CENTERIS - International Conference on ENTERprise Information Systems /
ProjMAN - International Conference on Project MANagement / HCist - International
Conference on Health and Social Care Information Systems and Technologies,
CENTERIS/ProjMAN/HCist 2018

Implementing cloud ERP solutions: a review of sociotechnical concerns

Vegard Uri Sørheller[a], Emeli Jørgensen Høvik[a], Eli Hustad[a], Polyxeni Vassilakopoulou[a],*

aUniversity of Agder, Universitetsveien 25, 4630 Kristiansand, Norway

Abstract

Cloud ERP solutions allow organizations of all sizes to support and coordinate key business processes by leveraging virtualization. Nevertheless, the implementation of cloud ERPs is not straightforward and there are significant issues that need to be taken into account when launching cloud ERP initiatives. To explore these issues, we conducted an in-depth systematic review of related research literature. We identified six key issues related to cloud ERP implementation: a) functionality fit, b) integration, c) data migration, d) organizational change, e) data security, and f) reliability. Furthermore, we mapped these issues to the different sizes of organizations. Based on this review, we identify two sociotechnical concerns that influence cloud ERP implementation: linking to the installed base to ensure continuity with the past and sustainability in the future. We argue that these two concerns have different implications for organizations of different sizes and we call for further empirical research.

* Corresponding author. Tel.: +0-000-000-0000 ; fax: +0-000-000-0000 .
  E-mail address: polyxenv@uia.no

1. Introduction

In our increasingly digitized world, cloud computing is enabling network access to a great variety of information technology resources (e.g., servers, storage facilities, applications, services). Cloud Enterprise Resource Planning Systems (ERPs) allow organizations of all sizes to support and coordinate key business processes by leveraging virtualization. Hence, the increasing interest for cloud deployments of ERPs [1, 2] is not surprising. The benefits of cloud-based ERPs relate to cost effectiveness, time savings, scalability and ease of updates [1, 3, 4]. Nevertheless, the implementation of cloud ERPs is not straightforward and there are significant issues that need to be taken into account when launching cloud ERP initiatives.

Our study identifies, reviews, analyses, and integrates a critical mass of research on cloud ERP implementation, offering a sound base for researchers and practitioners to advance the introduction of cloud ERPs in organizations. To ensure a robust and transferable result, we performed a systematic literature review [5] guided by the following question: "*Which concerns related to the implementation of cloud-based ERPs have been addressed in previous research literature?".* Our contribution is threefold. First, we identify six important issues that need to be taken into account by organizations that consider implementing cloud ERPs. Second, we map the key issues identified to different sizes of organizations and we point to two overarching sociotechnical concerns that influence cloud ERP implementation: linking to the installed base and sustainability. Third, we argue that to advance our knowledge on cloud ERP implementation, we need more empirical studies that show how organizations of different sizes proceed.

The remainder of the paper is organized as follows. Section 2 presents the method used for selecting and analyzing the articles for this review. In Section 3, we offer a synthesis of our findings structured in a concept matrix. Finally, in Section 4 we discuss the findings and conclude by identifying directions for further research.

2. Method

We performed the systematic literature review following the process proposed by Kitchenham [5]. The selection of papers was performed in October 2017. Hence, we covered studies published up to that time. To identify and select research articles to be reviewed, we used a predefined set of keywords and a set of inclusion / exclusion criteria aiming to reduce selection bias and to assure the quality and relevance of the papers selected [5].

The term "cloud ERP" was used as a primary search term. To identify as many relevant articles as possible, alternative expressions of the primary term were also used (specifically: a) "cloud based ERP" and b) "ERP" AND "Cloud computing"). We also used a set of secondary keywords: a) "implementation" (and as alternatives the closely related words: "application", "adoption") and b) "change process" (and as an alternative the closely related term "change management"). The search was performed in Oria, which allows searching simultaneously through the collections of all Norwegian academic libraries (including electronic books and articles) and in Google Scholar, Scopus and EBSCOhost to ensure maximum coverage.

