

“A Comparative Study about Cloud Based Enterprise Resource Planning (ERP) Systems: Analysis of Cloud ERP Implementation”

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Abstract – *Cloud computing is a new technology trend which changed how information systems operated and used, while ERP is one of the most used enterprise applications by the market, and considered the core of many corporations. The fact that ERP systems require high resources in term of cost, time and people in order to be implemented and maintained introduced many difficulties for organizations to set up such a vital system, which was the driving force to try to benefit from cloud computing to help organizations to implement ERP systems with less implementation cost and time. The product of this research was an intersect between the available relevant knowledge, and the market, where some market representatives were interviewed to bridge the gap between theoretical and practical point of views, and get deeper understanding regarding issues and features of ERP as cloud service.*

Enterprise Resource Planning (ERP) is used more than a decade; however, the continuing efforts to promote this technology have been carried out. With introducing Cloud Computing technology, a wide variety of service can be implemented on Internet, which has a profound effect on the application of information systems and Internet. Many researches focused on either ERP or Cloud Computing but few of them paid enough attention on the implementation of ERP on Cloud Computing environment. In this paper, the ERP and Cloud Computing are defined as a joint system. With the discovery of different aspects of these two technologies, using their specification and focusing on organizations specification, we suggest some recommendations for using them collaboratively. In this article, first, different aspects of this technology (Enterprise Resource Planning) are discussed. Later Cloud Computing and its current future, Cloud ERP and using Cloud Computing future for ERP implementation are discussed. Finally; we suggest some recommendations about how an enterprise can use the Cloud ERP benefits.

INTRODUCTION

Enterprise Resources Planning (ERP) systems are enterprise-wide information system packages, which consist of a comprehensive set of software modules that aim to support and integrate all key business processes across various functional divisions of an organisation by using a single data repository. Ever since its emergence in the early 1990s, ERPs have been widely implemented by thousands of knowledge-intensive organisations, with any size (e.g. including not just large companies, but also small and medium enterprises or SMEs), in many sectors (e.g. manufacturing firms, banks, universities, and hospitals), and in many countries (e.g. Western countries like the USA and Europe as well as Pacific Asian countries like China and India).

Traditionally, ERP resources (including data, module applications, and database servers) are internally hosted and maintained by user organisations (this is so called on-premise ERPs). This on-premise approach, which is still prevalently adopted by modern organizations to host and deploy ERPs, has certain inherent disadvantages, such as high initial investment and being too time-consuming to upgrade ERP installed on different user PCs. These disadvantages embedded in on-premise ERPs are expected to be significantly improved with the support of cloud computing technologies. In the new cloud environment, ERP packages and related data will be hosted on a third party vendor-managed and controlled infrastructure.

Companies can use their ERP applications and data as

on-demand services through a web browser, without physically installing the system in local PCs or storing the data in local servers. This new ERP deployment model will require less hardware investments, as well as less fees and internal hazard for system maintenance and upgrade. These attractive cloud features therefore result in an increasing trend for companies to consider migrating their hitherto internal ERP applications and databases into the cloud.

Current literature and studies on ERP are very rich, but the vast majority of them focus merely on on-premise ERPs. In contrast, research on cloud ERP has been very limited. Furthermore, the benefits of cloud technologies in general and cloud ERP in particular seem to be frequently and even over emphasised by cloud providers, whilst potential barriers and challenges related to this new ERP deployment method have not been fully explored and discussed in either the industry or the academia. The study reported in this paper therefore attempts to fill this knowledge gap. Specifically, it aims to seek in-depth insights from highly experienced IT professionals to identify and investigate potential benefits and barriers for migrating ERP systems to the cloud, as well as to provide useful lessons to help companies better prepare themselves for such crucial ERP and IT transformation.

Information is the most valuable asset for enterprises; it helps the companies keep track of their business, customers and stakeholders. Many systems were developed to organize and manipulate this information. For that reason, many organizations turned to use some kind of ERP systems over the past few years. Enterprise Resource Planning (ERP) may be defined as business management software that allows an organization to use a system of integrated applications to manage the business. Enterprise Resource Planning (ERP) systems considered as the core of successful data, information and knowledge management, which brought a new way of processing and delivering operational information which enabled organizations to integrate their business functions, and access real-time, up-to-date consistent data. The significant improvement resulted from using ERP systems emerged it as a vital tool for most of the organizations. ERP systems integrate the various firms' departments through different business functions to manage the internal resources such as finance, human resources (HR), manufacturing and logistics, and link the firm with the customers and vendors through supply chain management (SCM) and customer relationship management (CRM). ERP systems have evolved to become one of the largest IT investments for many companies during the 1990s. ERP systems offer the market with many features and advantages introduced through an easy to use, real-time, decision support system, which integrates all

