International Journal of Information Systems and Project Management

Volume 8 | Number 1 Article 1

2020

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International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at www.sciencesphere.org/ijispm

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Abstract:
Cloud enterprise resource planning (ERP) solutions allow organizations to support and coordinate key business processes by leveraging virtualization. Nevertheless, moving ERPs to the cloud is not straightforward, and organizational cloud ERP initiatives raise multiple concerns. We conducted an in-depth systematic review of relevant research literature and identified six key concerns related to cloud ERP implementation: a) the introduction of new ERP work arrangements, b) the migration of legacy data, c) the assurance of compliance with extant rules and regulations for security, d) the continuous alignment between ERP functionality and business processes, e) the ongoing integration between ERPs and the rest of the organization's application portfolio, and f) the establishment of adequate reliability levels. The identified concerns are associated with both transition management and operations supported by cloud ERPs. All the identified concerns are also related to the need to achieve infrastructural embeddedness. This need sets ERPs apart from other types of cloud-based applications, such as office automation solutions that do not have as many dependencies and exchanges with other systems and repositories within an organization's information infrastructure. We argue that the challenge of embeddedness has different implications for organizations of different sizes, and we call for further empirical research.

Keywords:
cloud enterprise resource planning (ERP) implementation; organizational size; information infrastructure; embeddedness; transition management.

DOI: 10.12821/ijispm080101

Manuscript received: 18 April 2019
Manuscript accepted: 22 May 2019

1. Introduction

Cloud computing enables network access to a variety of information technology (IT) resources (e.g., computing power and storage facilities). These networked resources can be delivered as services over the internet (typically represented by a cloud symbol in technical diagrams). The various models of cloud service delivery are collectively known as "X-as-a-Service," where X can be the development platform as a service (PaaS), the infrastructure as a service (IaaS), or the software as a service (SaaS) [1],[2]. Such cloud services have increased remarkably in recent years, and business systems delivered as cloud solutions have become important parts of the market segments [3]. Unlike traditional on-premise solutions, cloud services can be rapidly deployed, while their total cost is easy to estimate since it is linked to actual use. Furthermore, cloud services can support distributed business processes, facilitating globalization and potentially strengthening the competitive position of businesses.

The advent of cloud computing led to the development of cloud-based enterprise resource planning (ERP) solutions. ERPs are combinations of software modules that use common data repositories, allowing the integration of transactional data and business processes [4]. ERP systems have been introduced in organizations to increase efficiency [5], but the traditional ERP implementation has proven to be highly complex and demanding [6],[7]. Virtualization creates new possibilities for swift and cost-efficient ERP deployment [8]-[11], triggering the interest in moving ERPs to the cloud [12]. ERP systems delivered as cloud services (SaaS) are hosted remotely, and access is provided on demand, usually via a thin client, such as a web browser. The users do not own, manage, or operate the underlying infrastructure or individual ERP application capabilities [13]. The benefits of cloud-based ERPs are related to swift deployment, cost effectiveness, scalability, and ease of updates [10],[14]. Despite the alluring potential benefits of cloud ERPs, their adoption rates are very low compared with other cloud-based business applications [15]. For instance, organizations have quickly embraced cloud services for office automation applications and email exchanges but are reluctant to move their ERPs to the cloud. To gain an understanding of organizations' concerns about cloud ERP implementation, we reviewed the related research literature.

Specifically, we looked for recurring cloud ERP implementation concerns beyond strategic aspirations. The identified concerns are associated with both *transition management* and *operations* supported by cloud ERPs. Transitioning concerns include the introduction of new ERP work arrangements, the migration of legacy data, and the assurance of compliance with extant rules and regulations for security. The concerns related to operations include the continuous alignment between ERP functionality and business processes, the ongoing integration between ERPs and the rest of the organization's application portfolio, and the establishment of adequate reliability levels. All the identified concerns are related to the need to achieve infrastructural embeddedness. This need sets ERPs apart from other types of cloud-based applications, such as office automation solutions that do not have as many dependencies and exchanges with other systems and repositories within an organization's information infrastructure.

Overall, our study identifies, analyzes, and integrates a critical mass of research on cloud ERP implementation, offering a sound base for researchers and practitioners interested in the introduction of cloud ERPs in organizations. To ensure robust results, we performed a systematic literature review [16] guided by the following question: "*Which concerns related to the implementation of cloud-based ERP systems have been addressed in previous research literature?"* Our contribution is threefold. First, we identify recurring cloud ERP implementation concerns, explaining their limited diffusion. Second, we map the identified concerns to different sizes of organizations, pointing to the implications of size. Third, we synthesize our findings in a concise framework, revealing that infrastructural embeddedness is the key challenge for cloud-based ERPs.

