Cloud Computing and ERP: A Framework of Promises and Challenges

Research in Progress

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Abstract

Enterprise Resource Planning (ERP) systems are an integral component of IT infrastructure in many organizations. A recent trend for ERP is the shift from on-premises infrastructure to the cloud environment through utilization of cloud computing technologies. The characteristics of cloud computing induces many promises to cloud-based ERP systems - making 'Cloud ERP' a favourable alternative to on-premises ERP systems. However, moving ERP systems into the cloud also presents many challenges. This paper aims to evaluate the promises and challenges of cloud-based ERP systems from a review of the literature and propose a framework to be of utility for IT executives and researchers to assess the key promises and challenges of cloud environments for ERP systems. The contribution of this paper is threefold. First, we identify a set of key promises and challenges to help IT decision makers and researcher to gain a better understanding of cloud computing and ERP. Second, our framework identifies four dimensions of cloud ERP to be assessed: Efficiency, Flexibility, Ubiquity, and Security. We propose that all these dimensions encompass promises and challenges to varying degrees. Third, we propose research opportunities for IS researchers in the domain of cloud-based ERP systems based on the identified four dimensions.

Keywords

Cloud ERP, ERP, Cloud Computing, Literature Review, Framework

INTRODUCTION

Standardized software packages are the backbone of many business applications. Innumerable organizations rely on these standardized software packages to carry out their daily operations. On the one hand, standardized software packages are very robust and support many sophisticated business applications. On the other hand, researchers argue that the monolithic, standardized software packages may not sufficiently accommodate the diversity of complex organizations (Berente and Yoo 2012; Wagner and Newell 2004). A recent trend for ERP systems, which are a typical example of standardized software packages, is the shift from on-premises infrastructure to the cloud environment. Inherently, cloud computing comes in standardized forms. The adoption of cloud computing for ERP inevitably induced further standardization to ERP systems and thus produces new challenges and opportunities for modern organizations.

Organizations utilize ERP systems to integrate heterogeneous organizational systems and facilitate seamless business transactions across inter- or cross-organizational boundaries. Traditionally, the development of ERP systems involves maintaining a set of hardware and network configurations, typically using a database as an information repository. However, as ERP systems are becoming an integral component of organizational infrastructure, the complexity of these sophisticated and large-scale business applications grows rapidly. As a consequence, ERP systems are very costly to maintain. Organizations are constantly challenged to balance between sustaining competitiveness via high utilization of ERP systems and minimizing the cost of ERP systems. The emergence of cloud computing is considered to be a potential solution to this dilemma (Dutta et al. 2013; Hofmann and Woods 2010).

Cloud computing represents a state-of-the-art technology that delivers IT resources via the Internet. Organizations retrieves services from a pool of virtualized IT resources, allowing for an on-demand, pay-per-use

billing model (Armbrust et al. 2010; Buyya et al. 2009). The growth rate of the market for cloud computing is forecasted to be high in the near future. The market of public cloud services is predicted to grow from US$26 billion in 2012 to US$160 billion in 2020 (Choudhary and Vithayathil 2013).

Cloud-based ERP systems ('Cloud ERP') present a new delivery model for ERP systems that is based on cloud computing technology. It aims to offer similar functionality to on-premises ERP solutions enhanced with features unique to of cloud computing. Cloud ERP is gaining popularity and causing legacy ERP system to lose market share. It has, for instance, been argued that the first-quarter sales and earnings report of SAP AG in 2014 has missed analysts' estimates due to the rise of cloud ERP systems (Ricadela 2014).

Despite the increasing impact of cloud ERP, this is still a new and emerging domain. There are only few studies conducted on the adoption of cloud ERP and on the promises and challenges of this new paradigm. Existing literatures mainly examine ERP and cloud computing as two separate research domains. For ERP systems, there is an abundant amount of studies focusing mainly on issues related to on-premises systems. For cloud computing, there are numerable studies focusing on cloud computing in general but the different types of cloud services are often neglected. Subsequently, not many studies have specifically looked at different forms of cloud applications, including cloud ERP.

