Cloud-based Enterprise Resources Planning System (ERP)
A Review of the Literature

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Abstract: Cloud computing recently attracted a lot of attentions. The growing number of articles on cloud is an indication of its importance. Cloud ERP is a specific service delivered by cloud model. It provides companies the benefits of all business management functionalities with minimum IT investment and low cost. Despite cloud ERP is being promoted as a new strategy to improve companies' management and operations, no systematic research on cloud ERP has been published until now. The main objectives of this research are to review up-to-date publications on cloud ERP, to classify the publications based on a suitable classification of themes and to develop a conceptual framework for organizing its related knowledge. In this paper, 40 peer-reviewed journal and conference publications are analysed and classified into different themes. A concept framework is designed with four domains: Technology Innovation, Business Model, Development Method and Usage & Assimilation. This framework specifies the research gap between cloud ERP and business alignment. In the end, some research agendas are developed.

1 INTRODUCTION

In 1990s, as many companies targeted to extend their market globally, achieving balance and synchronization within companies became critical. Enterprise Resources Planning systems (ERP) were widely implemented in multinational companies to integrate diverse and complex corporate operations.

With the development of high-tech, one of the most important trends in recent years is cloud computing. It has the potentials to reshape the way IT services are consumed. Cloud computing is defined by NIST (National Institute of Standards and Technology) as a model for enabling on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort.

Lately, several ERP vendors have moved some of their ERP offerings to the cloud environment, e.g., SAP, Microsoft, etc. However, before the customers can see more and more services and suites moving to the cloud, further research efforts should be made to contribute to the knowledge on the marriage of cloud and ERP.

Since the topic of cloud ERP is relatively unexplored, our objective is to move the research forward and forecast the future of cloud ERP. Therefore, we are going to analysis current status of cloud ERP based on the literature introduced before. For this, following research questions are addressed:

What are the current research themes of cloud ERP research?

What is the future concept framework of cloud ERP research?

In this paper, we conduct a comprehensive literature review of cloud ERP to answer our research questions. This literature review is within a timeframe of 2000-2013. Particular attention is paid to the peer-reviewed papers published in journals and conferences. There are several review articles on cloud ERP (Shukla, Agarwal and Shukla, 2012; Grabski, Leech and Schmidt, 2011; Salleh, Teoh and Chan, 2012; Salleh, Bohari and Khedif, 2013; Duan et al., 2012). They reviewed state of art, emerging trends and relevant phenomenon in cloud ERP. But none of them provides any conceptual framework. The body of academic knowledge about cloud ERP is still premature. An apparent gap in cloud computing for ERP applications research exists (Elragal and Haddara, 2012). It is crucial to find out the possibilities with cloud computing when it comes to business systems like Enterprise Resource Planning (Symonds, 2012)

In this paper, the literature available on cloud ERP is reviewed with a focus on four themes: Business, Technology, Development and Usage. A

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conceptual framework is developing based on these four themes. This conceptual framework contributes in two ways. Firstly, we provide guidance for researchers with insight into what has been published in the mean while provide a broad view into the development of streams of cloud ERP research. Secondly, this conceptual framework can be useful for managers from industry in increasing their understanding of areas of cloud ERP.

The remainder of this paper is organized as follows. The definition of cloud ERP is reviewed in section 2. The methodology adopted in this research for carrying out the literature review is presented in section 3. We provide an overview of the main finding from prior studies based on themes classifications in section 4. In section 5, we present the conceptual framework based on our findings. The conclusions finally bring the remarkets of current research issues and further suggestions.

2 DEFINITION OF CLOUD ERP

In today's complex IT world, increasing attention has been paid to cloud ERP. In the year 2009, this concept firstly was brought up by industry leaders when Software as a Service (SaaS is one cloud service to deliver application and fulfil business requirements) increasing markedly. Many media and research centres such as Gartner (2009), IDC (2009) ZDNet (2009), and CIO Magazine (2009), also made several predictions on cloud ERP. Aberdeen Group (Castellina, 2011) characterized that ERP would be implemented by SaaS model since 2007. However, it was not prevalent until 2010.