We have organized the remainder of this paper as follows. In Section 2, we present the method used for selecting and analyzing the articles for this review. In Section 3, we offer a synthesis of our findings in two concise concept matrices. In Sections 4 and 5, we discuss the findings and draw conclusions by pointing to implications for research and practice and directions for further research.

2. Method

In this section, we first describe the scope of the literature review and the process we followed to select relevant articles. We then explain the method we applied to code and synthesize the findings of the selected articles. Overall, we conducted the systematic literature review by following the process proposed by Kitchenham [16]. Figure 1 provides an overview of this process.

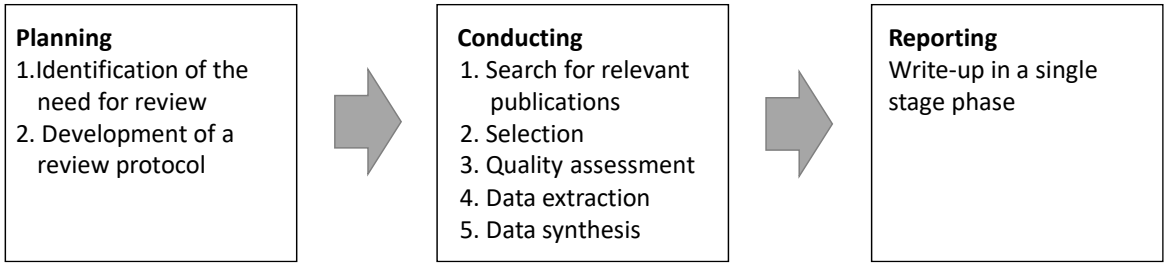

Fig. 1. Overview of literature review process (based on the process proposed by Kitchenham [16])

To identify and select the research articles for review, we used a set of search terms and a set of inclusion/exclusion criteria. The search terms and the inclusion/exclusion criteria were included in the review protocol. The use of a protocol is important for reducing selection bias and assuring the selected papers' quality and relevance [16]. We used 'cloud ERP' as the primary search term. To identify as many relevant articles as possible, we formulated the primary search term in a way that would ensure the inclusion of different alternative expressions. Specifically, the primary search string used was ('ERP' OR 'Enterprise Resource Planning') AND 'Cloud'. We used a set of additional terms to delimit the search within the research related to implementation. Specifically, the search word 'implementation' was added together with the related words 'adoption' and 'change' as alternatives. Thus, the complete search string used was (('ERP' OR 'Enterprise Resource Planning') AND 'Cloud') AND (('implementation') OR ('adoption') OR ('change')). By performing the search with the use of a compound string, we obtained a consolidated list of results, avoiding the problem of integrating and removing the duplication of the outcomes of different searches. The string was used to search publications by title, keywords, and abstract in Scopus. We restricted the search to publications that were peer reviewed, written in English, published in scientific journals and conference proceedings, and published until 2018.

The search yielded 183 unique articles in total. The next step was to read the titles and the abstracts of the identified articles, checking their relevance to the research question. For this step, we used the inclusion/exclusion criteria. Specifically, we excluded papers that only casually mentioned cloud ERP implementation but had a different focus (e.g., cloud computing in general or company disposition toward cloud ERPs). We also excluded papers published in outlets outside information systems (IS) research, computer science, business studies, and management research. Additionally, we disregarded articles focused on narrow domains (e.g., a specific type of farming, such as aquaponics). After this step, 49 papers were shortlisted.

Finally, the full text of each shortlisted paper was assessed for relevance by applying the inclusion/exclusion criteria to the full content. We also assessed the quality of the reported research by checking the rigorousness of each article's method description. After this step, a final corpus of 19 articles was selected. Figure 2 presents the sequence of these steps.

Table 1 presents the full reference list comprising the 19 selected articles. Additionally, Appendix A provides an overview of the key aims and insights of all selected articles.

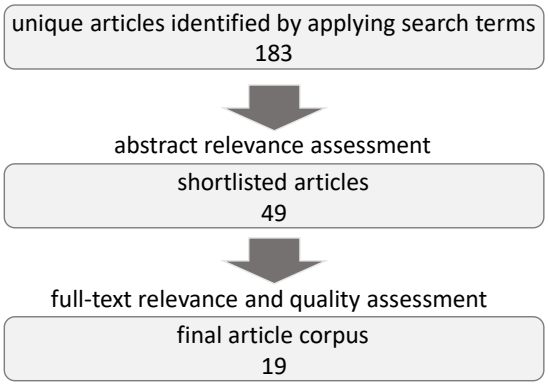

Fig. 2. Creating a corpus of articles for review: identification and selection process

