BENEFITS AND DRAWBACKS OF CLOUD-BASED VERSUS TRADITIONAL ERP SYSTEMS

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ABSTRACT

Since their inception, the vast majority of ERP systems have been implemented on premise. Traditional ERP systems provide various kinds of benefits such as a mature system functionality and abilities of greater customization and integration. In the past decade other software applications however have seen a shift to cloud computing that has become one of the fastest growing segments of IT industry. Moreover, cloud computing is a modern trend that reveals the next-generation application architecture. In this paper, based on a literature study, we identify and classify the benefits and drawbacks of cloud-based versus traditional ERP systems. Then we analyze and compare the features of cloud-based, hosted, and on-premises ERP. Finally, we discuss the revealed controversies of the previous research and reasons why or why not cloud-based ERP might be more of interest to SMEs than to large enterprises.

1   INTRODUCTION

The research literature concerning on-premise, hosted and cloud-based Enterprise Resource Planning (ERP) has exponentially grown in recent years (Botta-Genoulaz et al. 2005). Cloud-based ERP solutions appear to provide a number of benefits related to sizable cost savings and competitive advantage enhancements. It has also been stated that the cloud-based enterprise systems are more suitable for small and medium enterprises, primarily because of the subscription based pricing schemes that typically require significantly lower upfront investments (Forrest 2009).

At the same time the benefits and drawbacks of cloud-based ERP in comparison with on-premises ERP and, especially, hosted ERP do not seem to be investigated and classified sufficiently as yet. A wealth of qualitative analysis on cloud-based ERP and 'traditional' ERP is available to get a full sight of these two types of ERP systems (Scavo et al, 2012 & Grumman, 2011). However, there is still no consensus on the advantages and disadvantages of cloud-based and 'traditional' ERP (Scavo et al., 2012 & Grumman, 2011). The reasons why or why not cloud-based ERP might be more of interest to SMEs also has to be identified and clarified more comprehensively. Therefore, we consider further research on actual benefits, limitations, and risks of cloud-based ERP to be of interest to enterprises and research communities.

In this study ERP systems are subdivided into two main categories: traditional ERP and cloud-based ERP systems. Within the traditional ERP system the distinction is made between hosted and on-premise solutions. Our purpose is to investigate the proven advantages and disadvantages of cloud-based ERP systems in comparison with traditional ERP systems. For this, we will have the following research questions:

1. What are the advantages and disadvantages of cloud-based ERP compared to on-premises ERP and hosted ERP? Investigation on this matter is supposed to identify and classify respective benefits and costs, limitations and risks. The structure of drivers for cost savings enabled by cloud-based ERP is expected to be clarified.

2. Are the foregoing benefits and drawbacks more relevant for small and medium enterprises or not and why? Answer to this question also implies identifying whether there are some cloud ERP benefits and drawbacks pertinent only to SMEs.

1.1 Paper Structure

Section 2 explains the concept of traditional and cloud ERP systems. In section 3 the methodology for our research is explained. In section 4 we present our results, which are subsequently discussed in section 5. Section 6 lists conclusion and limitations of the study, as well as possible directions for future research.

2 THEORETICAL BACKGROUND

2.1 Traditional ERP systems

The Enterprise Resource Planning (ERP) concept can be studied from different perspectives. To start with the most obvious one, ERP is a product in the form of computer software. Furthermore, ERP can be seen as a development objective of mapping all processes and data of an enterprise into a comprehensive integrative structure. Third, ERP can be seen as the key element of an infrastructure that delivers a solution to business (Botta-Genoulaz et al. 2005, Klaus et al. 2000).

Klaus et al. (2000) define ERP as a comprehensive, packaged software solution that seeks to integrate the complete range of a business's processes and functions in order to present a holistic view of the business from a single information and IT architecture.

ERP has been promoted by the American Production and Inventory Control Society (APICS) since 1980 by extending the Manufacturing Requirements Planning (MRP II) operation system to other systems of the company such as finance, marketing and personnel. Currently, the overall resources of the firm can be integrated through ERP. According to ERP suppliers such as SAP, Oracle, PeopleSoft/J.D. Edwards, etc. more than 12 modules could be implemented through ERP. The most important modules or processes that an ERP system supports are: marketing, sales and distribution, enterprise solution, production planning, quality management, assets accounting, materials management, cost control, human resources, project management, financials, and plant maintenance (Berchet and Habchi 2005, Davenport 1998).

Within the traditional ERP a distinction can be made between two different solutions: - hosted and on-premise ERP. On-premise ERP solutions are usually acquired via a license model. The software is loaded onto servers and computers in-house. The enterprise also controls the infrastructure and platforms. Furthermore, the enterprise handles all maintenance and absorbs the costs of maintaining the servers and the space they require, as well as disaster recovery (WAC Consulting Group 2012). This means that the enterprise itself has to maintain the servers and the required space. A hosted ERP is defined as a service offered to an individual or an organization by a provider that hosts the physical servers running that service somewhere else. The service is most of the time offered through a direct network connection that may or may not run via internet (Fripp 2011).