organization's functions into one system with single database that can be accessed by suppliers and customers to get timely react regarding their needs. However, despite the huge benefits of ERP systems, there are some shortcomings raised due to the huge amount of resources required for the implementation and big risk of failure, which introduced difficulties prevented small and mid-size organizations from setting up ERP systems. ERP system is a costly and time consuming system to implement, and enclose high risk of failure and disruption to the customer's business continuity process. As ERP systems emerged as a vital tool for many organizations, these difficulties demanded the researchers to search for a new way to implement ERP applications. This research tries to investigate how beneficial it is to use cloud computing to help organizations implementing ERP systems with less implementation cost and time. Cloud computing is a new technology trend stated by the IT industry as the next potential revolution to change how the internet and information systems operate and use.

ERP systems place a vital role in the developments of a company. The implementation of ERP needs a good infrastructure and resources. Maintaining the resources and debugging through a big challenge to the firms. Any modification after the system implementation becomes difficult. Moving from one vendor to the other under unavoidable situations is a real challenge.

ERP maps the all the processes and data. It delivers business solutions to all the aspects of a company. ERP is a comprehensive software package that integrates the functions and processes. 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.

ERP systems are implemented in the companies by direct implementation of the software or by cloud based approach. The ERP systems traditionally used are implemented in the company premises. The servers and required packages of software are installed in the company itself. All the software is loaded onto the computers in house. The maintenance of the servers and emergency recovery is managed by the company itself. The enterprise itself is responsible for complete maintenance. Another option for ERP implementation is hosted networks, where the servers are located at different places and the company is connected through a direct network. The recent trends are utilizing the services of cloud based ERP systems. The remaining part of the paper is organized as follows..

CLOUD COMPUTING

Cloud Computing is a new computing method for delivering computing services. The Cloud Computing is a model to provide special services on the Internet. These services can be Networks, Servers, Storage environments, Software, Services and etc. These services are provided by companies like Amazon, Apple, Google ... and their security is provided by protocols such as web 2 and SOAP. The Cloud Computing can be an application delivered as a service on the internet like processing, spread sheet, email, calendar and etc. which have been provided by some providers like Google or Apple. It also can be Hardware's and system software's in the datacenters that provide those services on virtual machines. Amazon S2 and IBM Cloud are examples of these services. It can be rapidly provisioned and released with minimal management effort or service provider interaction.

Cloud Computing provides many specifications and abilities to use IT infrastructures, and these specifications are based on high quality services with low prices. Some specifications are limiting IT investment, Market environment data storage, capacity and elasticity that include flexible and scalable computing processing power to match elastic demand and supply, whilst reducing capital expenditure

and Pay as you go model and avoiding the expense and time-consuming task of installing and maintaining hardware infrastructure and software applications and demand computing resources , upfront commitment by Cloud users , Pay for use of computer resources , Portability of the application , Information access from anywhere , Guaranteed service level , Special supporting , and Security control improvement.

Based on the accessibility in Cloud Computing environment for users, this technology is divided into Public Cloud, Private Cloud and Hybrid Cloud. Public Cloud is a service that includes hardware, processing power and memory shares between different users and virtual machines are used to run and apply this service by users. VM's virtually separate hardware and software for each user. Users can access this service by web browsers. Based on user's processing power or memory usage that they should pay, we call such service pay as you go. For example, Amazon EC2 service charges few cents for using VM, this is cost effective toward buying new hardware and software and the cost of their maintainers. In this kind of service, hardware may be hosted in different locations.

In Private Cloud hardware and IT infrastructures located in an organization or these infrastructure used with physical

separation from other infrastructures, no hardware and software will be shared among users. This will cause an increase in security and performance, but we undertake extra cost for these improvements. Such a structure increases the customer's data security and customers can change settings and configuration based on their demand.

A private Cloud is set up within an organization's environment. It's hosted for single client, and privately owned and managed so it's access limited to client and its partner network. Private Cloud is easily aligned for security, compliance and needs regulatory requirement and more Enterprise control over deployment Hybrid Cloud is a combination of the two other structures. A hybrid Cloud is a private Cloud linked to one or more external Cloud services. It is a mix of both public and private Clouds and centrally managed and provisioned as a single unit and circumscribed by a secure network.