We coded and synthesized the selected articles by following a concept-centric logic [17]. The coding of the articles was specifically focused on concepts related to implementation concerns, excluding other cloud ERP topics that were irrelevant to the research question. The first step involved identifying and listing key concepts while reading each article. After completing this step, we evaluated, consolidated, and refined all the identified concepts. Therefore, the concepts evolved inductively from the literature. The articles and the concepts were cross-analyzed to ensure consistency and comprehensiveness. The final set of concepts was used for the development of a concept matrix that would present the associations between the articles and the concepts (Table 2). The development of the concept matrix was instrumental for bringing up insights from published research to answer the research question "*Which concerns related to the implementation of cloud-based ERP systems have been addressed in previous research literature?"* The results of the analysis are presented in Section 3.

Table 1. List of selected articles

#	**Reference list comprising the selected articles**
1	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.
2	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.
3	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*.
4	Elragal, A., & El Kommos, M. (2012). In-house versus in-cloud ERP systems: a comparative study. *Journal of Enterprise Resource Planning Studies*, vol. 2012, pp. 1–13.
5	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.
6	Gupta, S., Misra, S. C., Kock, N., & Roubaud, D. (2018). Organizational, technological and extrinsic factors in the implementation of cloud ERP in SMEs. *Journal of Organizational Change Management*, 31(1), pp. 83–102.
7	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.
8	Johansson, B., Alajbegovic, A., Alexopoulos, V., & Desalermos, A. (2015). Cloud ERP adoption opportunities and concerns: the role of organizational size. *48th Hawaii International Conference on System Sciences*, pp. 4211–4219.

#	Reference list comprising the selected articles
9	Johansson, B., & Ruivo, P. (2013). Exploring factors for adopting ERP as SaaS. *Procedia Technology*, 9, pp. 94–99.
10	Kranz, J. J., Hanelt, A., & Kolbe, L. M. (2016). Understanding the influence of absorptive capacity and ambidexterity on the process of business model change – the case of on-premise and cloud-computing software. *Information Systems Journal*, 26(5), pp. 477–517.
11	Loebbecke, C., Thomas, B., & Ullrich, T. (2012). Assessing cloud readiness at Continental AG. *MIS Quarterly Executive*, 11(1), pp. 11–23.
12	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.
13	McCrea, B. (2011). Putting the spotlight on ERP. *Logistics Management*, 50(6), pp. 32–35.
14	Meghana, H. L., Mathew, A. O., & Rodrigues, L. L. (2018). Prioritizing the factors affecting cloud ERP adoption – an analytic hierarchy process approach. *International Journal of Emerging Markets*, 13(6), pp. 1559–1577.
15	Mijac, M., Picek, R., & Stapic, Z. (2013). Cloud ERP system customization challenges. *Central European Conference on Information and Intelligent Systems*, pp. 132–140.
16	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.
17	Saeed, I., Juell-Skielse, G., & Uppström, E. (2012). Cloud enterprise resource planning adoption: motives & barriers. *Advances in Enterprise Information Systems*, II, pp. 429–434.
18	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.
19	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.

3. Results

The analysis of the selected articles reveals several concerns related to the implementation of cloud-based ERPs. Specifically, the identified concerns are associated with both *transition management* and *operations* supported by cloud ERPs. Transitioning concerns include the introduction of new ERP work arrangements, the migration of legacy data, and the assurance of compliance with extant rules and regulations for security. The concerns related to operations include the continuous alignment between ERP functionality and business processes, the ongoing integration between ERPs and the rest of the organization's application portfolio, and the establishment of adequate reliability levels. In the following subsections, we present these concerns in detail.

3.1 Concerns related to transition management

Introduction of new ERP work arrangements. Similar to conventional ERP solutions, the adoption of cloud-based ERPs leads to organizational changes [11]. Workers must adjust some of their routines to handle data differently. This can be especially challenging for large organizations that have to bring onboard numerous employees from different business units, investing significant resources and time to train everybody. Furthermore, the IT Department's resistance to the changes induced by cloud ERPs (e.g., related to working with external service providers) tends to be an issue for large businesses but not for small- and medium-sized enterprises (SMEs) [8],[10].

Migration of legacy data. 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 the data structures of cloud ERP solutions can be very different from those of the systems that are already in use on the premises [18]. The migration

from traditional ERP solutions to cloud-based ERP systems can be especially demanding for large organizations with complex systems, making migration very expensive and time consuming [10],[18].