Nowadays the trends of shifting from on-premise ERP to hosted ERP solutions and so on to cloud-based ERP can clearly be seen (Lin and Chen 2012, Acumatica 2010, Castelina 2011). Traditional ERP vendors are responding in various ways to this new development, with some offering hosted versions of their ERP applications as an alternative. While hosted ERP solutions deliver some of the same benefits, enterprises need to appreciate the significant differences which is more explained in the results section. Cloud and hosted ERP have overlapping benefits, but prospective customers should carefully consider their options to ensure the solution they choose deliver the business value they expect (Scavo et al. 2012).

2.2 Cloud ERP systems

In this section we first give a brief description of cloud computing in general before we elaborate on cloud based ERP systems.

Cloud computing in general

Since cloud computing has become popular there have been many attempts to formulate a complete definition that captures all of its characteristics (Vaquero et al. 2009). But even the most rigorous attempts fail in distinguishing clouds from cloud systems or emphasizing the abstraction of infrastructure complexity. McKinsey & Company provide the following definition of clouds (Forrest 2009), which is based on 22 research articles concerning the definition of cloud computing:

"Clouds are hardware-based services offering compute, network and storage capacity where:

1. *Hardware management is highly abstracted from the buyer;*
2. *Buyers incur infrastructure costs as variable OPEX;*
3. *Infrastructure capacity is highly elastic (up or down)."*

According to this definition, a true cloud has to comply with these key requirements, while a cloud service only has to comply with the first and the last one (i.e. underlying infrastructure is abstracted and capacity is highly scalable).
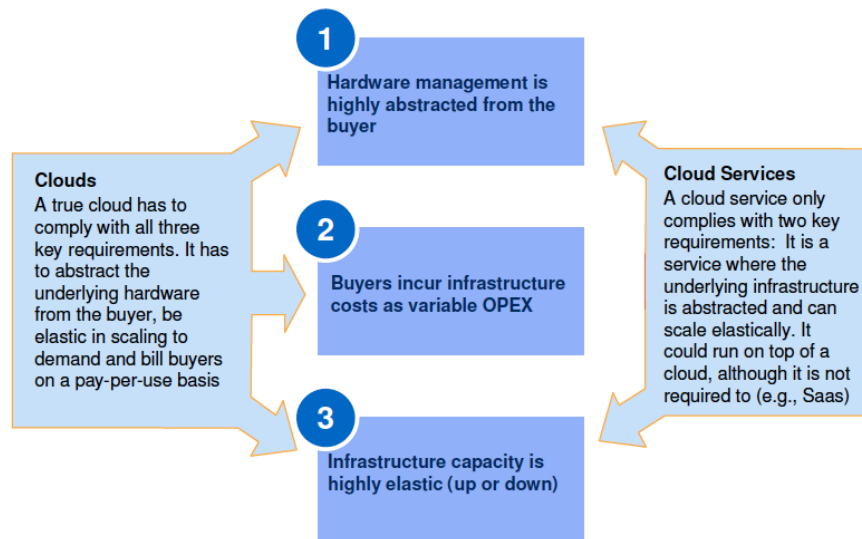

Figure 1: Clouds vs. Cloud Services (Source: Forrest 2009)

Compared to traditional systems, cloud technology offers numerous revolutionary advantages that can drastically improve the value creating capabilities of organizations. The most significant advantages are: much lower cost, faster time to market, and great opportunities for creating new sources of value (Forrest 2009).

Service delivery models

There are three delivery models in which cloud computing can be subdivided (Xu 2012): Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). Even though cloud ERP systems apply to the SaaS model, it is important to also have an understanding of the underlying service delivery models in order to fully understand the cloud concept.

Software as a Service targets the end user or business. It concerns the delivery of an application to multiple customers via an underlying database and object code. This is the category to which cloud ERP solutions belong. Other examples include Google Apps, ZOHO CRM and Apple's iCloud.

Platform as a Service is the delivery of middleware targeted towards developers with a platform that incorporates the entire development cycle, including hosting, testing, and deployment of web applications. Examples include Google App Engine and Zoho Creator.

Infrastructure as a Service is the delivery of computing power (i.e. processing power, storage space, and infrastructure throughput) targeted towards administrators. This service promotes a usage based pricing structure, where a customer only pays for the amount of capacity that is used. Amazon's EC2 is an example of this service model.