This research aims to bridge the gap between research on on-premises ERP and cloud computing. Given the inherent importance of ERP systems, cloud ERP can be expected to become one of the most essential cloud computing applications for organizations. Cloud ERP is very disruptive to the traditional ERP market and it is crucial for organizations to be aware of the impact of cloud computing to ERP. IT executives and researchers can thus clearly benefit from a better understanding of the potential promises and inherent challenges of cloud ERP for organizations. The contribution of this paper is to provide such a better understanding in the form of a framework based on research findings in both the ERP and cloud computing fields.

The rest of the paper is organized as follows: We begin by identifying the key promises and challenges of cloud computing, on-premises ERP systems, and cloud-based ERP systems. We then synthesize these promises and challenges into a framework. Further, we suggest potential research opportunities for realizing the benefits of cloud ERP systems.

PROMISES

Cloud ERP systems undoubtedly present numerous benefits for organizations. In this section, we will discuss the promises for such systems in detail. Existing literature has shown that IT executives generally have an overall attitudinal appraisal of cloud computing adoption (Benlian and Hess 2011). However, due to the scarcity of studies on cloud ERP, our identification of cloud ERP promises include findings from several related domains. Specifically, we will discuss the promises of ERP systems, cloud computing promises, and cloud ERP promises in the following.

ERP Promises

ERP is a well-researched domain and existing literature provides a sound basis for assessing the promises of ERP systems. In this section, we discuss some key promises that are mentioned repeatedly in the ERP literature. Specifically, we discuss how ERP systems integrate heterogeneous information systems (Promise 1), how ERP improve business processes through business process reengineering (Promise 2), and how ERP provides information for better decision making (Promise 3).

Promise 1: Integration of Heterogeneous Information Systems

Integration is one of the initial value propositions that ERP systems were created upon. It refers to unifying the enterprise system, processes, and data within the unique environment of an organization (Umble et al. 2003). The systems are used for seamless connection between organizational processes and units as well as suppliers and customers (Davenport 2000; Davenport et al. 2004). For example, the manufacturing operations can be integrated with the logistic operations to allow immediate delivery of products as soon as they are manufactured, shortening the cycle time of inventory.

Promise 2: Improved Business Processes

While the technical capabilities of ERP present great promise for the organization, it is often argued that the main promise of ERP lies in its ability to shape and improve business processes. ERP adoption is often accompanied by formal business process reengineering (BPR). BPR often leads to standardized business processes using best practices embodied in enterprise systems (Koch 2001). Optimizing enterprise systems and business processes in this way enables the benefits of enterprise systems to be truly realized. Organizations will gain greater business performance if they focus heavily on business process reengineering during implementation (Davenport 2000;

Davenport et al. 2004). For example, organization can improve management of accounting and corporate finances by exploiting the financial accounting module of ERP. The financial accounting module incorporates business best practices for the organization. Thus the software package reflects the most effective way to perform each business process according to the ERP vendor's interpretation.

Promise 3: Better Decision Making

Organizations transform data into meaningful information and knowledge to support their decision making. To aid in this transformation of information and, ultimately, to improve decision making is one of the most cited features of ERP systems (Davenport 2000; Davenport et al. 2004). For example, just-in-time manufacturing (JIT) is often supported effectively by enterprise systems; enabling the manufacturer to make timely decision supported by information provided by the ERP system, and to reduce production surplus and excess inventory.

Cloud Promises

Cloud computing is a relatively young and emerging domain in comparisons to ERP. Existing literature mainly examine cloud computing applications in general without distinguishing between different forms of cloud applications. This section presents the key promises of cloud computing that we found in the cloud computing literature. Specifically, we describe how cloud computing enables ubiquitous business applications that is accessible anywhere (Promise 1) and on-demand IT resources that adjust according to demand (Promise 2).