Assurance of compliance with extant rules and regulations for security. Security is a key concern for organizations deciding to adopt cloud-based services [10], [19]-[21]. In cloud-based ERPs, all organizational information, such as financial data and customer details, needs to be stored with a third-party supplier; thus, data security can be threatened if encryption and other related mechanisms are not properly implemented. It can be challenging for cloud ERP suppliers to build user trust, and their data protection measures should be explained [19]. For many businesses, it is difficult to decide to rely on suppliers for secure storage, implementation of security policies, and application of access control rules [9],[12],[18],[22]. Furthermore, regulations in many countries are not in favor of cloud solutions for enterprise data storage [23] or impose stringent compliance requirements [19]. Consequently, organizations are increasingly apprehensive about cloud ERP data storage arrangements. Additionally, cultural aspects can considerably influence company stances regarding data security. For instance, companies in Western Europe can be particularly reluctant to use cloud software because of concerns regarding data security [24]. Overall, many enterprises are uncomfortable with losing control over the storage and the management of their own data by adopting cloud ERPs [23]. Ensuring compliance with extant rules and regulations for data security is one of the most common concerns.

3.2 Concerns related to operations

Continuous alignment between ERP functionality and business processes. Cloud-based ERPs are usually not as comprehensive in terms of functionality as traditional on-site ERP systems. Unsurprisingly, business units with standardized processes across industries (e.g., human resources, purchase management, accounting) were the first to demand cloud ERP services [24]. Business units that perform less standardized work tend to be less interested as it can be difficult to find a cloud-based solution to fit all the needs of an implementing organization [8],[25],[26]. Furthermore, organizations frequently need to adapt their ERPs over time, adjusting to changing needs. Thus, alignment should be continuously ensured via system adaptability [21]. This is especially challenging for organizations that need functionalities that are not required by many other firms. Cloud ERP service providers rarely add functionalities that only benefit a few of the companies using their cloud software [27]. Consequently, organizations implementing cloud ERPs may need customized cloud-based ERP services [19].

Ongoing integration between ERPs and the rest of the organization's application portfolio. Many cloud-based ERP systems have noticeable limitations in integrating with existing application portfolios [8]. Overall, organizations that implement cloud ERPs depend on cloud ERP providers' ability to solve integration issues [23]. This can create problems, especially regarding business-critical systems or processes [12],[28]-[29]. Furthermore, integration can be difficult for organizations with complex legacy systems [10]. Therefore, ease of integration is one of the key factors influencing cloud ERP adoption [21]. The introduction of service-oriented architecture can support the orchestration of cross-functional business processes and the integration between ERP and non-ERP components of the information infrastructure [9].

Instituting adequate reliability levels. When a company chooses a cloud-based ERP system, reliability is crucial [20]. Delays or failures can create serious problems [14], so ensuring system availability is necessary [21],[23]. This means that a predictable, stable, and reliable network connection is required [19],[30]. Organizations that need round-the-clock access to their ERPs express significant concerns about the timeliness and the quality of cloud provider support services [27]. Overall, it is important for ERP users to ensure that their systems have reliable response times [19].

The concept matrix presented in Table 2 provides an overview of the findings and shows how the identified concerns (listed in columns) are associated with the analyzed articles (listed in rows). Organizations of different sizes have different capabilities and resources, so their concerns may differ. Although not all the articles that we analyzed specify the sizes of the studied organizations, several articles provide insights specific to different sizes of organizations, especially making the distinction between large companies and SMEs. To trace potential differences, we decided to map the concerns according to organizational sizes by using the relevant information available in 10 out of the 19 selected papers. These mappings are presented in Tables 3a and 3b.

Table 2. Concept matrix for all selected articles

Article # (full references provided in Table 1) (Appendix A provides the key aims and insights)	Transitioning Concerns			Operating Concerns		
	Introduction of new ERP work arrangements	Migration of legacy data	Assurance of compliance with security regulations	Alignment between ERP functionality and processes	Integration between ERPs and application portfolios	Instituting adequate reliability levels
1			X	X	X	X
2			X	X		X
3	X		X	X	X	X
4	X		X			
5	X		X	X	X	
6			X	X		X
7	X	X	X	X	X	X
8	X	X	X	X	X	X
9			X	X		X
10			X	X		X
11			X	X	X	
12	X			X		
13			X			X
14			X	X	X	X
15	X				X	
16	X		X		X	
17			X	X	X	X
18	X		X		X	X
19			X	X	X	

Table 3a. Concept matrix based on organizational size* – Small and Medium Organizations

Article # (full references provided in Table 1) (Appendix A provides the key aims and insights)	Small and Medium Organizations					
	Transitioning Concerns			Operating Concerns		
	Introduction of new ERP work arrangements	Migration of legacy data	Assurance of compliance with security regulations	Alignment between ERP functionality and processes	Integration between ERPs and application portfolios	Instituting adequate reliability levels
1			X	X	X	X
2			X	X		X
3						
5	X		X	X	X	
6			X	X		X