Service delivery types

Another subdivision that can be made is that of public versus private clouds (Jlelati et. al. 2012). In public clouds, the respective service is accessible by anyone via the Internet, and infrastructure is shared by multiple tenants. Because of this, public cloud poses a higher security risk. For a private cloud on the other hand the service is located on (virtually) separate infrastructure, which gives the user full control over data and security. A third variant is a hybrid cloud model, where the more business sensitive parts of the service are hosted privately, while less sensitive data is outsourced to public cloud providers.

Cloud ERP

As mentioned earlier, Cloud ERP solutions are delivered via the Software as a Service model. It is important to note that some ERP solutions that are marketed as 'cloud based' are in fact hosted ERP solutions (Scavo et al. 2012). True cloud ERP systems are those that implement the characteristics of clouds in the previous category. These systems are typically accessed via a common browser over an Internet connection, allowing access that has little dependency on client configuration. Examples in this relatively new category include SAP Business ByDesign, which was coded separately from its existing on-premise offerings.

3   RESEARCH METHOD

After getting further understanding about the ERP theories, we decided to do a literature review and then analyze the results of this literature review to answer our research questions. This section explains our research design and data collection method.

3.1   Research Design and Data Collection

Because of the scope of the assignment, we decided to do a literature review based on 15 to 20 papers. Considering the rapid development of cloud computing, we only used articles published after 2006 and either from top rated journals or with a relatively high number of citations.

While reviewing the articles, we will note whether the authors were discussing cloud-based ERP, hosted ERP and/or on-premise ERP, and whether they explained any particular factor as more or less important for SMEs than for large organizations. While summarizing the main statements of each paper, we will paraphrase the most felicitous opinions that reflect the essence of the final set of the advantages of cloud-based ERP and hosted ERP compared to on-premise ERP will also be done. Similar statements made in different articles will be aggregated into the final set of cloud ERP benefits and drawbacks.

After listing a table of all the benefits and drawbacks of cloud-based ERP compared to hosted ERP and on-premise ERP, we will identify the most frequently mentioned ones and classified them into different relevant groups such as benefits, costs, limitations and risks. A table of relevant distinctive features of cloud-based ERP, hosted ERP and on-premise ERP will be made on the base of previously identified advantages and disadvantages separately mentioned in the selected articles. A conclusion about the advantages and disadvantages of cloud-based ERP compared to 'traditional' ERP will be done by further analyzing the results we can achieve from our literature reviews. Moreover, a study on the impacts of such advantages and disadvantages of cloud-based ERP on SMEs will be conducted.

3.2   Scope

In this paper, we decided to limit our research to SaaS (Software as a Service) ERP based on public cloud (as opposite to private/hybrid cloud) because on the one hand cloud-based ERP is usually provided in the form of SaaS, and on the other hand public clouds are key components of software as a service offerings. Thus, the identification of the aforementioned benefits and drawbacks is going to be limited to SaaS public cloud-based ERP. We also assume that, unless the opposite is clear from the description in a certain literature source, the common advantages and disadvantages of cloud-based as well as SaaS enterprise applications may also be applicable to cloud-based ERP.

3.3   Identification of ERP comparative characteristics

In order to conduct the literature review, 17 papers were selected and carefully studied. The majority of these papers are either from top rated journals such as Computer Economics, Decision Support Systems and so forth, and the most frequently cited articles.

Although these papers are all relevant to the topic of cloud-based ERP and its comparison with traditional ERP, each paper has its specific concern or focus. Some of these papers give a general idea about the essential characteristics of cloud-based ERP and traditional ERP systems. Scavo et al. (2012), for instance, discuss choosing between cloud and hosted ERP and why it matters, while others focus on one or two particular aspects of the advantages or disadvantages of cloud-based ERP compared to traditional ERP. Another example is a paper by Misra & Mondal (2011) that we used for assessing the SME relevance aspect as it discusses company's suitability for the adoption of cloud computing and modeling its corresponding Return on Investment. The numbered list of papers is listed in Appendix A.

The sizeable part of grouping and classification of the different cloud ERP pros and cons referred to in different papers was done while reviewing and analyzing each of them to fit the resulting classification table. In addition, we also analyzed and eliminated the remaining overlap and repetition within the comparative characteristics that we had got in the interim version of our classification table with forty characteristics. This more explicit part of the identification and classification process is pictured in Appendix B.