Promise 1: Accessible Anywhere

The ubiquity of cloud computing enables IT resources to be accessible any time in any location using any device, via the Internet, allowing business applications to be seamlessly utilized at location and time that are most suitable for the requirements of the workload (Buyya et al. 2009; Mell and Grance 2009). The job of a door-sales person will be made much more efficient when the product can be demonstrated, purchased, and paid on a tablet computer, allowing on-the-spot execution and transaction at the locations of the customers.

Promise 2: On-demand IT Resources

Although ubiquity is a promising feature of cloud computing, it can be achieved through other methods. Therefore, many organizations value the feature of on-demand IT resource of cloud computing more than its ubiquity. Cloud computing enables commoditization of IT resources. This service model treats IT resources as a conventional utility such as electricity or gas, which is owned and operated by the service provider to accommodates fluctuating usages of multiple clients, and charges for services based on the amount of IT resources consumed, without upfront charges (Mell and Grance 2009). Many cloud computing solutions provide three elasticity dimensions that are adjustable: resources, quality, and cost, to accommodate requirements of users (Dustdar et al. 2011). Moreover, IT resources are collected as a single resource pool, which appears to have infinite and immediately available IT resources for the clients. Resource pooling seeks to increase efficiency, flexibility, and reliability of IT resources (Wischik et al. 2008) and further allows to reduce the environmental impact of IT operations in the spirit of 'green computing' (Hooper 2008), for instance by increasing electrical efficiency (Murugesan 2008).

Promises of ERP in the Cloud

Cloud ERP is a much more recent development compared to cloud computing and ERP. The amount of literature on cloud ERP is very scarce. Cloud ERP system seeks to provide organizations with flexible business process transformations via cloud computing platforms. ERP in the cloud encompasses the promises of both ERP and cloud computing. Referring to the promises discussed before, integration of heterogeneous information systems, improved business processes, better decision making, accessible anywhere, and on-demand IT resources, are all embedded in the cloud ERP model. Furthermore, shifting legacy ERP system to the cloud eliminates the cost of acquiring hardware and maintaining it on site, turning capital expenditure into operational expenditure for the organization (Promises 1) as well as shortening the implementation period (Promises 2).

Promises 1: Cost Reduction

ERP in the cloud is generally associated with less cost than on-premises ERP systems. Cost savings in cloud ERP can be attained in the areas of upfront costs, hardware, and IT labour. Unlike on-premises ERP systems, cloud ERP systems require minimal upfront costs (Armbrust et al. 2010). Cloud ERP is thus often a good solution for small to medium sized enterprises because only minimal upfront capital is required. Further cost reductions are significant for cost associated with purchasing and maintaining the servers as well as IT labour (Lenart 2011). Internal IT staff is freed from not having to maintain on-premises solutions (Buyya et al. 2009) and the risk of infrastructure and hardware damage is reduced by adopting cloud ERP.

Promises 2: Shortened Implementation Period

Besides general cost reductions, cloud ERP vendors often claim to offer quicker implementations than on-premises ERP solutions. The increased speed of implementation is enabled by not having to install physical IT infrastructure and by the ability to roll out deployments simultaneously across multiple locations (Lenart 2011). Cloud ERP packages often come in the form of a standardized product in which quality of the system has been demonstrated in various deployments. They are built for easy and quick implementation (Raihana 2012). In contrast, traditional tailored IT systems are time-consuming and contain more risks. The deployments of cloud ERP are usually around six months compared to the one year that typical on-premises ERP systems take to implement.

CHALLENGES

In the previous section we discussed key promises of cloud computing, ERP, and cloud ERP. In this section, we will discuss the challenges brought by shifting ERP systems into a cloud-environment. These challenges stand as barriers to the adoption of cloud ERP. Our investigation of cloud ERP challenges is based on literature from the same domains explored for the promises in the previous section. Specifically, we will look at ERP challenges, cloud computing challenges, and cloud ERP challenges.

ERP Challenges

Despite the increasing use of ERP for organizations, some long existing challenges of ERP make the adoption of ERP often a difficult decision. This section presents the key challenges of ERP that we found in the ERP literature. Specifically, we discuss how software functionality can mismatch the requirements of the business (Challenge 1), and the complexity involved in the implementation process (Challenge 2).