Article # (full references provided in Table 1) (Appendix A provides the key aims and insights)	Small and Medium Organizations					
	Transitioning Concerns			Operating Concerns		
	Introduction of new ERP work arrangements	Migration of legacy data	Assurance of compliance with security regulations	Alignment between ERP functionality and processes	Integration between ERPs and application portfolios	Instituting adequate reliability levels
7			X	X	X	X
8			X			X
11						
14						
18	X		X		X	X

*Only 10 out of the 19 selected papers contain organizational size-specific information; these 10 papers are included in this table.

Table 3b. Concept matrix based on organizational size* – Large Organizations

Article # (full references provided in Table 1) (Appendix A provides the key aims and insights)	Large Organizations					
	Transitioning Concerns			Operating Concerns		
	Introduction of new ERP work arrangements	Migration of legacy data	Assurance of compliance with security regulations	Alignment between ERP functionality and processes	Integration between ERPs and application portfolios	Instituting adequate reliability levels
1						
2						
3	X		X	X	X	
5						
6						
7	X	X	X	X	X	X
8	X	X	X	X	X	X
11			X	X	X	
14			X	X	X	X
18						

*Only 10 out of the 19 selected papers contain organizational size-specific information; these 10 papers are included in this table.

4. Discussion and implications

The concerns identified through our literature review are sociotechnical in nature and point to the need to ensure continuity with the past and sustainability in the future by embedding cloud ERPs in the information infrastructures that are already in place. Infrastructural embeddedness entails being "sunk" into other structures, social arrangements, and technologies [31]. Specifically, implementing cloud ERPs involves becoming part of the installed base of applications and data, work processes, and governance arrangements [31]-[33]. 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, extend and transform them.

When implementing cloud ERPs, the old and the new need to be linked together, becoming interoperable in one way or another. Therefore, the old (the installed base) heavily influences how the new can be designed, and the overall infrastructure is developed through extending and improving the installed base [34]. The installed base may create path dependencies and lock-in mechanisms [35]. Vendor lock-in has been identified as a possible barrier to implementing cloud solutions, and the relationship between the vendor and the consumer of a cloud solution is important in the consumer's decision to move to the cloud [36]. Furthermore, as cloud-based ERP solutions are built on a different service model than the traditional ERP systems, they have consequences for the established control structures within an organization. For example, the IT Department has traditionally controlled the systems and the related infrastructure. When implementing cloud-based ERP solutions, the control is shifted to external suppliers. It follows that the IT Department will need to adapt and introduce new ways of organizing and training the staff in new skills [37]. Overall, the implementation of cloud ERPs entails positioning and fitting them in the overall information infrastructure, which consists of multiple sociotechnical components, including data and applications, work processes, and governance arrangements [32]. Ensuring embeddedness (i.e., becoming sunk) in work processes, data and applications, and governance arrangements involves specific activities during both the transition period (introducing new ERP work arrangements, migrating legacy data, and ensuring compliance with extant rules and regulations) and the subsequent day-to-day operations (through the continuous alignment between ERP functionality and business processes, the ongoing integration between ERPs and the rest of the organization's application portfolio, and the establishment of adequate reliability levels). Figure 3 presents the synthesis of our findings in a framework for ERP implementation, which focuses on infrastructural embeddedness. The cloud ERP should be embedded in the information infrastructure through the activities of transitioning (noted in the inner circle) and of day-to-day operations (noted on the sides of the triangle).