As it can be expected, the major reason for the overlap and repetition turned out to be that different sources describe the same factors but usually focus on and emphasize different aspects of them. For instance, 3 articles mentioned more efficient collaboration across geographies as an advantage of cloud-based systems (including ERP) over other types of enterprise applications (Castellina et al. 2011, Armbrust et al. 2010, Saugatuck 2008). One article pointed out broad network access as a distinctive feature of cloud ERP (Scavo et al. 2012). Four sources referred to ease of use (Rong et al. 2012, Dubin 2011, Armbrust et al. 2010, Saugatuck 2008). Three articles generally mentioned improved quality of cloud-based applications (Benlian, Hess 2011, Dubin 2011, Saugatuck 2008). At the same time two other articles emphasized improved usability, accessibility, and mobility for users of cloud-based ERP systems (Engebrethson 2012, Jlelati et al. 2012). We considered all the aforementioned aspects as overlapping and belonging to the same group of comparative characteristics. Therefore, we grouped them into one advantage titled "Improved Accessibility, Mobility, and Usability".

4   RESULTS

4.1   Classified benefits of cloud-based ERP as compared to on premise ERP

The following table reports our findings in the key advantages of cloud-based ERP and hosted ERP in comparison with on-premise ERP as identified from our literature review.

Table 1: Benefits of cloud-based ERP as compared to on-premise ERP. Numbers refer to articles; minus sign (-) notates an opposite meaning; **Bold** type notates characteristic that applies specifically for SME's (more relevant for SMEs).

Benefits	Cloud-based	Hosted
Lower upfront costs	1, 5, 6, 8, 9, 10, 11, **16**	1
Lower operating costs	1, 2, 3, 5, 6, 8, 9, 10, 11, -14, **16**	1, 17
Rapid implementation	1, 3, 5, 6, 8, 9, 10, 15, 16	1
Scalability	1,4, 6, 10, 11, -13, 15, **16**	
Focus on core competencies	2, 3, 5, 8	
Access to advanced technology	3, **8**	
Rapid updates & upgrades	1, 8, 15	
Improved accessibility, mobility, and usability	15, 16, 1, 8, 9, 10, 11, 5, 3	1
Easier integration with cloud services	1, -4, 6, 8	1
Improved system availability and disaster recovery	**1**	1

Lower upfront costs

Cloud computing substantially reduces the capital expenses incurred by an enterprise in order to implement an ERP system (Marston et al. 2010) or to switch to a new cloud-based one (Benlian and Hess 2011). The part of the upfront costs that is mainly reduced includes expenses for hardware, user licenses, and implementation, excluding user training and customization (Grumman 2011). According to our literature review this benefit is generally considered to be more important for SMEs than for large enterprises.

Lower operating costs

Cloud-based ERP lowers operating costs for energy, maintenance, configuring, upgrades, and other IT staff costs and efforts (Castellina et al. 2011, Marston et al. 2010). This benefit is generally considered as having increased relevance for SMEs.

Rapid implementation

Rapid implementation is generally agreed to be among the top benefits of cloud-based ERP. It could also contribute to easier change of cloud service providers (Benlian and Hess 2011) and reduced time of providing new products in certain types of business (Marston et al. 2010).

Scalability

Resource pooling and rapid resource elasticity of cloud-based ERP make the infrastructure capacity highly elastic (Scavo et al. 2012). That in turn enables faster time to market (Kim et al., 2009, Marston et al. 2010), high level of strategic flexibility and improved competitiveness (Benlian and Hess 2011). This feature is reported as a possible advantage that is particularly relevant for SMEs in competing with large rivals.

Focus on core competencies

Cloud-based ERP and other enterprise applications allow focusing the resources that would be used to maintain an IT department on other essential areas of business (Castellina et al. 2011). In some cases it mainly results in reduced pressure on internal IT department which can focus on servicing core competencies (IT solutions, 2011).

Access to advanced technology

Cloud-based applications often enable access to specialized technology and advanced computing resources that otherwise would have not been accessible to SMEs (Saugatuck 2008).

Rapid updates & upgrades

Cloud-based ERP systems usually get faster updates and new functionality than traditional ERP systems (Engebrethson 2012).

Improved accessibility, mobility, and usability
Besides their inherited features of mobility and accessibility cloud-based ERP and other enterprise applications can usually boast higher levels of user friendliness and usability than other types of ERP (Engebrethson 2012, Jlelati et al. 2012).

Easier integration with cloud services
Using benefits of SaaS shared infrastructure, companies that adopted cloud-based ERP may get relatively inexpensive integration with other cloud services once respective cloud providers have integrated their infrastructures (Scavo et al. 2012).

Improved system availability and disaster recovery
In many cases SaaS providers ensure measures such as backup routines, fallback and recovery procedures, conditioned power etc. of higher quality than most SMEs do in-house (Scavo et al. 2012).

4.2   Classified drawbacks of cloud-based ERP as compared to on-premise ERP

Table 2 demonstrates the key additional costs, risks, and limitations of cloud-based ERP and hosted ERP in comparison with on-premise ERP identified from our literature reviews.

Table 2: Drawbacks of cloud-based ERP as compared to on-premise ERP. Numbers refer to articles; minus sign (-) notates an opposite meaning; **Bold** type notates characteristic that applies specifically for SME's (drawback is less relevant for SMEs).