The search yielded 288 articles in total. This initial list of articles included several duplicates (because the search results originated from several different databases). We imported our article list into the bibliographic resources management software Endnote which includes functionality for automatic de-duplication. This way, we ended up with 99 unique articles. The next step, was to read the titles and abstracts of the selected papers checking their relevance to the research question. For this step we used the inclusion – exclusion criteria defined. Specifically, we included only articles written in English for which the full text was available and we excluded papers that only casually mentioned cloud ERP implementation but had a different focus (e.g. cloud computing in general, or intentions towards cloud ERP adoption). We also excluded papers published in outlets outside the Information Systems, Computer Science, Business and Management domains. Two of the authors went through all the articles and independently assessed them. After this step, 38 papers were shortlisted. Finally, the same two authors went through the full text of the shortlisted papers and assessed their quality. For the quality assessment each article's method description was checked for scientific rigorousness and to verify that the research reported is indeed relevant to the research question of our

literature review. After this step we ended up with 17 articles. Figure 1 presents the steps followed to identify and select the articles.
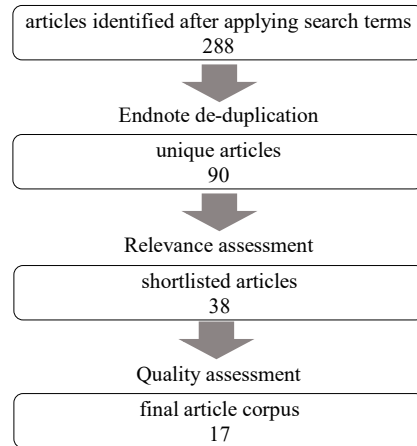

Fig. 1. Creating a corpus of articles to review: identification and selection process

The list of articles selected is presented in Table 1. The table provides the full references and summarizes the key aims and insights of the selected articles.

Table 1. Articles selected for the review - overview of key aims and findings

#	Title	Year	Key Aims	Insights	Full Reference
1	Is a cloud ERP solution right for you?	2013	Discuss factors to be considered for deciding if a cloud-based ERP is right for a company.	Advantages and disadvantages of cloud-based ERP. Factors in terms of costs and safety.	Arnesen, S., (2013) Is a Cloud ERP Solution Right for You? Strategic Finance, 95(2), pp. 45-50.
2	The rise of two-tier ERP: what it is and what it means.	2011	Describe two-tier ERPs are and when it's right to use them.	Reasons for companies to choose cloud-based ERPs.	Ron Gill CMA, C. F. M. (2011). The rise of two-tier ERP. Strategic Finance, 93(5), pp. 35- 40.
3	In-house versus in-cloud ERP systems: A comparative study.	2012	A framework for comparison between traditional and cloud based ERP.	Results show that cloud ERPs are faster to implement, cost less, are easier to use and scale. However, traditional ERPs allow more control.	Elragal, A., & El Kommos, M. (2012). In-house versus in-cloud ERP systems: a comparative study. Journal of Enterprise Resource Planning Studies, 2012, pp. 1-13.
4	Assessing Cloud Readiness at Continental AG.	2012	Use a field-tested method to evaluate maturity.	Five guidelines for businesses to switch to cloud services. The method can resolve compliance and security issues.	Loebbecke, C., Thomas, B., & Ullrich, T. (2012). Assessing Cloud readiness at Continental AG. MIS Quarterly Executive, 11(1), pp. 11-23
5	Moderating Effect of Compliance, Network, and Security on the Critical Success Factors in the Implementation of Cloud ERPs.	2016	Explore correlations in key success factors (organizational, human, and technological ones).	The successful implementation of cloud-based ERP relates to organizational factors but the relationship was found to be moderate.	Gupta, S., & Misra, S. C. (2016). Moderating Effect of Compliance, Network, and Security on the Critical Success Factors in the Implementation of Cloud ERP. IEEE Transactions on Cloud Computing, 4(4), pp. 440-451.