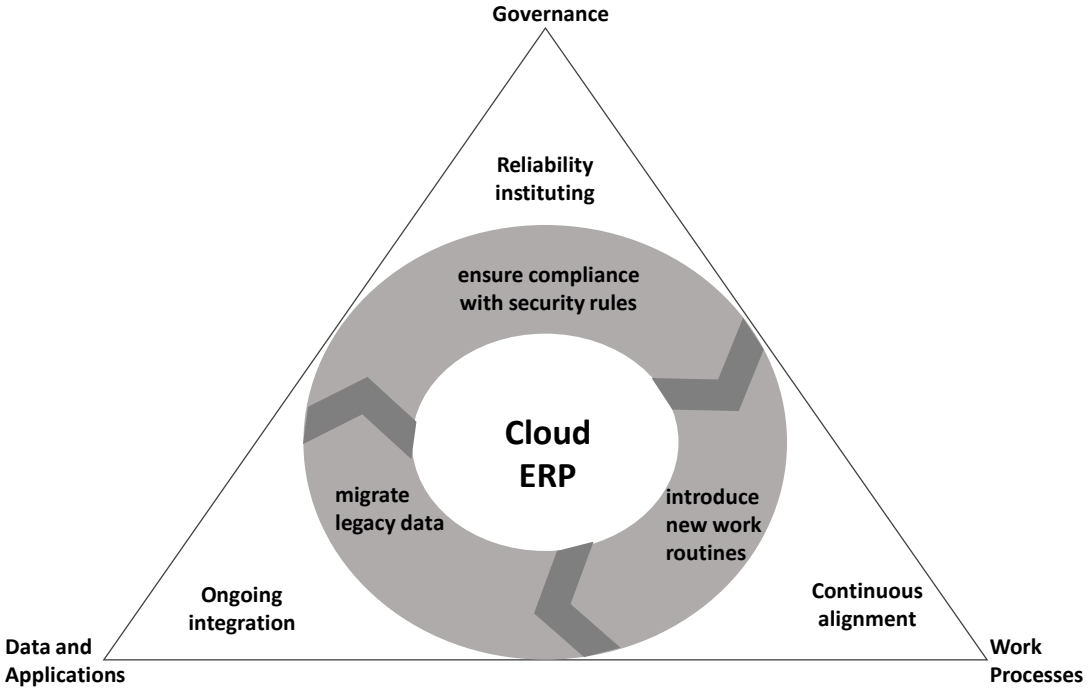

Fig. 3. Implementing cloud ERPs: the challenge of infrastructural embeddedness

The framework presented in Figure 3 is common for all organizations, irrespective of size. Nevertheless, some of its aspects are more challenging for large organizations because they tend to have more extensive and complex existing information infrastructures than smaller companies [38]. For instance, in Tables 3a and 3b, which present the specific concerns of large enterprises and SMEs, data migration only appears as a specific concern for the former. This is probably because many SMEs decide to implement cloud ERPs without having legacy ERPs in place (i.e., they introduce ERPs for the first time). Furthermore, SMEs tend to have more informal structures than larger companies and consequently can move to cloud ERPs more swiftly [39].

The size-specific concept matrix (Tables 3a and 3b) illustrates a gap in the literature regarding cloud-based ERP implementation relative to organizational size. In their study, Johansson and colleagues [10] identify that SMEs and large businesses may have different needs in implementation and mention that scant research compares them, as confirmed by our matrix. We suggest that more research is needed toward this direction, especially in exploring the challenges of large organizations where there is less experience because vendors mostly target SMEs that can now obtain ERP functionality at a low cost due to limited implementation overhead and simplicity. Nevertheless, large companies also recognize and appreciate the advantages of cloud ERPs, such as IT efficiency and business agility [10].

Unsurprisingly, most of the identified concerns can be traced back to the challenges related to adopting cloud computing and introducing ERPs [23]. For instance, previous research provides evidence that the security issue is one of the main obstacles to utilizing cloud computing services for business-critical applications [40]-[41]. In this review, ensuring compliance with security regulations is the most prominent concern and is mentioned in almost all the reviewed articles. There are multiple reasons for being apprehensive about security. On one hand, there are strategic reasons for safeguarding core business information; on the other hand, regulatory requirements are becoming increasingly strict. Organizations are particularly worried about international and national regulations, as well as laws for data storage when moving business-critical systems to the cloud [42]. It is important that they assess the quality of different cloud service providers before making a decision on choosing their provider. Some service providers may lack contract competency, and the combination of poorly developed contracts and little evidence of security makes it difficult to ensure compliance with security regulations when introducing cloud services [24]. A quick look at the size-specific concept matrix in Tables 3a and 3b reveals that this concern is discussed for smaller and larger organizations, irrespective of organizational size. The legal issues related to data security when considering cloud ERP solutions can be particularly challenging for small enterprises that mostly lack organized legal departments. With a cloud ERP solution, it is difficult to know where the data are located, and which legislation would apply to these data. In a supply chain in the cloud, the SaaS provider may be located in China, while the platform or infrastructure provider could be based in Germany. What then are the rules, and who is responsible if conflicts occur?

Another area of concern that is frequently found in the literature is related to introducing new ERP work arrangements. Although cloud ERPs can be quickly launched, they still require significant time for organizational adaptations, including new roles for the IT Department. Many small organizations have no existing ERPs in place, and cloud solutions offer them the opportunity to introduce capabilities that were previously inconceivable. These organizations also need to initiate new work arrangements for their newly introduced ERPs. More research is needed to investigate the needs of small companies, probably also distinguishing among different industries and maturity levels of the pre-existing information infrastructures.