Drawbacks	Cloud-based	Hosted
Subscription expenses	1, 14, 5, 6, 13	
Security risk	-2, 3, 4, 5, -5, 6, 7, 9, 11, 13, 14, 15, **16**, -1	-1
Performance risks	3, 6, -9, -10, -11, 13, 14, 15, 16	
Customization and integration limitations	1, -8,12, **14**, 15, **16,** 17	-1, -17
Strategic risks	3, 10, 11, 14	
Compliance risks	13, 14, 16	
Loss of IT competencies	3, **16**	
Functionality limitations		-1, -14
Limitation on hybrid deployment strategy		-1, -14
SLA issues	4, 9	

Subscription expenses
An explicit part of cloud-based ERP additional costs is widely used periodic subscription fees that do not depreciate over time, in contrast to capital investments in traditional ERP software (Bartolj et al. 2009).

Security risks
Security and confidentiality risks are reported to be among the top concerns about cloud-based ERP (Engebrethson 2012, Marston et al. 2010). At the same time according to our literature review this group of risks appear to be one of the most controversial and is reviewed further in the discussion section of this paper. According to our review, those security risks of cloud ERP adoption are usually more important for large enterprises than for SMEs.

Performance risks

Leaving out pure integration issues, performance risks of cloud-based ERP are essentially related to threatened speed and reliability of network, outage risks and limitations on data transfer (Kim et al., 2009).

Customization and integration limitations

Many cloud-based ERP systems have noticeable constraints on interoperability with home-grown applications and integration into existing application portfolios and IT infrastructures (Karabek et al. 2011). Unlike on-premise and hosted ERP, cloud-based ERP may not allow extensive customization and complex integration with some third-party services and systems (Scavo et al. 2012). At the same time this issue is referred to as of less importance for SMEs.

Strategic risks

Outsource such a business critical system as ERP, companies usually bear increased strategic risk of high dependency on the service provider (Bartolj et al. 2009).

Compliance risks

Cloud-based applications often face additional difficulties in complying with data, energy and environmental standards as these regulations are generally designed without regard to peculiarities of cloud computing (Kim et al., 2009).

Loss of IT competencies

As a result of outsourcing the major part of IT support, organizations may lose some valuable IT competencies as well as face their IT department's resistance towards organizational changes. (Jlelati et al. 2012). These effects of cloud adoption are generally considered as more important for large enterprises than for SMEs.

Functionality limitations

Cloud ERP is based on not that mature systems as traditional ERP and may not be functionally rich enough to "satisfy the back-office needs of organizations in every type of industry" (Scavo et al. 2012).

Limitation on hybrid deployment strategy

Cloud-based ERP usually has substantial limitations on hybrid deployment strategy that may be required to (I) retain legacy systems if needed, (II) integrate ERP with on-premise systems that require low latency and (III) overcome deficiency of public network infrastructure (Scavo et al. 2012).

SLA issues

In many cases it is rather hard to accurately define Service Level Agreements (SLAs) negotiated between cloud service provider and their corporate clients (Kuyoro et al. 2011). These SLAs usually do not really cover such aspects as confidentiality and integrity leaving space for unclear damage liability (Rong et al. 2012).

4.3   Comparison of features of cloud-based, hosted and on-premise ERP

Having identified and classified the benefits, costs, risks, and limitations of cloud-based ERP as opposed to 'traditional' ERP, we analyzed them further in order to clarify and compare relevant characteristics of cloud-based, hosted and on-premise types of ERP systems. For that we transformed the previously identified benefits and drawbacks of cloud-based ERP comparing to 'traditional' ERP into distinctive features relevant for comparison of three types of ERP concerned. These features were formulated in such a way so that the more particular features are pertinent to a certain type of ERP and the more recognized/proven/developed they are, the more advantageous this type of ERP may be considered to be.

Table 3 demonstrates our key findings identified on the basis of the analysis of the previously listed research literature. The features were rated for each ERP type according to the number of sources which referred to them or which they may be clearly deduced from. The table also attempts to reflect the fact that some features were referred to as pertinent to some ERP types not to full extent, or received noticeably contradictive references.