Cloud ERP is a term without a commonly accepted scientific or technical definition. In some of research papers (Saini et al., 2011; Raihana, 2012; Makkar and Bist, 2012; Mangiuc, 2011; Duan et al., 2012; Al-Johani and Youssef, 2013; Keshwani and Sharma, 2013), it is also referred to SaaS ERP or ERP as a Service.

"Cloud computing" has the potential to radically change the ERP environment (Grabski, Leech and Schmidt, 2011) and fulfil companies information needs (Saini, Khanna and Kumar, 2012). It is possible to combine the benefits of using an innovative method such as cloud computing and ERP to develop a new generation of tools for back office (De Maria et al., 2011).

Many researchers (Appandairajan, Zafar Ali Khan and Madiajagan, 2012; Binu and Meenakumari, 2012; De Maria et al., 2011; Elragal and Haddara, 2012; Hao, Juell-Skielse and Uppström, 2012; Kiadehi and Mohammadi, 2012; Lenart, 2011; Mangiuc, 2011; Symonds, 2012; Raihana, 2012; Sunder, 2011; Salleh, Teoh and Chan, 2012; Saini et al., 2011; Saeed, Juell-Skielse and Uppström, 2012; Vimalkumar, Rajamani and Jayasubramanian, 2012) attempted to define cloud ERP and its characteristics. Salleh, Teoh and Chan (2012) claimed that most of the definitions are vendor-driven, and it is very important to think cloud ERP from academic and industrial perspectives.

Theoretically, cloud ERP is package software delivered by the Internet. It consists of all the solutions to manage simplified and standard business flows on a web-based architecture (De Maria et al., 2011). It is very easy and simple to use, deploy and maintain (Makkar and Bist, 2012; Binu and Meenakumari, 2012). User can simply lease and access services which are related to their business through the cloud (Salleh, Teoh and Chan, 2012) based on the pay-as-you-go model. This means the users should pay based on the processing power or memory usage (Appandairajan, Zafar Ali Khan and Madiajagan, 2012; Kiadehi and Mohammadi, 2012). Therefore, service provider is responsible for the operation, upgrading and maintenance of the software relevant technology (Saini et al., 2011; Raihana, 2012; Makkar and Bist, 2012).

A true cloud ERP is multi-tenant, that is, all the users are using the same application but in different instances. Users only need to know the endpoints to access cloud ERP's capabilities, which include all storage, computing, database and other resources, through a single application instance and expect it to support their unique business. Moreover, user can scale up and down the resource consumptions, depending on their dynamic business needs (Sunder, 2011; Saini et al., 2011). Any changes or updates need to be effected only once and immediately to all subscribing users (Sunder, 2011). It is interesting that users may or may not know that the ERP application is built by the resource from multiple services and potentially from multiple locations (Saini et al., 2011; Raihana, 2012).

3 METHODOLOGY

In this paper, literature review was employed as the research methodology. By reviewing high quality research literature can accumulate existing knowledge and contribute to a cumulative culture desired in any research field especially in

Information System (IS) (Salleh, Teoh and Chan, 2012).

Harzing's Publish or Perish software was used to find out which are the most cited publications concerning the subject of this paper. A general citation search was made by using the phrase "CLOUD ERP" with double quotes to ensure the search condition. This study aims to synthesize the review of past literature on cloud ERP spanning from a period of the last decade, so the Year of publication is between 2000 and 2013. The literature was searched extensively in different resources in the disciplines of business, management, industrial production, information system and technology, etc.

As a result, 124 papers were found by 20 September, 2013 (cut-off-date). By eliminating non-English papers and reduplicate papers (35), only 89 validated articles were left. For the sake of rigorousness, bachelor/master/PhD thesis, textbooks, unpublished working paper were excluded. Only peer-reviewed journal, conference and book of chapter (conference proceedings) were included. Therefore, only 40 articles were carefully selected after refining to synthesize the literature and grasp an understanding of cloud ERP phenomenon. The literature included publications by numerous publishers, in particular Elseriser, Emerald, Springer, etc. As cloud ERP is a relatively new topic, such a small number is unsurprising.