5. Conclusion

Evidence suggests that organizations that want to reduce the complexity of IS implementation and use tend to positively consider cloud solutions as alternatives to on-premise systems [43]. Nevertheless, organizations want to control their core business processes and are frequently skeptical about moving complex and business-critical systems, such as their ERPs, to the cloud, opting to introduce the cloud concept through simpler and less critical applications (e.g., office support tools). However, it is important to think strategically and consider what solution creates the best business value [11]. This is especially challenging for organizations that have already complex on-premise systems and traditional platforms in place. In this paper, we have identified several recurring cloud ERP implementation concerns beyond

strategic aspirations. By synthesizing a corpus of selected research articles on cloud ERP implementation, we offer a sound base for researchers and practitioners interested in the introduction of cloud ERPs in organizations. Our contribution is threefold. First, we identify some recurring cloud ERP implementation concerns, pointing to the work involved in introducing such systems in organizations that already have information infrastructures in place. Second, we map the identified concerns to different sizes of organizations, foregrounding the implications of size. Third, we integrate the findings in a concise framework, covering the multiple aspects of infrastructural embeddedness for cloud-based ERPs.

In our literature review, we have found surprisingly few empirical papers that focus on the implementation of cloud-based ERP solutions and sociotechnical concerns in this regard. One reason might be that cloud-based ERP solutions are still not widespread. Furthermore, as noted, several of the reviewed articles do not explicitly state the sizes of the organizations under study. It is important for research to be properly contextualized to be useful for further development, and we urge researchers to report as much contextual information as possible (e.g., organizational size, industry, years in operation). To advance our knowledge on the implementation of cloud ERP solutions, we need more empirical studies that show the issues addressed by organizations of different sizes.

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Appendix A. List of selected articles – overview of key aims and insights

#	Title	Year	Author(s)	Key Aims	Insights
1	A framework for ERP systems in SME based on cloud computing technology	2013	Al-Johani, A. A., & Youssef, A. E.	Identify benefits and drawbacks of cloud ERPs through a comprehensive comparison of ERPs before and after moving to the cloud. Propose a framework for cloud ERPs tailored to SME needs, and test it in an actual case.	Although several challenges and drawbacks are associated with cloud ERPs, the overall benefits for SMEs are more significant. The proposed framework can be applied to facilitate SMEs' transfer of their ERPs to the cloud, realizing solution integration and industry functionality at a relatively low cost.
2	Exploring determinants of cloud-based enterprise resource planning (ERP) selection and adoption: a qualitative study in the Indian education sector	2016	Das, S., & Dayal, M.	Explore the drivers for cloud ERP selection and adoption through a framework that integrates three technology adoption theories (diffusion of innovations, task-technology fit, and extended technology acceptance model), and test the framework in three cases.	The results suggest that vendors should focus on providing secure, standardized, long-term, convenient, and high-quality services, balancing between customization-related additional costs and business value. Adopting organizations should determine organizational fit and train their employees to minimize resistance.
3	Benefits and drawbacks of cloud-based versus traditional ERP systems	2013	Duan, J., Faker, P., Fesak, A., & Stuart, T.	Identify and classify the benefits and the drawbacks of cloud-based versus traditional ERPs. Analyze whether the benefits and the drawbacks of cloud-based ERPs are more relevant for SMEs than for large enterprises.	Lower costs, scalability, access to specialized technology, and disaster recovery facilities are important for SMEs. At the same time, the known drawbacks of cloud-based ERPs are less important to SMEs. For some SMEs, extensive customization and integration may be irrelevant. Similarly, loss of IT skills and competencies, the IT Department's resistance to change, and certain security risks may not be major issues for SMEs.
4	In-house versus in-cloud ERP systems: a comparative study	2012	Elragal, A., & El Kommos, M.	Provide a framework for comparison between traditional and cloud-based ERP implementation.	The results show that cloud ERPs are faster to implement, easier to use, scalable, and cost less. However, traditional ERPs allow more control; thus, many organizations deem them more secure.
5	Moderating effect of compliance, network, and security on the critical success factors in the implementation of cloud ERPs	2016	Gupta, S., & Misra, S. C.	Explore correlations in key success factors (organizational, human, and technological) in the implementation of cloud ERPs.	Structural equation modeling is used to establish whether there are moderating effects of compliance, network, and security on the success factors for cloud ERP implementation. There is no significant effect on people and technological success factors. Only the organizational success factors are found to be moderated.
6	Organizational, technological and extrinsic factors in the implementation of cloud ERP in SMEs	2018	Gupta, S., Misra, S. C., Kock, N., & Roubaud, D.	Investigate the relationship between SMEs and cloud service providers and identify crucial factors that lead to successful implementation of cloud ERPs.	The findings include organizational and technical factors for successful implementation of cloud ERPs in SMEs, as well as the extrinsic factors that may influence cloud service providers' performance. The resource dependency theory is used to explain SME concerns.
7	Identification of challenges and their ranking in the implementation of cloud ERP: a comparative study for SMEs and large organizations	2017	Gupta, S., Misra, S. C., Singh, A., Kumar, V., & Kumar, U.	Identify critical challenges in the implementation of cloud ERPs.	A number of challenges are ranked, showing also how small, medium, and large businesses differ.