Table 3: Comparison of features of cloud-based, hosted and on-premise ERP

Relevant Distinctive Features	Cloud-based ERP	Hosted ERP	On-premise ERP
Direct Costs			
Lower upfront costs (hardware, user licenses, implementation, excluding training and customization)	xxx	x	
Lower operating costs and efforts (energy, maintenance, configuring, upgrades, IT staff costs)	xxx	x	
No non-depreciable subscription fees		x	xx
Impact on Competitive Advantages and Organization			
Scalability (highly elastic infrastructure capacity), faster time to market	xxx		
Rapid implementation, easier to switch among IT providers	xxx	x	
Enables enhanced focus on core competencies	xx		
Higher level of independency from the ERP provider			xx
Minimized loss of IT skills and IT staff resistance to changes			x
Functionality & Usability			
Functionally rich to satisfy the back-office needs of organizations in all types of industries		xx	xx
Rapid acquisition of bug fixes and new functionality	xxx		
Improved accessibility, mobility, and usability	xxx	x	
Integration & Customization & Performance Capabilities			
Enables extensive customization and complex integration		xx	xx
Easier integration with other cloud services	xx	x	
Improved system disaster recovery and availability	x	x	
Low dependency on deficiency of network reliability and speed			xxx
Ease of retaining on-premise legacy systems			xxx
Easier integration with on-premise systems that require low latency			xx
Allows hybrid deployment strategy to incorporate 3 features above		xx	
Security & Standards			
Enables high level of security and confidentiality	x	xx	xxx
Clear data damage liability and SLA conditions			x
Easier compliance to data & environmental regulations		x	xx

Legend

x   referred to (deduced from) only in one source, or pertinent only partially, or has noticeably contradictive references

xx   referred to (deduced from) in 2 to 5 sources

xxx   referred to (deduced from) in more than 5 sources

Comparing table 3 with the tables in sections 4.1 and 4.2, one can notice that there are certain changes in the wording of previously identified benefits and drawbacks made in order to define them as features convenient for comparison.

For instance, some drawbacks of cloud-based ERP referred to extensively in the literature as "security and confidentiality risks" were transformed into the feature of "high level of security and confidentiality". At the same time from the literature (references presented in the tables in sections 4.1 and 4.2) it may also be inferred/deduced that hosted and particularly on-premise ERP may be characterised as having this higher level of confidentiality and security. Some sources (Engebrethson 2012) also provide survey results that directly confirm that on-premise ERP is generally considered by IT executives as enabling better security and confidentiality. Others (Scavo et al. 2012) mention that hosted ERP solutions can also deliver improved security compared to in-house solutions. There are also some references (e.g. Castellina et al. 2011) arguing that cloud-based ERP have certain features that can increase the level of security. Based on the number of the aforementioned types of references or explicit inferences the 'high level of security and confidentiality' feature was rated accordingly for each ERP type.

Overall, keeping in mind that the size, industry and some other parameters of a particular enterprise may not be taken into account, the table in this section shows that:
1. Cloud-based ERP solutions generally tend to outperform other types of ERP within the feature categories of 'Direct Costs', 'Impact on Competitive Position and Organization', and 'Functionality & Usability'.
2. On-premise ERP and hosted ERP generally outperform cloud-based ERP in the categories of 'Integration & Customization & Performance Capabilities' and 'Security & Standards'.
3. Hosted ERP solutions often deliver compromise level of features that are strongly pertinent either to cloud-based ERP or to on-premise ERP.

5   DISCUSSION

Cloud-based ERP solutions have become one of the fastest growing segments of IT industry (Popovic 2010). Moreover the shift from traditional ERP to cloud-based ERP is clearly notable (Lin and Chen 2012). In particular many SME's shift to cloud-based ERP solutions (Castelina 2011). Cloud-based ERP appears to provide a number of benefits and drawbacks. These are analyzed in the previous section in comparison to traditional ERP based on a number of popular articles. Furthermore, during the analysis SME's are taken into consideration in order to find out whether cloud-based ERP solutions are of more interest to SME's. The findings of the analysis is shortly discussed below.

First, when it comes to cost benefits of cloud-based ERP, most reviewed papers generally agreed upon lower upfront and operating costs. The reason for this is the fact that enterprises do not need to make huge upfront investment in IT infrastructure. Also, unlike the traditional ERP, cloud-based ERP can be configured on demand, and maintained and replicated rapidly which leads to a much better utilization of the computing infrastructure. This in turn will lead to lower upfront and operational costs.

Second, almost all the authors state that cloud-based ERP can rapidly be implemented within the enterprise unlike the traditional ERP which needs more effort and time. Cloud-based ERP delivers a rapid deployment model that enables applications to grow quickly and match increasing usage requirements. The user can easily scale up or scale down depending on its needs (Verma 2012). On the contrary, Kim et al. 2009 mention in their paper, the inability for the service providers to scale up their computing infrastructure as customer demands increase beyond the original expectation. It is therefore important for the enterprises to first understand the service provider's capacity assumption and scale-out plans regarding the computing infrastructure. Moreover, advantages like access to specialized and advanced technology, easy integration with other cloud services, rapid updates and upgrades are more or less mentioned in different papers to be evident within the cloud-based ERP systems.