Challenge 1: Software Design Misfits

It is often discovered during implementation of ERP systems that there are gaps between the functionality offered by the ERP software package and the requirements of the business. These gaps are often described as software design misfits (Ng 2013; Soh et al. 2000; Wang et al. 2006). These misfits are often associated with failures in understanding business requirements and managing change appropriately, and the complexity of ERP systems amplifies the impact of software design misfits. Poor estimation and lack of an effective methodology in the system design phase lead to cost and time overruns (Sumner 2000; Wang et al. 2006). For example, a study conducted in a hospital revealed that the patient management module of the hospital's ERP system did not have the required billing and collection functionality. An add-on module for patient management had to be developed at a later stage to resolve this issue, which incurred cost and time overrun (Soh et al. 2000).

Challenge 2: Complex Implementation Process

Software design misfits are one of the many examples of the potential issues during the implementation of ERP projects. ERP implementation is often very expensive and time-consuming, often involving significant capital investments and drastic changes to existing business practices. Failures in ERP implementation often cost organizations millions of dollars (Bingi et al. 1999). For example, a former $5 billion drug distributor, FoxMeyer Drug, went bankrupt in 1996 due to failure of implementing ERP software package. FoxMeyer Drug filed a $500 million lawsuit against SAP claiming the ERP software package was a significant factor of the firm's financial breakdown (Bingi et al. 1999; Scott and Vessey 2002).

Cloud Challenges

Cloud computing is an emerging and not yet a fully mature paradigm. A large proportion of existing studies on cloud computing are thus conducted to identify or address varies issues and risks embedded in the adoption of cloud computing. This section presents the key challenges of cloud computing that we found in the cloud computing literature. Specifically, we discuss why security controlled by third party is a concern for organizations (Challenge 1), how vendor lock-in affects the organization (Challenge 2), how cloud services perform inconsistently (Challenge 3), and why poorly defined service-level-agreements (SLAs) can be hazardous for organizations (Challenge 4).

Challenge 1: Security Controlled by Cloud Services Provider

Security is one of the main issues that companies are concerned about in regards to cloud computing adoption. In particular, maintaining security in access control, privacy, and identity management has become a priority for companies considering the adoption of cloud computing (Takabi et al. 2010). The resource sharing nature of cloud computing means activities in the cloud are hard to trace in the short-lived virtualized environment-especially when users have no control over the physical location of data (Kaufman 2009).

Challenge 2: Vendor Lock-in

While security is one of the main considerations, there are many other aspects that organizations consider carefully when they are selecting the cloud services provider. This is partly due to the fear of switching cost incurred in the case that they wish to change to other cloud services providers. Organizations often see vendor lock-in as a major issue to the adoption of cloud services. Vendor lock-in in cloud computing occurs when users of cloud services find it difficult to transition to an alternative vendor, usually due to the proprietary technology of a particular cloud service (Hofmann and Woods 2010). Crucially, data in the cloud is usually stored in a proprietary format and cannot be exchanged with other cloud services (Armbrust et al. 2010). Thus, companies often stay with a cloud services vendor to avoid switching cost. Organizations also have to consider whether the vendor will operate in the long term to support continuous provision of cloud services (Hofmann and Woods 2010). For example, Amazon's Dynamo service stores data in a proprietary format. The data can only be processed by Amazon and cannot easily be transferred to another vendor.

Challenge 3: Unstable Performance

In order to avoid switching cost, organizations are very careful about the selection of their cloud services providers and the performances of the cloud services is one of the key measures that organizations assess. Performance in cloud computing refers to the availability, reliability, speed, and outage risks of cloud services. Performance variability is an issue which is often neglected in discussions of cloud computing. However, it has been shown that performance of cloud services is often unstable at different time of the day (Hofmann and Woods 2010). Cloud services providers are also not yet capable of guaranteeing high availability. This can be a critical factor for high turnover, international businesses for which even 99% or 99.9% uptime holds the potential of possible enormous losses. These factors indicate that cloud computing is not yet capable of delivering performance on par with on-premises solutions.