Cloud services are provided in three services:

- IaaS (Infrastructure as a Service)
- PaaS (Platform as a Service)
- SaaS (Software as a Service)

In Infrastructure as a Service, customers buy their needed infrastructures, you own and purchase the software and virtual power to execute as needed. This service is a running virtual server on a virtual environment . You pay for your usage, as we mentioned before by "as you go" model. This minimizes the need for huge initial investment in computing hardware such as servers, networking device and processing power . The Amazon EC2 is an example of this service, by this model customer's focuses on the decrease of hardware such as servers, storage and network devices. In IaaS, financial and functional flexibility were not found in internal data centers or with co-services.

Platforms as a Service is constructed from platform, depend on the integrating of operating systems, middleware, application software or an environment development which encapsulate service through an API manner. The Microsoft Azure is an example of this service. Of course, such a service is based on virtual machines and provided by web browsers or client software which is provided by Cloud providers using internet.

Software is a service which is a complete application that is offered as a service on demand . It's like that you rent the software to the users, such software is accessed by both web browsers and Cloud client or front end. On the other hand, SaaS is hosted software in Cloud provider's data centers. The Google APP and Apple Cloud are example of

such service, and can be accessed by browsers or client software.

ERP SYSTEM

An Enterprise Resource Planning (ERP) is the term that covers whole product line. It is an integrated computer-based application used to manage internal and external resources, including tangible assets, financial resources, materials, and human resources. Any business greatly benefits by adapting this feature because you can customize it or integrate it with other packages to satisfy unique requirements. Its purpose is to facilitate the flow of information between all business functions inside the boundaries of the organization and manage the connections to outside stakeholders. Built on a centralized database and normally utilizing a common computing platform, ERP systems consolidate all business operations into a uniform and enterprise-wide system environment. An ERP system can either reside on a centralized server or be distributed across modular hardware and software units that provide "services" and communicate on a local area network. The distributed design allows a business to assemble modules from different vendors without the need for the placement of multiple copies of complex and expensive computer systems in areas which will not use their full capacity. ERP is a massive software architecture that supports the streaming and distribution of geographically scattered enterprise wide information across all the functional units of a business house. It provides the executives with a comprehensive overview of the complete business execution which in turn influences their decisions in a productive way. ERP referred to the way a large organization planned to use its organizational wide resources. Formerly, ERP systems were used in larger and more industrial types of companies. However, the use of ERP has changed radically over a period of few years. Today ERP can be applied to any type of company, operating in any kind of field.

ERP VS CLOUD ERP

Capital cost -

Cloud based systems are becoming more popular because of the flexibility it offers. Cloud gives the firms all the services of computing, networking and storing from distinct location. It avoids the infrastructure cost of the companies. The maintenance is taken care by the provider. The companies need not required technical abilities to maintain the systems and software packages. The capacity of the cloud based systems can be easily increased without disturbing the existing services. All the software run on top of the cloud. These abilities of cloud technology offer lot of advantages. The cost of ERP

implementation is significantly reduced by introducing the cloud based approach.

Cloud services -

Cloud based systems are generally sub divided into three types based on the services provided. the three types are Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). The ERP implementation based on cloud services is grouped under SaaS. ERP is end user business. The platform based cloud is a middle ware application provided by distance provider. Hardware services are provided by infrastructure services. Based on the access types the cloud can be divided into two types private and public systems. Private systems are accessed and managed by the company; it will not be accessible to the customers directly. Public cloud systems are accessed by anyone and the customers can directly access the systems. Even a hybrid cloud can be implemented to cater the needs of the companies which offer online services . The hardware of the hybrid cloud is maintained by companies, but the data is outsourced. Cloud ERP systems are accessed via common browser over internet connection and allow the user to get all the information through client configuration. ERP is based on public cloud approach. The service based cloud implantation provides offerings in the form of services and the public nature gives the key components of software to the users.

Advantages of cloud based ERP-

The cost of the cloud based ERP implementation is lower compared to the traditional implementation. The cost of energy and maintenance, configuration etc is reduced. The scalability feature of cloud based ERP is enormous. The elasticity of the cloud based approach is one of the main advantages. The flexibility of cloud ensures competitive advantages to a particular company. Another advantage is faster implementation of software. Any changes suggested by the consumer can be implemented easily. The companies are free to concentrate on their improvements without thinking about the software implementations. Resource sharing and allocation becomes a very difficult task in the host based ERP systems. In cloud systems all the difficulties are handled care by the providers. Migrating to a new technology or software is simpler in cloud based applications.