#	Title	Year	Key Aims	Insights	Full Reference
6	Competition and challenge on adopting cloud ERP.	2014	Provide a framework that facilitates organizations to assess whether ERP cloud services are right for them.	Lists factors that should be considered and identifies four main concerns.	Weng, F., & Hung, M. C. (2014). Competition and challenge on adopting cloud ERP. International Journal of Innovation, Management and Technology, 5(4), pp. 309-313.
7	A framework for ERP systems in SME based on cloud computing technology.	2013	Investigate cloud ERP benefits and propose a framework to facilitate cost reduction and execution delays.	Cloud-based ERP can reduce 50% of development costs, 40% of technical support costs, 10% of test costs and 30-40% of total project expenses.	Al-Johani, A. A., & Youssef, A. E. (2013). A framework for ERP systems in SME based on cloud computing technology. International Journal on Cloud Computing: Services and Architecture, 3(3), pp. 1-14.
8	Understanding cloud computing adoption issues: A Delphi study approach.	2016	Identify the most important issues businesses face when deciding on the adoption of cloud services.	Findings indicate that safety, strategy, legislation and ethical issues are the most important factors to consider when adopting cloud-based systems.	El-Gazzar, R., Hustad, E., & Olsen, D. H. (2016). Understanding cloud computing adoption issues: A Delphi study approach. Journal of Systems and Software, 118, pp. 64-84.
9	Identification of challenges and their ranking in the implementation of cloud ERP: A comparative study for SMEs and large organizations.	2017	The goal is to identify critical challenges in the implementation of Cloud ERP.	Identified a number of challenges and how small, medium and large businesses differ.	Gupta, S., Misra, S. C., Singh, A., Kumar, V., & Kumar, U. (2017). Identification of challenges and their ranking in the implementation of cloud ERP. International Journal of Quality & Reliability Management, 34(7), pp. 1056-1072.
10	Benefits and drawbacks of cloud-based versus traditional ERP systems.	2013	Identify and classify the advantages and disadvantages of cloud-based versus traditional ERPs.	Advantages of cloud-based ERPs are lower operating costs, fast implementation, swift updates, scaling usage by number of licenses.	Duan, J., Faker, P., Fesak, A., & Stuart, T. (2013). Benefits and drawbacks of cloud-based versus traditional ERP systems. Proceedings of the 2012-13 course on Advanced Resource Planning.
11	Cloud computing as an operational model for ERP services: Definitions and challenges.	2014	Conceptual clarification and exploration of adoption challenges for cloud ERP services.	Security and Privacy, Legacy Systems, Implementation, Compatibility, Disruptive Technologies, Service Level Agreements, Cost, Supplier Power, Trust and Support Challenges were identified.	Awad, H. A. (2014). Cloud computing as an operational model for ERP services: Definitions and challenges. International Journal of Innovation and Applied Studies, 8(2), pp. 499-502.
12	Cloud ERP adoption opportunities and concerns: the role of organizational size.	2015	The purpose is to identify and classify opportunities and concerns that are often associated with Cloud ERP with respect to organizational size.	Small and medium-sized businesses can reap significant benefits and do not have significant concerns. Large companies have greater concerns related to complexity and specific requirements.	Johansson, B., Alajbegovic, A., Alexopoulo, V., & Desalermos, A. (2015). Cloud ERP adoption opportunities and concerns: the role of organizational size. In System Sciences (HICSS), 2015 48th Hawaii International Conference on pp. 4211-4219.