#	Title	Year	Author(s)	Key Aims	Insights
8	Cloud ERP adoption opportunities and concerns: the role of organizational size	2015	Johansson, B., Alajbegovic, A., Alexopoulos, V., & Desalermos, A.	Identify and classify opportunities and concerns that are often associated with cloud ERPs with respect to organizational size.	Small- and medium-sized businesses can reap significant benefits and have no major concerns. Large companies have greater concerns related to complexity and specific requirements.
9	Exploring factors for adopting ERP as SaaS	2013	Johansson, B., & Ruivo, P.	Map the value proposition for ERPs delivered as SaaS. Explore perceived benefits and concerns regarding cloud ERP adoption.	The 10 key factors identified are costs, security, availability, usability, implementation, ubiquity, flexibility, compatibility, analytics, and best practices. The main concerns include costs, data security, and system availability.
10	Understanding the influence of absorptive capacity and ambidexterity on the process of business model change – the case of on-premise and cloud-computing software	2016	Kranz, J. J., Hanelt, A., & Kolbe, L. M.	Explore the business model changes by studying the technological trajectory of ERP software that shifts from on-premise to on-demand software services.	A theoretical model built on the concepts of absorptive capacity and organizational ambidexterity is proposed. The factors that determine how and why incumbents change business models to provide cloud ERP services are identified. Some insights on ERPs switching from on-premise to on-demand services are offered.
11	Assessing cloud readiness at Continental AG	2012	Loebbecke, C., Thomas, B., & Ullrich, T.	Use a field-tested method to evaluate the studied organization's maturity for cloud services.	Five guidelines for businesses to switch to cloud services are presented. The suggested approach can resolve compliance and security issues.
12	GAHPSort: a new group multi-criteria decision method for sorting a large number of the cloud-based ERP solutions	2017	López, C., & Ishizaka, A.	Support companies in choosing cloud-based ERP systems through a decision support tool validated in a real case.	The paper highlights the differences between traditional and cloud-based ERP and proposes how to proceed in the selection process.
13	Putting the spotlight on ERP	2011	McCrea, B.	Investigate the supply chain software space to find how ERP systems are used, covering both cloud-based and on-premise ERPs.	The study identifies several benefits for and barriers to ERP systems, along with the status toward cloud computing and a detailed mapping of applications in use or planned.
14	Prioritizing the factors affecting cloud ERP adoption – an analytic hierarchy process approach	2018	Meghana, H. L., Mathew, A. O., & Rodrigues, L. L.	Rank different factors influencing cloud ERP adoption in multinational companies.	The five most important factors are data accessibility, availability, user friendliness, scalability, and data backup and recovery, while vendor trustworthiness and data retention are ranked relatively low.
15	Cloud ERP system customization challenges	2013	Mijac, M., Picek, R., & Stapic, Z.	Provide an overview of customization challenges.	The study identifies 12 challenges and problems with the customization of cloud-based ERP systems.
16	Cloud ERP: a new dilemma to modern organisations?	2014	Peng, G. C. A., & Gala, C.	Explore benefits and barriers associated with the adoption of cloud-based ERPs.	The study identifies 15 benefits and 18 critical barriers.
17	Cloud enterprise resource planning adoption: motives & barriers	2012	Saeed, I., Juell-Skielse, G., & Uppström, E.	Build a unified framework of motives for and barriers to cloud ERP adoption.	Most of the motives and the barriers found can be traced back to ERP outsourcing and/or cloud computing. The motives and the barriers are strategic, operational, and technical.
18	Adoption of software as a service (SaaS) enterprise resource planning (ERP) systems in small and medium sized enterprises	2015	Seethamraju, R.	Explore specific factors and challenges in the adoption of cloud ERP systems in SMEs.	Cloud ERP systems are considered suitable for SMEs. They can support visibility and standardized processes, as well as support and improve performance.
19	Competition and challenge on adopting cloud ERP	2014	Weng, F., & Hung, M. C.	Provide a framework that facilitates organizations' assessment of whether ERP cloud services are right for them.	The important factors that should be considered are listed. The four main concerns are related to data security, business profit, internet accessibility, and total cost.

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