When the year of publication is considered, it becomes clear that this subject of study is relatively recent, as shown in Table 1. For example, only 1 article published before 2011. The sudden increase of publication between years 2011-2013 indicates the boom of cloud computing and applications of SaaS.

Table 1: Number of articles on cloud ERP between 2000-2013 (as of 20/09/2013).

	2000-2009	2010	2011	2012	2013
Number of Publications	0	1	8	20	11

Figure 1 presents the distribution of reviewed articles in past 4 years (2010-2013) from different publication outlets. The majority of the literature (20 articles, 50%) is published in various international journals while 37.5% (15 articles) is from conferences. 5 papers (12.5%) are chapters of books. The detailed information of journals, conferences and book chapters are presented in the reference list.

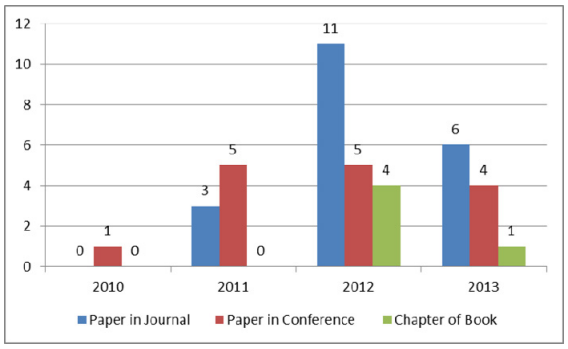

Figure 1: Number of articles in different publication outlets between 2010-2013 (as of 20/9/2013).

4 CLASSIFICATION OF CLOUD ERP

A thematic analysis was developed to exam the themes of reviewed literature. The results are presented in Table 2 (all articles are arranged alphabetically by authors' surnames).

The classification of cloud ERP was based on the literature introduced in this review and the interest of cloud ERP research. Currently, cloud is gaining a considerable attention in Information System (IS) literature, therefore the existing classification schemes of IS (Barki, Rivard and Talbot, 1993) was selected as a base of themes classification.

It is difficult to divide the articles by different themes, especially when there are no fixed rules for this division. Therefore, this division is only made to simplify the research findings and make it easy for readers to follow. One research paper may contribute to several of these themes.

Business theme indicates the impact of cloud ERP on business strategy, i.e. the company's competitive advantages or disadvantages, etc. since the combination of cloud and ERP is quite new and receives increasing attention, **technology** is seen as the highly debated topic. Because cloud is an alternative way to develop software, **development** becomes a major topic in this research area. Some articles related to end users belong to practical topic; therefore they are included into **usage** theme.

Table 2: Classification on themes in cloud ERP.