#	Title	Year	Key Aims	Insights	Full Reference
13	Adoption of software as a service (SaaS) enterprise resource planning (ERP) systems in small and medium sized enterprises (SMEs).	2015	Explore specific factors and challenges in the adoption of SaaS ERP systems in SMEs.	SaaS ERP systems are considered the best option for SMEs. A SaaS ERP can support visibility, standardized processes, support and improve performance.	Seethamraju, R. (2015). Adoption of software as a service (SaaS) enterprise resource planning (ERP) systems in small and medium sized enterprises (SMEs). Information systems frontiers, 17(3), pp. 475-492.
14	Exploring determinants of Cloud-based enterprise resource planning (ERP) selection and adoption: A qualitative study in the Indian education sector.	2016	Tests a sociotechnical framework, which consolidates three theoretical approaches for technology adoption.	The results suggest that vendors should focus on providing cost-effective, reliable, secure, standardized systems and good support quality. Adopting organizations should determine organizational fit and train their employees.	Das, S., & Dayal, M. (2016). Exploring determinants of cloud-based enterprise resource planning (ERP) selection and adoption: A qualitative study in the Indian education sector. Journal of Information Technology Case and Application Research, 18(1), pp. 11-36.
15	GAHPSort: A new group multi-criteria decision method for sorting a large number of the Cloud-based ERP solutions.	2017	Support companies in choosing cloud-based ERP systems through a decision support tool validated in a real case.	Highlighted the differences between traditional and cloud-based ERP and proposed how to proceed in the selection process.	López, C., & Ishizaka, A. (2017). GAHPSort: A new group multi-criteria decision method for sorting a large number of the cloud-based ERP solutions. Computers in Industry, 92, pp. 12-24.
16	Cloud ERP system customization challenges.	2013	Provide an overview of customization challenges.	Identified 12 challenges and problems with the customization of cloud based ERP systems.	Mijac, M., Picek, R., & Stapic, Z. (2013). Cloud ERP system customization challenges. In Central European Conference on Information and Intelligent Systems.
17	Cloud ERP: a new dilemma to modern organisations?	2014	Explore benefits and barriers associated with the adoption of cloud based ERPs.	Identified 15 benefits and 18 critical barriers.	Peng, G. C. A., & Gala, C. (2014). Cloud ERP: a new dilemma to modern organisations? Journal of Computer Information Systems, 54(4), pp. 22-30.

3. Findings

We analyzed the articles selected and identified a number of concerns related to the implementation of cloud-based ERPs. Specifically, the concerns identified are associated to: a) Functionality Fit, b) Integration, c) Data Migration, d) Organizational Change, e) Data Security, f) Reliability. In the paragraphs that follow we present these findings.

Functionality Fit: cloud-based ERPs are usually not as comprehensive in terms of functionality as traditional ERP systems. It can therefore be difficult to find a cloud-based solution to fit all the needs of an implementing organization [7-9]. This is especially challenging for organizations that need a functionality that not many others require. Suppliers rarely add functionalities that only benefit few of the companies using their cloud software [10].

Integration: many cloud-based ERP systems have noticeable limitations when it comes to integration with existing application portfolios and IT infrastructures. This can create problems especially with regards to business-critical

systems or processes [2, 11, 12]. Although according to Duan and colleagues this is rarely an issue for small organizations [4], the concern is raised in several articles that focus on SMEs [3, 13, 14].

Data Migration: the implementation of cloud-based ERP systems can be challenged when there is a need to migrate data from existing repositories to the cloud-ERP database. The rules and data structures of cloud ERP solutions can be very different to the rules and structures of systems that are already in use [15, 16]. Migration from traditional ERP solutions to cloud-based ERP systems can be very demanding for large organizations that have complex infrastructures, making migration very expensive and time consuming. The assistance of existing system suppliers can be instrumental in such cases although suppliers can also create difficulties in data migration [16]. This problem is not encountered by SMEs to the extent faced by large companies [14].

Organizational Change: similarly to conventional ERP solutions, the adoption of cloud-based ERPs leads to organizational changes [17]. Workers must adjust some of their routines in order to handle data differently. This can be especially challenging for large organizations that need to bring numerous employees onboard investing significant resources and time to train everybody. In smaller businesses there are fewer employees and this makes personal follow-up possible [14].

Data Security: in cloud-based ERPs, all organizational information, such as financial data and customer details, need to be stored with a third party supplier. Security is one of the barriers to the adoption of cloud-based solutions [18] and it can be difficult for businesses to decide relying on suppliers for secure storage of such information [2, 14, 19, 20].

Reliability: when a company chooses a cloud-based ERP system, the reliability of the supplier is crucial. Delays or failures in support can create serious problems [3]. Organizations that need round the clock access to their ERP express significant concerns about the timeliness and quality of cloud provider support services [10].

We synthesized the findings in a concept matrix [6] which is presented in Table 2. The concept matrix maps the articles (listed in rows) to the concerns related to the implementation of cloud-based ERPs (registered in columns). As organizations of different sizes have different capabilities and resources, it is possible that their concerns differ when implementing cloud ERPs so, we decided to register them separately in the matrix. However, not all articles specify the size of the organizations studied so a generic "undefined size" category was added.