Challenge 4: Poorly Defined Service-Level-Agreements (SLAs)

The above mentioned challenges such as security controlled by the cloud services provider, and unstable performance of cloud services can potentially create many problems for organizations. Therefore, the cloud service user and the cloud services provider need to have a legally binding contract that contains essential guarantees for companies to use and be able to rely upon the services (Hofmann and Woods 2010). These legally binding contracts are referred to as Service-Level-Agreements (SLAs). The lack of a well-established SLA can result in cloud service providers denying responsibility when conflict or issues arise (Marston et al. 2011). At the current state, SLAs often provide very few protections to the clients.

Challenges of ERP in the Cloud

Most of the individual challenges for ERP and cloud computing discussed above naturally apply in an environment where both of these paradigms are merged. Referring to the challenges discussed before, software design misfits, complex implementation process, security controlled by cloud services provider, vendor lock-in, unstable performance, and poorly defined SLAs are all embedded in the cloud ERP model. However, there are a number of challenges which are particularly accentuated in a cloud ERP environment. We will discuss two such challenges in this section; specifically why customization (Challenges 1) and integration (Challenges 2) are difficult to achieve for ERP in the cloud environment.

Challenge 1: Standardized Software Packages not Easily Customizable

Cloud ERP solutions are often difficult to customize as they come in standardized packages. Customization in cloud ERP refers to the degree to which the software packages are customized to fit the specific requirements of the organization. The cloud infrastructure is owned and management by the cloud services provider and the users have thus very limited control over the system (Peng and Gala 2014; Saeed et al. 2012). Therefore, cloud ERP may not be suitable for companies with very specific requirements. For example, existing cloud computing platforms are not designed to accommodate specific requirements such as having distributed data centres at specific locations. This kind of requirements contradicts with the characteristics of cloud computing of having a centralized infrastructure.

Challenge 2: Integration Impaired in Strict Cloud Environment

The high level of standardization in cloud solutions not only limits the customizability of cloud ERP systems, it also makes integration of heterogeneous services very difficult. The cloud infrastructure is owned and managed by the cloud services provider and systems can often only be integrated if the cloud provider explicitly supports this (Li et al. 2012; Peng and Gala 2014; Saeed et al. 2012).

CLOUD ERP FRAMEWORK

The previous two sections identified a set of key promises and challenges for ERP, cloud computing, and cloud ERP. We have shown that cloud ERP presents great potential promises but also entails many potential challenges. In this section, the discussed promises and challenges are synthesized into a framework for evaluating cloud ERP adoption. Specifically, the proposed framework focuses on the promises and challenges of cloud ERP in comparison to on-premises ERP along the four dimensions of efficiency, flexibility, ubiquity and security. The framework captures the essential elements of cloud ERP and breaks down a very complex phenomenon into four fundamental dimensions. While existing researches explore the promises and challenges of cloud ERP to various degrees (Porkert and Sutton 2013; Seethamraju 2013), our framework presents a simple and direct indication of the areas that must be considered when IT executives and researchers are assessing cloud ERP systems. Thus, the unique value of our framework lies in aggregating and synthesizing existing knowledge in an easily accessible form. In the following, we first present the framework and then explain each of the dimensions in the framework and their respective levels of promises and challenges.