	Articles
Business	**External environment impact** Khajeh-Hosseini, Sommerville and Sriram, 2010; Lenart, 2011; Saeed, Juell-Skielse and Uppström, 2012; Saini, Khanna and Kumar, 2012
	Internal organization impact Al-Johani and Youssef, 2013; Appandairajan, Zafar Ali Khan and Madiajagan, 2012; Binu and Meenakumari, 2012; De Maria et al., 2011; Duan et al., 2012; Gheorghe and Lupaşc, 2012; Grabski, Leech and Schmidt, 2011; Iqbal, Juell-Skielse and Uppström, 2011; Keshwani and Sharma, 2013; Kiadehi and Mohammadi, 2012; Lenart, 2011; Makkar and Bist, 2012; Mangiuc, 2011; Okezie, 2012; Purohit, Jaiswal and Pandey, 2012; Raihana, 2012; Saeed, Juell-Skielse and Uppström, 2012; Saini et al., 2011; Salleh, Teoh and Chan, 2012; Saini, Khanna and Kumar, 2012; Salleh, Bohari and Khedif, 2013; Suciu, Ularu and Craciunescu, 2012; Shukla, Agarwal and Shukla, 2012; Symonds, 2012
Technology	**Cloud Environment** Al-Johani and Youssef, 2013; Clohessy and Acton, 2013, 2; Duan et al., 2012; Gheorghe and Lupaşc, 2012; Hao, Juell-Skielse and Uppström, 2012; Kiadehi and Mohammadi, 2012; Keshwani and Sharma, 2013; Lenart, 2011; Mangiuc, 2011; Makkar and Bist, 2012; Raihana, 2012; Saini et al., 2011;Salleh, Teoh and Chan, 2012
	Data Management Appandairajan, Zafar Ali Khan and Madiajagan, 2012; Keshwani and Sharma, 2013; Saeed, Juell-Skielse and Uppström, 2012; Sunder, 2011
	Security Appandairajan, Zafar Ali Khan and Madiajagan, 2012; Binu and Meenakumari, 2012; Gicev, Atanasova and Pehcevski, 2013; Iqbal, Juell-Skielse and Uppström, 2011; Lenart, 2011; Suciu, Militaru and Todoran, 2012
Development	**Lifecycle** Gheorghe and Lupaşc, 2012; Hao, Juell-Skielse and Uppström, 2012; Okezie, 2012
	Implementation Al-Johani and Youssef, 2013; Appandairajan, Zafar Ali Khan and Madiajagan, 2012; Duan et al., 2012; De Maria et al., 2011; Grabski, Leech and Schmidt, 2011; Lenart, 2011; Mangiuc, 2011; Kiadehi and Mohammadi, 2012; Okezie, 2012; Suciu, Militaru and Todoran, 2012; Suciu, Ularu and Craciunescu, 2012
	Functionalities Al-Johani and Youssef, 2013; Castellina, 2011; Elragal and Haddara, 2012; Lenart, 2011; Mangiuc, 2011; Saini et al., 2011
Usage	**Education &Training** Dykshoorn and Nemani, 2013; Hao, Juell-Skielse and Uppström, 2012; Purohit, Jaiswal and Pandey, 2012
	Use cases Al-Johani and Youssef, 2013; Clohessy and Acton, 2013; Clohessy and Acton, 2013, 2; Musaeva and Petrochenkov, 2011; Okezie, 2012; Purohit, Jaiswal and Pandey, 2012; Shukla, Agarwal and Shukla, 2012; Suciu, Militaru and Todoran, 2012; Sunder, 2011; Suciu, Ularu and Craciunescu, 2012

5 CONCEPTUAL FRAMEWORK OF CLOUD ERP

Following the initial literature review, a conceptual framework has been developed for identifying areas of research concern with regards to cloud ERP and the relationships among different themes, as shown in Figure 2.

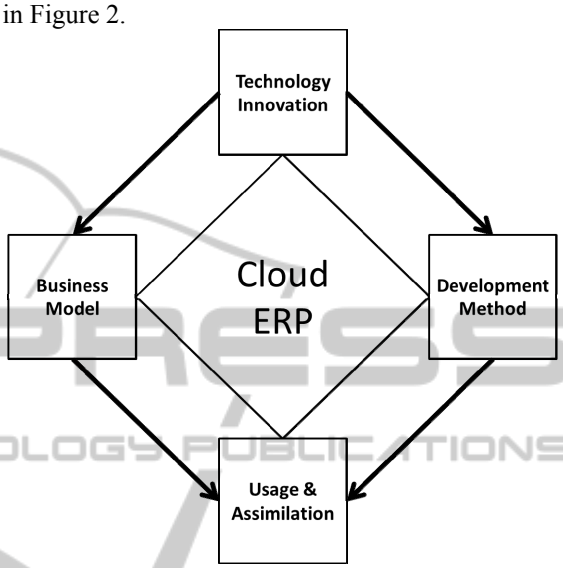

Figure 2: Cloud ERP diamond conceptual framework.

This framework is defined in terms of four fundamental domains of cloud ERP research which we have labelled: Technology Innovation, Business Model, Development Method and Usage & Assimilation. Each of these domains suggests different research orientations as well as provides a theoretical foundation for future research. This framework could also be used to identify research gap and develop research agenda to address this gap.

5.1 Technology Innovation Leads to a New Business Model

Nowadays, progressive organizations are evolving towards a more agile business model which must be supported by advanced technology. This change will drive impressive business outcomes and increase competitiveness. Cloud computing is a catalyst for technology innovation and also is an innovation in itself.