According to the findings in the previous section, the risk issues are the most occurring drawbacks of cloud-based ERP in comparison to the traditional ERP. Security risk is one the drawbacks many articles

mentioned. Enterprises are always insecure regarding data that is stored in the cloud since they do not have control over security, but depend upon the cloud-based service providers. This will make the enterprise more vulnerable since cloud has become a honey pot for hackers. Also, a dishonest employee of the service provider could potentially disrupt the computer system or data (Kim et al. 2009). A hosted solution is typically prone to the same risks. On the contrary, on-premise solutions tend to be more secure since the enterprises have more direct control over the systems.

Another risk issue is the performance which includes amongst others the communication between the clients computer and cloud-based service provider, speed and reliability of the network. The performance tend to decrease as the number of users and the amount of data transferred to and from increases (kim et al. 2009). On the contrary to this statement, Rong et al. 2012 mention in their paper that the cloud model simplifies installation, operation and maintenance of information system while increasing system reliability and efficiency.

Another frequently mentioned issue is the limitation on extensive customization and complex integration with other services. This issue might bring forth many technical and business challenges for both providers and adopters. If an organization has installed many complex applications composed of many internal systems it will be a real challenge in terms of integration. Yet third party companies are able to help an organization with such processes. Integration with other services is yet another factor which is dependent on each organization's systems and culture (JIelaty and Monzer 2012). Unlike cloud-based ERP, within on-premise all the business processes are integrated throughout an organization. The integration enabled both internal and external customers to more easily share information with one another (Engebrethson 2012).

5.1   SME aspects

One of the research purposes of this paper is to analyze whether the foregoing benefits and drawbacks of cloud-based ERP compared to 'traditional' ERP are more relevant for small and medium enterprises. We found that the benefits of cloud-based ERP in lowering upfront costs and operating costs are especially relevant to SME decision making on whether to choose cloud-based ERP, according to Jlelati et al. (2012). This is because small organizations, compared to large organizations, usually do not have large enough human and financial resources to invest in information systems and therefore adopting cloud-based ERP could be an effective method to reduce the IT costs.

Besides, Benlian and Hess (2011) claimed scalability, one of the benefits of cloud-based ERP, is also a key factor to SME's especially for small organizations who want to expand their market share to compete with large organizations. Moreover, Benlian and Hess (2011) and Saugatuck (2008) found that SME's can get easier access to specialized & advanced technology and resources by adopting cloud-based ERP so that they can gain more competitive advantages over their competitors.

In conclusion, lower upfront costs and operating costs, scalability and access to specialized & advanced technology, and improved disaster recovery have special importance for SME's to consider adopting cloud-based ERP.

At the same time, some recognized disadvantages of cloud-based ERP may be considered as of less importance for SMEs. For SMEs, that have quite simple or no existing legacy systems, cloud ERP limitations on extensive customization and integration are not that relevant. (Bartolj et al. 2009, Jlelati et al. 2012), Similarly, loss of IT skills and competencies, IT department's resistance towards organizational changes, and certain security risks are usually not a big issue for SMEs in contrast to large businesses (Jlelati et al. 2012).

6   CONCLUSION

We have presented a review of recent research on cloud-based enterprise applications, investigating proven benefits and drawbacks of cloud-based ERP compared to traditional ERP. The key identified benefits of cloud-based ERP in comparison with traditional ERP include lower upfront costs, lower operating costs, rapid implementation, scalability, focus on core competencies, access to advanced technology, rapid updates & upgrades, improved accessibility, mobility, and usability, easier integration with cloud services, and improved disaster recovery.

The major additional costs, risks, and limitations of cloud-based ERP comprise subscription expenses, security risks, performance risks, customization and integration limitations, strategic risks, compliance risks, loss of IT competencies, functionality limitations, limitation on hybrid deployment strategy, and SLA issues.

According to our research, cloud-based ERP generally tend to outperform hosted and on-premises ERP within the feature categories of 'Direct Costs', 'Impact on Competitive Position and Organization', and 'Functionality & Usability'. On-premises ERP and hosted ERP generally outperform cloud-based ERP in the categories of 'Integration & Customization & Performance' and 'Security & Standards'. Hosted ERP solutions often deliver compromise level of features that are strongly pertinent either to cloud-based ERP or to on-premises ERP.

Our literature review also revealed certain controversies among the previous researchers' opinions regarding several benefits and drawbacks of cloud-based ERP. Such claimed benefits as scalability and some operating cost savings may be not realized to satisfactory extent in some cloud-based ERP systems. At the same time such recognized drawbacks as security and performance risks may not be any higher for latest versions of cloud-based ERP than for traditional ERP. In our opinion, given the general tendency of quite dynamic cloud ERP improvement, one of the causes of the aforementioned controversies could be differences in capabilities of different cloud-based ERP systems examined at different times.