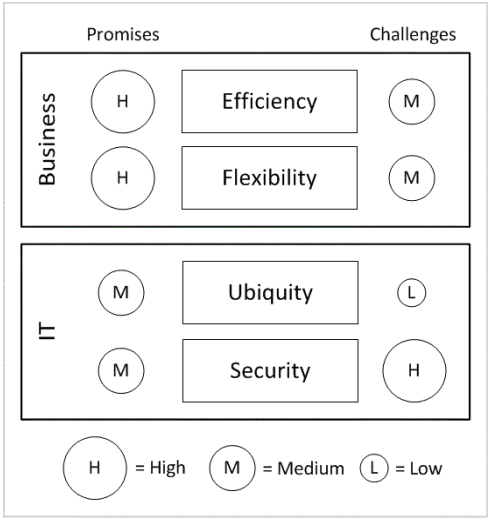

Figure 1: Cloud ERP evaluation framework

The framework centres on two domains: Business and IT. The two domains are adopted from the Strategic Alignment Model (Henderson and Venkatraman 1993), which discusses the interdependence between business strategy and IT strategy. In particular, business strategy is seen as the driving force of IT strategy, and IT strategy is seen as the enabler of business strategies. Since the Strategic Alignment Model focuses on the two domains of business and IT, our proposed framework inherits these domains as its fundamental boundary. We have identified four dimensions in this framework. The respective levels of promises and challenges of the four dimensions are assessed and indicated by their levels of impact (High, Medium, or Low). For the business domain, we have identified Efficiency and Flexibility as the two key dimensions. Through our literature review, we found these two dimensions reflected in most of the promises and challenges. For the IT domain, we found Ubiquity and Security to be two distinctive themes in the discussions of cloud ERP promises and challenges. In the remainder of this section, we will discuss each of the dimensions, Efficiency, Flexibility, Ubiquity and Security in more detail.

Efficiency

The dimension of efficiency represents the amount in cost, time, and effort required to achieve intended purposes of business applications (Ostroff and Schmitt 1993).

Cloud ERP increase efficiency in multiple facets of the organization and has the potential to reduce cost, time, and effort drastically in comparison to on-premises ERP solutions. In particular, efficiency of implementation is improved by implementing standardized software packages that are designed for quick and easy implementation; without the need to install physical IT infrastructure on premise (Raihana 2012). Cloud computing also transforms traditional ERP adoption from a capital expenditure into an operating expense, which is considered to be more manageable, involving lower effort and risks (Armbrust et al. 2010). Furthermore, IT resources are managed more efficiently through the centralized infrastructure, saving costs associated with electricity and maintaining on-premises hardware (Brynjolfsson et al. 2010).

However, cloud ERP also introduces various challenges for organizational efficiency. Cloud ERP, as highly standardized software packages, may not always execute as efficiently as customized software packages found in

on-premises ERP solutions that are developed to meet specific business requirements (Peng and Gala 2014; Saeed et al. 2012). Also, instead of maintaining the IT infrastructure within the organization, the performance of cloud ERP is highly dependent on cloud technology, which suffers from data transfer cost and service outages (Hofmann and Woods 2010). Furthermore, efficiency of cloud ERP can be impaired by poorly-defined service-level-agreements (SLAs); issues might not get resolved efficiently when conflicts arise between the organization and the cloud ERP vendor (Hofmann and Woods 2010). Overall, we estimate the potential risk of cloud ERP impacting organizational efficiency negatively as moderate.

Flexibility

The dimension of flexibility relates to the ability of an organization to plan for unforeseen development in its environment and adapt to changes in circumstances (Lucas Jr and Olson 1994).

Cloud ERP carries the potential to enhance organizational flexibility greatly through on-demand IT resources. This service model accommodates fluctuating usage of IT resources and clients are charged for just the amount of IT resources consumed (Mell and Grance 2009). Organizations can access a virtually infinite and immediately available supply of IT resources, providing quick scalability and elasticity to the organization, as well as eliminating the problems of under provisioning or over provisioning of IT resources found in on-premises ERP solutions (Buyya et al. 2009). Thus cloud ERP often provides far greater business flexibility than on-premises ERP solutions.

Conversely, the strict environment of the cloud gives the organization very limited control over the system. Thus integration and customization are very difficult to achieve in cloud ERP in comparison to on-premises ERP systems (Li et al. 2012; Peng and Gala 2014; Saeed et al. 2012). Organizations are also restricted by the proprietary of cloud ERP services, which induces switching cost when the organization wishes to transition to an alternative vendor (Armbrust et al. 2010). Thus, although cloud ERP entails many potential promises for organizational flexibility, it also presents various challenges, which must be addressed to not affect organizational flexibility negatively. In comparison with the challenges presented for the other dimensions, we assess the potential negative impact on organizational flexibility as moderate.