Unlike the old ERP with many constraints in old technologies, for today this new cloud ERP solution should look at deeper and further business scope and actions. In order to fully comprehend the capabilities afforded by cloud, it is necessary to explore the innovation potential (Clohessy and Acton, 2013, 2).

The next phase of cloud technology evolution is expected to be a more networked solution which enables the communication across different organizations. In this sense, cloud ERP service will extend to wilder business impact. Furthermore, the usage of cloud ERP should be expandable regarding to the business.

Kiadehi and Mohammadi (2012) emphasized that cloud impacts the business strategy and optimizes the business by providing more agility, business & IT alignment, service flexibility and industry standards.

The future of cloud ERP is to encourage cross-functional cooperation and to solve business problems. There is a commitment to the establishment of consistent baseline performance information across a number of functional areas (Clohessy and Acton, 2013, 2). More and more companies are now recognizing that the business model is changing to be more agile, productive of IT and available (Suciu, Ularu and Craciunescu, 2012).

5.2 Technology Innovation Affects the Development Method

Cloud can reduce the cost, complexity and time required to realize the IT services. The use of the term cloud implies that the technologies include virtualization and load balancing technology and these technologies allow applications to be deployed across multiple servers and database resource. The success that has been achieved in other enterprise systems development needs to be replicated in cloud ERP development. Cloud ERP can address cross-organization planning, coordinated implementation on many business and organizational levels. In some cloud ERP solutions, a certain degree of customization and industry-specific support is needed.

The development lifecycle will definitely be changed with the emergence of new technologies. This is due to the fact that cloud computing will shorten and change the activities of the lifecycle. It is very fast to go to market. The customer demands, globalization and quick information flow require cloud ERP works at a high speed.

With an ever-growing list of cloud ERP vendors, there will be more options for enterprises. On the other hand, although the implementation time is reduced, enterprises have to invest much more time into pre-implementation activities, such as selection, negotiation, customization, etc. However, it is difficult to evaluate the quality of cloud ERP vendors. They have own set of pricing, billing, flexibility, support and other important parameters.

5.3 Business Model and Development Method Jointly Change the Usage and Assimilation

Cloud ERP has dramatically changed how users utilize ERP services and conduct their business. These changes in business and technology also affected the way people work. Cloud ERP enables people working from multiple locations in a simple, convenient and flexible style. The usage of cloud ERP will improve people's commitment to the company and productivities (Dykshoorn and Nemani, 2013). The ability to work flexibly reduces communication time greatly. Because of the characteristics of cloud ERP and the fact of different development methods, there are obvious differences in usage compared with traditional ERP.

Obviously, without proper implementation and business decision, this cloud ERP may not provide the promised value. Assimilation means that companies progress from understanding cloud ERP's potential and functionalities to mastering and deploying them in their key value chain process (Pishdad and Haider, 2013). After cloud ERP is implemented in a company and its usage becomes routinized and embedded within the companies' work processes and value chain activities, it leads to institutionalization of cloud ERP.

After all, it is very important to pay attention to post-implementation activities. Proper usage of cloud ERP not only results in greater levels of organizational performance, but also increases users' satisfaction and motivation.

5.4 Research Gap

Obviously, cloud based solution impacts not only the IT industry but also customers' industries. From the business perspective, the real potential of cloud is to improve the alignment between IT and business. Only when approached correctly, cloud can offer a new set of benefits.

However, it is essential to understand that cloud is not a solution for every company. The decision and selection depend on resource availability, IT infrastructure, functional requirements, total cost of ownership for the software, and delivery options to the specific company.

Cloud ERP can enhance the business productivity hence the companies can deliver business value much sooner. However, cloud ERP has not gained strong business adoption as we

expected mostly due to lack of knowledge about how to align cloud ERP strategy to business strategy.

Cloud ERP should be aligned with the organizational environment and gain social approval (Pishdad and Haider, 2013). Aligning IT to the business goal is the highest ranked cloud ERP priorities and challenge. It is extremely important to companies which are considering cloud ERP adoption. We noticed that no such research indicates cloud ERP and business alignment or their relationships. Therefore, we suggest more research efforts should be conducted to fulfil the research gap.

