Obtain stakeholders review and feedback - Requirement assessment - Assess change readiness - Current state technology performance assessment - Prioritise the current state of technology strengths and weaknesses	- Direct and manage project work - Execute integration test - Identify user roles and authorisation - Prepare test systems for initial user demonstration - Configure and validate final scope - Prepare and perform final confirmation - Review conversion timing and planning - Getting the best return on investment - Perform quality assurance - Manage stakeholders' expectation - Procure required technology - Set up conversion and interfaces - Going live - Data transfer	- Review and monitor project work - Perform integrated change control - Report performance - Monitor the risks - Control stakeholders' management - Check the software and hardware installation	- Preparing plan closure - Evaluate the system - Close the project

5. Conclusions

This study aimed to evaluate the validity of the S-ERP guidelines using expert review methods to improve the quality and reliability of the guidelines. The evaluation process consists of two main tasks: data collection and analysis. The data is collected through interviews with twelve experts in sustainability and ERP areas. The results of the interview are then qualitatively analysed. As a result, the preliminary S-ERP guidelines needs to

be segmented into two parts: sustainability implementation guidelines and system implementation guidelines. The experts confirmed that the final guidelines can be generally used by the practitioners to implement S-ERP systems. The effective S-ERP systems implementation would streamline the sustainable business operations and reporting and assist the organisations to diminish the operational costs up to 50 % and energy consumption by 40 %. The results of this study contributes to both academics and practitioners. For academics, the proposed S-ERP guidelines would advance research on the subject of S-ERP system. For practitioners, the developed S-ERP guidelines could be applied as a new tool that can help the practitioners to implement the S-ERP systems in their organisations. An application of the S-ERP guidelines through a case study would be a potential study that evaluates the usability of the guidelines in a real practice. In this case, the researchers can directly analyse and compare the theoretical approach and real practice of the guidelines.

Acknowledgements

References

APEGBC, 2013, APEGBC Sustainability Guidelines. Association of Professional Engineers and Geoscientists of British Columbia, Burnaby, British Columbia, Canada.

Chofreh, A.G., Goni, F.A., Ismail, S., Shaharoun, A.M., Klemeš, J.J., Zeinalnezhad, M., 2016a, A master plan for the implementation of sustainable enterprise resource planning systems (Part I): Concept and methodology, Journal of Cleaner Production, 136, Part B, 176-182.

Chofreh, A.G., Goni, F.A., Klemeš, J.J., 2016b, A master plan for the implementation of sustainable enterprise resource planning systems (part II): development of a roadmap, Chemical Engineering Transactions, 52, 1099-1104.

Chofreh, A.G., Goni, F.A., Klemeš, J.J., 2018, Evaluation of a framework for sustainable enterprise resource planning systems implementation, Journal of Cleaner Production, 190, 778-786.

Goni, F.A., Chofreh, A.G., Mukhtar, M., Sahran, S., Abdul Shukor, S., 2012, Segments and elements influenced on ERP system implementation, Australian Journal of Basic and Applied Sciences, 6, 209-221.

GRI, 2015, Reporting Principles and Standard Disclosures, Global Reporting Initiative, Amsterdam, Netherlands.

Johannsdottir, L., Olafsson, S., Davidsdottir, B., 2015, Leadership role and employee acceptance of change: Implementing environmental sustainability strategies within Nordic insurance companies, Journal of Organizational Change Management, 28(1), 72-96.

Lambrechts, W., Van den Haute, H., Vanhoren, I., 2009, Sustainable Higher Education. Appeal for Responsible Education, Research and Operations. Lannoo Campus, Leuven, Netherlands (in Dutch).

Leu, J.D., Lee, L.J.H., 2017, Enterprise resource planning (ERP) implementation using the value engineering methodology and Six Sigma tools, Enterprise Information Systems, 11(8), 1243-1261.

Malik, I.H., 2009. ERP Implementation: A Complete Guide <www.slideshare.net/guest42d52b7c/erp-implementation-a-complete-guide> accessed 21.01.2018.

Morse, J.M., Richards, L., 2012, Readme First for a User's Guide to Qualitative Methods. Sage Publications, Inc., Thousand Oaks, California, USA.

Sadrzadehrafiei, S., Chofreh, A.G., Hosseini, N.K., Sulaiman, R., 2013, The benefits of enterprise resource planning (ERP) system implementation in dry food packaging industry, Procedia Technology, 11, 220-226.

Sahran, S., Goni, F.A., Mukhtar, M., 2010, ERP implementation challenges in small and medium enterprise: A framework and case study, Advanced Materials Research, 139-141, 1636-1639.

Sun, H., Ni, W., Lam, R., 2015, A step-by-step performance assessment and improvement method for ERP implementation: Action case studies in Chinese companies, Computers in Industry, 68, 40-52.

Welfering, F., Rupprecht, S., Bührmann, S., Böhler-Baedeker, S., 2014, Guidelines. Developing and Implementing a Sustainable Urban Mobility Plan, European Union. <www.eltis.org/sites/default/files/guidelines-developing-and-implementing-a-sump_final_web_jan2014b.pdf> accessed 24.04.2018.