Ubiquity

The dimension of ubiquity relates to the degree of which the information system is accessible from various client platforms and locations (Mell and Grance 2009).

Cloud ERP generally enhances the ubiquity of traditional ERP. With services always available online, cloud ERP are more capable of being utilized independent of time, location, and device. Thus organizations can execute business applications at the time and location that are deemed to be most suitable, using any device (Brynjolfsson et al. 2010; Buyya et al. 2009; Mell and Grance 2009). This is particularly advantageous for meeting sophisticated business requirements. However, while a cloud-based system may provide more ubiquitous services, many current ERP systems are designed in a way which allows accessing these systems from various locations. Thus, we assess the potential of cloud ERP to provide more ubiquitous enterprise services as moderate.

New challenges introduced by cloud ERP systems for achieving ubiquitous access to systems are overall very limited.

Security

The dimension of security refers to the degree of which the confidentiality, integrity, and availability of the information system are protected (Gordon and Loeb 2004).

Security in the cloud is controlled by the cloud ERP vendor. This frees internal IT resources from having to maintain the security of on-premises ERP systems. This is particularly beneficial for organizations with low security standards because having security handled by the cloud ERP vendor can potentially induce higher level of security (Chen et al. 2010). Overall, while cloud ERP systems will not bring exceptional advances for organizational security, there are moderate promises which can be realized.

Unlike on-premises ERP systems, organizations have very limited control over security of cloud ERP systems. In difference to an isolated, on-premises IT infrastructure used by many on-premises ERP systems, cloud ERP are often embedded in a shared system landscape; leaving the system more exposed to potential attacks and hazards (Zissis and Lekkas 2012). This is of particular importance when an organization requires high levels of system security and data confidentiality. The literature further indicates that organizations often find it very difficult to entrust their security in the hands of the cloud ERP vendor (Kaufman 2009; Rabai et al. 2013). Thus, we assess the challenge in maintaining a high level of security after adoption of a cloud ERP system as highly significant.

ERP and cloud computing are complex and broad fields, and the four dimensions of the proposed framework certainly cannot capture all aspects of importance for cloud ERP adoption. Further, assessing the impact of a technology as complex as cloud ERP can hardly be achieved with ultimate precision. Notwithstanding this qualification, the framework has been developed based on an extensive review of the literature from various fields of research. Thus, while we do not claim for the presented dimensions to be complete, we argue that these dimensions are important dimensions to consider. We propose the levels of impact of the potential promises and challenges as guidelines and a starting point for future discussion.

RESEARCH OPPORTUNITIES

The framework proposed in the previous section provided an overview of the key promises and challenges of cloud computing to ERP. The framework aims to be of value for both practitioners considering the adoption of cloud ERP and for researchers interested in exploring this novel domain. To further aid future research endeavours about cloud ERP and cloud ERP adoption, we propose research opportunities for each of the key dimensions identified in the framework for which high or moderate level of challenges were identified (efficiency, flexibility and security) and suggest specific areas further study should examine.

Efficiency: Explore Better Ways in Which Cloud ERP Systems Can Be Customized

We portrayed that customization for cloud ERP is often difficult to achieve since cloud ERP comes in standardized software packages that cannot be modified easily. Thus systems are not developed for specific business processes but aimed to serve generic, 'best practice' business processes (Peng and Gala 2014; Saeed et al. 2012). This may impair the capability embedded in specialized and business-specific business processes. Thus, we believe exploring ways in which cloud ERP systems can be made more customizable while maintaining the benefits of cloud based systems is a promising endeavour for future research.