Presenting on Figure 4, the arrow is only one way from technology innovation to the business model. Actually, it should be two-direction arrow and it indicates that the cloud ERP are used to support the IT and business strategy alignment.

6 CONCLUSIONS AND REMARKS

ERP system has come a long way in its evolution. Now we move to the era of cloud and we are using cloud for business-critical application, such as ERP. Every revolutionary paradigm shift brings along new business opportunities. We have recognized the benefits of using cloud ERP. In this review paper, a comprehensive literature review on cloud ERP was conducted based on a vast amount of papers published. A methodology, which consists of 3 steps, was followed:

- Selecting and accumulating the papers pool
- Setting up filters to collect the target papers
- Classifying all the papers by common themes

Our study reveals 40 publications from journals and conferences. With regards to the overall reviewed papers in this paper, we draw some key points:

1. Many of the early cloud ERP research papers are relatively simple, descriptive studies of cloud ERP. Majority of the papers deal with the problem at the conceptual level, and also the papers pool is small since many of the reviewed papers are written by the same group of authors.

2. It lacks longitudinal studies, so it is difficult to report the long-term effects of cloud ERP. The literature is mainly in the period 2011-2013. There could be some bias in such a short time booming.

3. The current research of cloud ERP in these papers fairly focused on “cloud technology” and its business benefits. It is scant of practical and empirical research directly pointing to cloud ERP. Definitely, cloud ERP research needs greater focus on theoretical support and theory development to explain findings.

Additionally, a conceptual framework has been developed for cloud ERP research areas based on the classification of themes of all reviewed papers, according to the topic of interest. Four domains were identified: Technology Innovation, Business Model, Development Method and Usage & Assimilation. The contributions of this framework are twofold:

- For managers, it can assist in creating an understanding of the broad spectra issues of concern that one has to take into consideration in regard to cloud ERP.
- For researchers with an interest in cloud ERP, the conceptual framework can be used for positioning their research and interests, and it helps in creating an understanding of the broader context of cloud ERP related research.

Based on our literature review, we present some research opportunities and implications as follows:

- In most of the literature, the term cloud ERP is perceived differently by authors. Some authors perceive it as SaaS ERP, others define it as ERP as a service. There is a need to establish a common definition, accepted by both industries and academia. We expect an exponential growth in the number of cloud ERP research in a near future. A unified definition and a set of technical standards of cloud ERP are expected.
- The current literature lacks focus on cloud ERP implementation and development. We were not able to find any article that directly addresses cloud ERP strategy and its implementation phase.
- Furthermore, literature lacks cases that using cloud ERP in the organization and comparisons between “on-premise” and “on-demand”. This kind of comparison might be fruitful for cloud ERP literature.
- Moreover, the usage of cloud ERP in organization had scant attention. Only few articles examined cloud ERP post-implement.
- Many research focus on cloud ERP business impact and technology, but seldom on post implementation impact. This highlights a critical research gap and the needs of careful attentions to activities such as education and training.
- In general, majority of the existing papers are from vendor’s perspective, and it lacks paper from user’s perspective. It could be beneficial if researchers can study from both perspectives; therefore different stakeholders

may avoid previous pitfalls.

Even though this article reports all the articles on cloud ERP without any constraints, more selection criteria can be applied to reduce or increase the number of articles for a different kind of review report or research depending on the nature or the research question. For instance, the research on different kinds of organizations using cloud ERP is meaningful.

This paper has limitation. Our sample was mainly based on academic publications. As cloud ERP is industry-driven in nature, many good professional articles may also embrace this phenomenon. This may hinder the ability of the present paper to delineate a complete picture for the current development in this domain.

In the future, the field of cloud ERP will certainly continue to mature and even more in the extension period. As significant market share will be gained with the implementation process, different topics such as the importance of using cloud ERP and the assessment of cloud ERP values seem to be becoming of interests to both the researchers, businesses and industrial organizations as they are potential areas for future research. It might be a time for scholars or academia to reflect on their experiences and begin publishing for common good.

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