We also identified that such advantages of cloud-based ERP as lower upfront costs, lower operating costs, scalability, access to advanced technology, and improved disaster recovery may be considered as more relevant or pertinent for SMEs than for large enterprises. In addition, such cloud ERP disadvantages as limitations on extensive customization & integration, loss of IT competencies, and security risks in most cases are not that important for SMEs in contrast to large enterprises. Therefore, cloud-based ERP generally might be considered as more suitable option for SMEs than for large businesses.

As one of the reasonable directions for future research in this area we would suggest investigating the influence of private and hybrid clouds as possible service delivery types on the achieved benefits and drawbacks of cloud-based ERP adoption. Additional quantitative research evidence based on recent cases could also be helpful in getting further insight into suitability of cloud-based ERP for enterprises of different sizes and industries.

A   REFERENCES USED FOR LITERATURE ANALYSIS

The following references where used in the literature analysis, with their reference number listed below. For the complete listing please refer to the References list.

No.	Source
1	Scavo, F., Newton, B. & Longwell, M. 2012. Choosing between cloud and hosted ERP, and why it matters.
2	Grumman, N. 2011. In-house ERP systems vs. cloud computing.
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9	Rong et al. 2012. Beyond lightning: A survey on security challenges in cloud computing.
10	Dudin E. B. & Smetanin Y. G. 2011. A Review of Cloud Computing.
11	Armbrust et al. 2010. A view of cloud computing.
12	Karabek M.R., Kleinert J. & Pohl A. 2011. Cloud Services for SMEs: Evolution or Revolution.
13	Kim W., Kim S.D., Lee E. & Lee S. 2009 Adoption Issues for Cloud Computing.
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16	Jlelaty M. & Monzer Y. 2012. Factors in Cloud Computing Adoption (MSc thesis).
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B   INTERIM CLASSIFICATION TABLE

Nr.	Additional Benefits & Drawbacks Compared to On-premise ERP	Classification & Grouping
1	Pooled computing resources	grouped to 12
2	On-demand self-service (easy to configure and update on one's own)	combined with 11
3	Rapid elasticity of computing resources	grouped to 12
4	Broad network access	grouped to 23
5	Measured service and usage-based pricing	grouped to 8 and 9
6	Dramatically speed up implementation, reduced time-to-market (16)	
7	Rapidly consume new functionality (updates)	
8	Lower upfront costs (CAPEX)	
9	Lower operating costs (OPEX) (mainly about reduced energy, upgrades and maintenance costs, IT staff (6)); *subscription fees* (14)	
10	Easier to use	grouped to 23
11	Ease of upgrades, maintenance, and configuring (reduced planning, acceptance testing and other switching procedures to perform an upgrade)	combined with 9

12	Scalability (resource pooling and rapid resource elasticity make infrastructure capacity highly elastic)	
13	Easily integrate with other cloud services	
14	Based on mature systems and are functionally rich to satisfy the back-office needs of organizations in every type of industry	
15	Allows hybrid deployment strategy to (I) retain legacy systems if needed, (II) integrate ERP with on-premise systems that require low latency and (III) overcome deficiency of public network infrastructure.	
16	May enable greater customization and integration	
17	Focusing the resources that would be used to staff an IT department on other essential areas of the organization. Reduced strain on internal IT departments that can focus on servicing core competencies.	
18	Highly secure	grouped to 28 as -2
19	Easier to switch among IT providers	combined with 27
20	Fosters the company's concentration on its core competencies	combined with 17
21	Access to specialized & advanced resources	
22	Improved quality of application services	combined with 23
23	Improved Accessibility, Mobility, Usability	
24	Performance risks (speed and reliability of network, scope, interoperability with your home-grown applications, integration into existing IT environments, data transfer; outage risks & prevention costs)	
25	Additional customization constraints	grouped to 16
26	Economic risks (unanticipated costs etc.)	left out
27	Strategic risk (high dependency on the service provider)	
28	Security risk (confidentiality and security, unclear damage liability)	
29	Issues related to compliance to regulations/standards (incl. energy & environmental performance of cloud service providers)	
30	SLA issues (hard to accurately define SLA)	
31	Extends IT capabilities (vague)	left out
32	Financial value : reduced capital and operating expense, speed implementation	grouped to 6, 8, 9
33	Limited IT resources needed	grouped to 9
34	Efficient collaboration across geographies	combined with 23
35	More agile decision making	left out
36	Loss of IT skills and competencies, IT department's resistance towards organizational changes	
37	Improved system availability and disaster recovery capabilities	
38	Outsource the information system allows a company to better utilize its human and technical capital; IT staff can focus on core competencies	grouped to 17
39	An SME can take advantage of the latest leading-edge technologies that might otherwise be beyond its reach.	combined with 21
40	Non-depreciable subscription fees	

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