Flexibility: Explore Which Aspects of Cloud ERP Systems Organizations Need to Control

We discussed that organizations often do not have much control over the cloud ERP system. Cloud ERP systems run in the strict cloud environment. Organizations receive services over the Internet, with very limited control over the system itself, for instance in terms of being able to make changes to the system or monitor its usage (Peng and Gala 2014; Saeed et al. 2012). Since control over a cloud-based system is so difficult (and possibly costly) to establish, we suggest that future research can explore for which aspects of a cloud ERP control is required and which level of control would be required. Explorative qualitative studies would lend themselves towards this goal.

Security: Explore How Organizations Can Be Involved in Managing the Security of Cloud ERP Systems

Security is one of the main concerns that organizations have when they consider whether to shift their ERP systems into the cloud. Organizations that require high levels of system security and data confidentiality are particularly reluctant to entrust their system security in the hands of a third party (Hofmann and Woods 2010). Further study should investigate how users can be involved in maintaining the security of cloud ERP systems. By involving users in the controlling and monitoring of the security in cloud ERP, the anxiety of having security completely controlled by the cloud ERP vendor can be mitigated. Specifically, more study is required to investigate how users can be involved in maintaining the security of cloud ERP and what levels of involvement users can have. We believe this research opportunity can be addressed through action design research (Sein et al. 2011). Instead of designing a standardized software package and then implement it in an organization, this study can involve the organization in the very beginning through to each phase of the cloud ERP project, incorporating the interwoven activities of building the cloud ERP system, intervening in the organization, and evaluating the cloud ERP system concurrently (Sein et al. 2011). Researchers will then be able to determine how the organization can be involved in managing the security in each phase. The overall result from such studies would contribute toward improving involvement of organizations in managing the security of cloud services as well as improving transparency between standardized software package vendors and the organization.

CONCLUSION

Previous researches have questioned the suitability of the monolithic standardized software packages for accommodating the diversity of complex organizations (Berente and Yoo 2012; Wagner and Newell 2004). Our paper explored cloud-based ERP systems, which are arguably more standardized and regulated than legacy ERP systems. Do these systems offer promises to organizations which outweigh their limitations? Our research indicates that, overall, this can be the case but that caution must be exercised in adopting cloud ERP – caution both in assuring that the benefits of this technology are realized and that challenges and risks are mitigated.

To this end, we have identified a set of key promises and challenges for cloud-based ERP systems. We have synthesized these promises and challenges into a framework for assessing the promises and challenges of cloud ERP. This framework identifies four dimensions of cloud ERP: Efficiency, Flexibility, Ubiquity, and Security. Based on these dimensions, we further suggest four research opportunities for exploring cloud ERP systems in future studies.

The contribution of this paper is threefold. First, we have identified a set of key promises and challenges for cloud computing, on-premises ERP, and cloud ERP. These promises and challenges help IT decision makers and researchers to gain a better understanding of what the benefits and drawbacks are for cloud computing, on-premises ERP, and cloud ERP. Second, we have synthesized the key promises and challenges into a framework. The framework provides an overview of the key dimensions of cloud ERP. These dimensions can be utilized by IT executives or researchers to systematically assess the promises and challenges of cloud ERP systems. Third, we have suggested a set of research opportunities in the field of cloud ERP. These research opportunities aim to provide directions for further studies on cloud ERP and provoke more researchers to conduct studies in this area.

We believe that the current state of research on cloud-based ERP systems warrants a high-level analysis of these systems. This paper provides such an analysis by drawing from diverse literature sources bridging business- and IT-oriented research and integrating findings from these sources into a provisional framework. Cloud ERP, however, is an emerging topic and there is urgent need for studies well beyond the scope our discussions can offer. Thus, we understand the findings and framework presented in this paper, which is solely based on a review of the literature, primarily as stepping stones for future empirical and design-based studies. Our framework should thus be seen as a preliminary contribution until its validity has been empirically examined. ERP systems have not only changed organizational IT systems but have transformed the very core of what constitutes organizations today. Cloud-based ERP systems hold within them the same potential and we hope our paper can encourage and guide future research in this tremendously promising area.

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