Table 2. Concept Matrix

Article #	Small & Medium Organizations						Large Organizations						Undefined Size					
	Functionality Fit	Integration	Data Migration	Organisational Change	Data Security	Reliability	Functionality Fit	Integration	Data Migration	Organisational Change	Data Security	Reliability	Functionality Fit	Integration	Data Migration	Organisational Change	Data Security	Reliability
1														X	X		X	
2																	X	
3																X	X	
4																	X	
5	X	X		X	X													
6													X	X			X	
7	X	X			X	X												
8													X	X	X	X	X	X
9	X	X			X	X	X	X	X	X	X	X						
10													X	X	X		X	
11													X	X	X	X	X	X
12			X				X	X	X									
13		X		X	X	X												
14	X				X	X												
15													X			X		
16														X		X		
17														X		X	X	

4. Discussion and Conclusion

ERPs are combinations of software modules that use common data repositories allowing the integration of transactional data and business processes [21] and are critical for contemporary organizations [22]. The advent of virtualization creates new possibilities for swift and cost efficient deployment of ERPs [4, 7, 13, 17, 19] but also raises significant concerns. The concerns identified are: a) Functionality Fit, b) Integration, c) Data Migration, d) Organizational Change, e) Data Security, f) Reliability. These concerns are sociotechnical in nature and point to the need to ensure continuity with the past and sustainability in the future.

Specifically, the concerns about functionality fit, integration and data migration relate to the need to embed to the "installed base", i.e. the organizational, and technical arrangements that are already in place [23]. The installed base serves as the foundation for business development, and can be both enabling and constraining. The new cloud-based ERPs need to fit and make use of existing arrangements and at the same time transform them. Sustainability in the future is pursued by implementing organizational changes, ensuring data security and seeking reliable cloud ERP suppliers.

Security is the most prominent concern that was mentioned in almost all articles reviewed. Organizations have multiple reasons for being apprehensive about security. On the one hand, there are strategic reasons for safeguarding core business information while on the other hand, regulatory requirements are becoming increasingly strict. Another area of concern that is frequently discussed in the literature is the one related to "organizational change". Although cloud ERPs can be quickly launched, they still require significant time for organizational adaptations. A quick look at the concept matrix reveals that these two concerns are discussed for smaller and larger organizations irrespectively of organizational size. On the contrary, the issue of data migration is not discussed for small organizations. Many small organizations do not always have an existing ERP in place and cloud solutions are giving them the opportunity to introduce capabilities that were not conceivable before. More research is needed to investigate the needs for data migration of small companies, probably differentiating also among different industries and maturity levels of the pre-existing information infrastructure.

Our concept matrix illustrates that there is a gap in the literature as regards cloud-based ERP implementation relative to size of organizations. Johansson and colleagues identified in their study that SMEs and large businesses face different challenges [4] and mention that there is too little research comparing them, which is also confirmed by our matrix. We suggest that more research should be done towards this direction. The literature shows that large, medium and small businesses can have different advantages and challenges associated with implementation of cloud-based ERPs. Interestingly, there are few prior research studies that address the implementation of cloud-based ERP solutions in large-size businesses. Due to low implementation costs and simplicity, vendors mostly target SMEs. Furthermore, several of the articles reviewed are not stating explicitly the size of organization under study. It is important for research to be properly contextualized in order to be useful for further development and we urge researchers to report as much contextual information as possible (e.g. organization size, industry, years in operation).

Our study analyzed and integrated a significant volume of research on cloud ERP implementation, offering a sound base for researchers and practitioners to work further on. We identified six important issues that need to be taken into account by organizations that consider implementing cloud ERPs. The issues identified point to two overarching sociotechnical concerns that influence cloud ERP implementation: ensuring continuity by linking to the installed base and sustainability. As organizations of different sizes have different capabilities and resources, we decided to register related concerns separately in the concept matrix developed and found that a) not all articles specify the size of the organizations studied and b) among those that do specify, there is a clear focus on SMEs. To advance our knowledge on cloud ERP solutions implementation, we need more empirical studies that show issues addressed by organizations of different sizes.