Disadvantages of cloud ERP-

The conventional ERP approach needs huge capital investments. The cloud based systems are subscriptions based. The main difficulty of cloud approach is security and confidentiality. The reliability of the network and

integration issues is few other disadvantages of cloud ERP. The companies are at a risk of depending more on the cloud providers for its operations related to ERP. The standards and regulations specified by government and other organizations are not based on cloud type of procedures. Meeting those requirements becomes difficult for the organizations. Cloud based ERP procedure is not competent enough to handle the back office needs of an industry.

ERP AS CLOUD SERVICE

Usually information systems built up by different components from different manufacturers using different production and business models. When you are selling one component of a whole system, you cannot compete if your component not compatible with the rest of the system. Here comes the importance of standards principles . ERP is a modular system, where different ERP products are available in the market from different vendors with many different varieties. To have a standard that supports the ability of using modules from different vendors, integrate them together as one system will have great value for the customers.

Company	Role	Country	Interviewee position	Duration
Lawson	Supplier	Sweden	VP & Product Management	50
Medius	Supplier	Sweden	Regional Manager of After-sales	50
SYSteam	Supplier	Sweden	Product / Marketing Manager	40
Bejoken	Consumer	Sweden	Product & IT-Manager	60
Eldon	Consumer	Sweden	CIO	60
Sapa Group	Consumer	UK	MIS Manager	30
SAS Tech AB	Consumer	Sweden	CIO	90
Cloetta	Consumer	Sweden	IT Manager	45

Table1: Summary of the interviews.

Cloud computing allows on-demand ERP systems provisioning with zero-installation, fast and easy configuration at low cost, and immediate access in scalable data centers . The difference in on-demand ERP system is that providers will be responsible for the installation, maintenance and upgrades to deliver a ready to run application to the clients. As hardware and software are already installed and ready to use all the clients need

is a pc with secure internet connection and web browser . ERP on-demand can contain all the different modules of the on-premise package starting with the core modules such as financials, HR and manufacturing, as well the external modules like CRM and SCM. ERP as service should be delivered in low coupled modules implemented as a set of distributed web services, which means customers can attach and detach modules as they need. Customer's companies can start small with limited number of modules and users then they can add modules and user licenses as they grow. ERP on-demand is suitable when organizations have limited capital budget, limited IT support, or no desire to invest in large IT backbone infrastructure. ERP on-demand delivers a comprehensive set of business benefits to the market, like :

- Easy to deploy without the need for extensive IT experiences.
- Fast deployment – in weeks, comparing to on-premise which takes quite longer time in months and sometimes years. • No need to build large IT backbone infrastructure.
- Affordable and predictable: close to zero upfront cost, with monthly basis subscription, will make it possible to small-to-midsize businesses to deploy and benefit from such huge and costly ERP applications.
- Time to value: as ERP on-demand can be quickly installed, it will be quickly part of the work process and start producing.
- Flexible: corporations may pick the services based on their needs and capabilities.
- Scalable: organizations can scale up or down their IT infrastructure according to their consumption needs.
- Upgrades and enhancements are done on a regular basis without disrupting the work process.
- Configurations have become increasingly easy to adjust the system to fit the company needs and specifications through a set of parameter settings.
- With the support of SOA, integration with on-premise legacy software will becomes easier.

While ERP on-demand offers customers with many potential business benefits, there are many concern issues customers must consider about ERP on-demand before implementing the system. Some of the vital issues are regarding the quality of service provided and guaranteed through SLA, the security and privacy of the system

through different levels includes: web-based access, and data centers protection. Customers must consider as well the provider's capabilities in terms of extra power supplies, and backup and recovery, to ensure business continuity and no disruption would occur that may cause the system to stop or miss-function.

BENEFITS OF CLOUD-BASED ERP IMPLEMENTATIONS

Using a Cloud/SaaS-based ERP implementation, organizations can lower TCO, more easily align their IT infrastructure with specific business requirements, gain a highly scalable solution, simplify ERP deployment and management, simplify upgrades, as well as access their applications anytime, anywhere with a high degree of reliability.