References

[1] Lenart A, editor ERP in the Cloud–Benefits and Challenges. EuroSymposium on Systems Analysis and Design; 2011: Springer.
[2] Peng GCA, Gala C. Cloud ERP: a new dilemma to modern organisations? Journal of Computer Information Systems. 2014;54(4):22-30.
[3] Seethamraju R. Adoption of software as a service (SaaS) enterprise resource planning (ERP) systems in small and medium sized enterprises (SMEs). Inform Syst Front. 2015;17(3):475-92.

[4] Johansson B, Alajbegovic A, Alexopoulo V, Desalermos A, editors. Cloud ERP adoption opportunities and concerns: the role of organizational size. System Sciences (HICSS), 2015 48th Hawaii International Conference on; 2015: IEEE.

[5] Kitchenham B. Procedures for performing systematic reviews. Australia: NICTA, 2004.

[6] Webster J, Watson RT. Analyzing the past to prepare for the future: Writing a literature review. MIS quarterly. 2002:xiii-xxiii.

[7] Duan J, Faker P, Fesak A, Stuart T. Benefits and drawbacks of cloud-based versus traditional ERP systems. Proceedings of the 2012-13 course on Advanced Resource Planning. 2013.

[8] Weng F, Hung M-C. Competition and challenge on adopting cloud ERP. International Journal of Innovation, Management and Technology. 2014;5(4):309.

[9] López C, Ishizaka A. GAHPSort: A new group multi-criteria decision method for sorting a large number of the cloud-based ERP solutions. Computers in Industry. 2017;92:12-24.

[10] Das S, Dayal M. Exploring determinants of cloud-based enterprise resource planning (ERP) selection and adoption: A qualitative study in the Indian education sector. Journal of Information Technology Case and Application Research. 2016;18(1):11-36.

[11] Mijac M, Picek R, Stapic Z, editors. Cloud ERP system customization challenges. Central European Conference on Information and Intelligent Systems; 2013: Faculty of Organization and Informatics Varazdin.

[12] Gupta S, Misra SC. Moderating Effect of Compliance, Network, and Security on the Critical Success Factors in the Implementation of Cloud ERP. IEEE Transactions on Cloud Computing. 2016;4(4):440-51.

[13] Al-Johani AA, Youssef AE. A framework for ERP systems in SME based on cloud computing technology. International Journal on Cloud Computing: Services and Architecture. 2013;3(3):1-14.

[14] Gupta S, Misra SC, Singh A, Kumar V, Kumar U. Identification of challenges and their ranking in the implementation of cloud ERP: A comparative study for SMEs and large organizations. International Journal of Quality and Reliability Management. 2017;34(7):1056-72.

[15] Awad HA. Cloud computing as an operational model for ERP services: Definitions and challenges. International Journal of Innovation and Applied Studies. 2014;8(2):499.

[16] Arnesen S. Is a cloud ERP solution right for you? Strategic Finance. 2013;94(8):45.

[17] Elragal A, El Kommos M. In-house versus in-cloud ERP systems: A comparative study. Journal of Enterprise Resource Planning Studies. 2012;2012:1.

[18] El-Gazzar R, Hustad E, Olsen DH. Understanding cloud computing adoption issues: A Delphi study approach. Journal of Systems and Software. 2016;118:64-84.

[19] Gill R. The rise of two-tier ERP: what it is and what it means.(TECHNOLOGY)(enterprise resource planning). Strategic Finance. 2011;93(5):35.

[20] Loebbecke C, Thomas B, Ullrich T. Assessing Cloud readiness at Continental AG. MIS Quarterly Executive. 2012;11(1).

[21] Markus ML, Tanis C. The enterprise systems experience-from adoption to success. Framing the domains of IT research: Glimpsing the future through the past. 2000;173:207-173.

[22] Bradford M. Modern ERP: select, implement, and use today's advanced business systems. Raleigh, NC: Lulu. com; 2015.

[23] Star SL, Ruhleder K. Steps toward an ecology of infrastructure: Design and access for large information spaces. Inform Syst Res. 1996;7(1):111-34.