Lower upfront costs and TCO-

The Forrester "State of ERP in 2011" report found that 79 percent of respondents were looking to SaaS ERP to reduce TCO while 54 percent wanted to reduce up-front costs. SaaS lowers costs by providing:

- Economies of scale—Many Cloud applications and services share resources and costs among a large pool of users. Infrastructure can also be centralized in areas of lower costs. Service providers can pass along these lower costs to their customers.
- Virtualization—Cloud systems take advantage of virtualized infrastructure. By enabling consolidation of infrastructure resources, such as servers and storage, virtualization allows systems to be utilized more efficiently thus reducing costs.
- Pay as you go—Customers pay for SaaS based ERP solutions on a monthly basis with charges based on actual usage—typically without an initiation or setup/ installation free. Such a pay-as-you-go model reduces capital costs.
- Reduce hardware and maintenance costs—Often the difference in TCO is not in the cost of software and services but in the cost of hardware and IT staff. SaaS reduces the costs of the infrastructure, professional services, and ongoing support requirements to install, configure, deploy and maintain an ERP system.
- Thin client—Most SaaS systems use a thin client model in which the software is accessed over the internet. Eliminating thick PC clients that require

software to be installed on the PC provides a huge initial savings because organizations don't need to purchase and install the software on each PC. Ongoing maintenance costs are also lower because the vendor performs ongoing maintenance centrally rather than having to upgrade individual machines.

Align IT Infrastructure with Business Requirements-

Because organizations subscribe to only the services they need, Cloud-based ERP provides a high level of deployment flexibility to allow organizations to tightly align their business strategy with the technology needed to achieve it and match their solution to fluctuating business conditions. At the same time, Cloud/SaaS-based implementations allow smaller companies with limited budgets to access incredibly robust technologies in an affordable manner.

Scalability-

Instead of spending considerable time and money building an infrastructure, organizations can get started right away by hooking into a SaaS application. Some vendors allow organizations to start with no minimum number of users. If they grow rapidly, they can easily buy access to more capacity instead of having to upgrade internal infrastructure.

Ease of Deployment and Management-

Fifty percent of respondents to the Forrester survey had limited IT resources and no interest in building IT staff. Cloud-based ERP, which provides browser-based access to the ERP application, eliminates the need to install and maintain client software or to deal with servers, network connections, application software and so on. As a result, organizations don't need to hire full time IT staff with expertise in the software and hardware. When something goes wrong, they can simply call the vendor to fix the problem. By outsourcing IT headaches to a third party, organizations can focus on what they do best.

Reduce Cost and Effort of Upgrades-

Sixty eight percent of respondents to the Forrester survey selected a SaaS implementation because they wanted to reduce cost and effort of upgrades. By taking on some of the burden of the upgrade process, SaaS ERP solution providers reduce the cost and effort of the upgrade. This means organizations using SaaS deployments are often in a better position to take advantage of innovations delivered by ERP solution providers.

Accessibility -

When a SaaS ERP system works with web based software, users can access their applications from anywhere at any time without the need for the organization to install a virtual private network (VPN).

High Reliability-

Because cloud computing uses multiple redundant sites, it provides business continuity and disaster recovery.

CONCLUSION

Cloud ERP applications have been getting tremendous demand for companies battling the business challenges. It is a maturing deployment model that may provide a greater opportunity to capitalize on an ERP investment which encourages standardization through visible economic drivers and provides the opportunity for greater focus on strategic activities. Balance of enthusiasms for cloud ERP with realistic expectations is needed. The association of right people at the time the system is evolving is crucial.

In research terms, this study adds to the knowledge of ERP and cloud computing in general and contributes meaningful insights into cloud ERP benefits and barriers in particular. The results of this study confirmed that many previous findings about on-site ERP barriers, risks and success factors can still be valid and applicable to a cloud ERP context.

The study further extended these existing theories by establishing an empirical ontology, which contains a set of new benefits and barriers that are specifically related to cloud ERPs.

Finally, as introduced in this study cloud computing has two sides, one contains potentially great benefits, and other side contains many challenges providers must overcome to make this service more trustful, as well many risks customers must worry about before adoption this service. At this time vendors must try to overcome these challenges, and customers will face a trade-off between the benefits and risks of cloud computing. However, a wide believe of most of the vendors and buyers including that cloud computing - like any other technologies trends, abandoned at the beginning, but as time pass, it will become real, which is something has to do with the normal evolution.

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