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Cloud ERP: Implementation of Enterprise Resource Planning Using Cloud Computing Technology

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ABSTRACT

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.
KEYWORDS: Enterprise Resource Planning, ERP, Cloud Computing, Cloud ERP, Cloud Computing Security

1. INTRODUCTION

According to the Wikipedia definition, ERP includes a wide range of different activities that lead to improved performance of an organization and all data and processes of an organization are collected in a single system. The ERP causes great improvement in organization information systems on different aspects of organization works. This includes great optimization in Sale and Marketing, Finance and Accounting, Material and manufacturing planning management, Human Resources, Supply chain management, Customer Relationships Management (CRM) and etc. [1]

ERP systems are software tools to manage organization data. ERP provides information integrity by using Integrated databases. In1960, the existing software in organizations was only used for inventory control. [2]

MRP (Material Resource Planning) systems were introduced in 1970s, which focused on marketing and product manufacturing planning for production and inventory orders. In 1980, the quality and capacity planning was considered in MRPII systems. MRPII+ has provided products and services based on customer's demand.

In the late of 1990, the ERP system has been introduced. [2]

The ERP integrates data on suppliers, production, customers in supply chain and is created to integrate business processes of an organization to create whole integrated information which flows from suppliers in all production steps, distribution and to delivery of product to customers. [2]

1. Cloud Computing

Cloud Computing is a new computing method for delivering computing services. [3]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 [4] 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 [4] on virtual machines. Amazon S2 and IBM Cloud are examples of these services. It can be rapidly provisioned and released with minimal management effort [5] 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[4] , upfront commitment by Cloud users[4] , Pay

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for use of computer resources[4] , Portability of the application[6] , Information access from anywhere[6] , Guaranteed service level[7] , Special supporting [8] , and Security control improvement[8].
The application of this new technology reduces IT costs and increases business capabilities. In Figure 1, some aspects of this new technology are shown which cause to reduce the IT costs and optimization in business. [9]

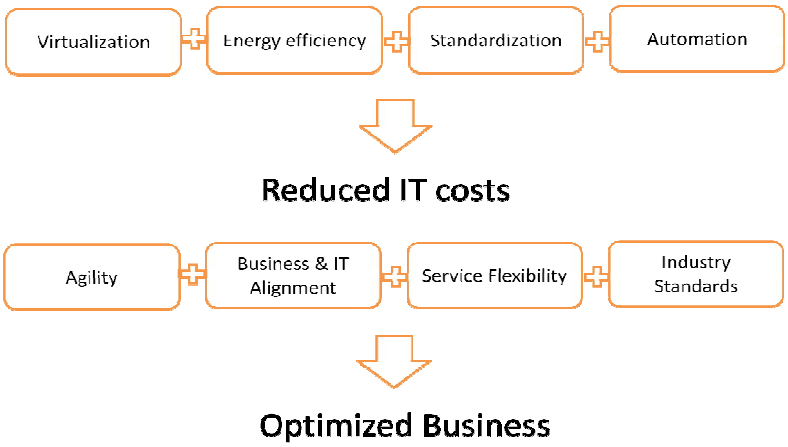

Figure 1[9]

Based on the accessibility in Cloud Computing environment forusers, this technology is divided into Public Cloud, Private Cloud and Hybrid Cloud. Public Cloud is a servicethat includes hardware, processing power and memory shares between different usersand 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 memoryusagethat 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 Cloudhardware 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.Sucha structure increasesthe 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. [8] It's hosted for single client[10], and privately owned and managed so it's access limited to client and its partner network[9]. Private Cloud is easilyalignedforsecurity, compliance and needs regulatory requirement and more Enterprise control over deployment [8]

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 [8] and centrally managed and provisioned as a single unit and circumscribed by a secure network [11].
Cloud services are provided in three services:

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

In Infrastructureas aService, 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 [6]. 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 [8]. 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.InIaaS, financial and functional flexibility were not found in internal data centers or with co-services. [12]

Platforms as a Serviceisconstructedfrom platform, depend on the integrating of operating systems, middleware, application software or an environmentdevelopmentwhich encapsulate service through an API manner.[10]The Microsoft Azure is an example of this service. Of course, such aserviceis based on virtual machines and provided by web browsers or client softwarewhich isprovided by Cloud providers using internet.

Software is a servicewhichis a complete application that is offered as a service on demand [10]. It's like that you rent [6] the software to the users, such software is accessed by both web browsers and Cloud client or front end.On the other hand, SaaSis hosted software [8] 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.

2. Cloud ERP

Cloud ERP is nothing more than hosted ERP on a Cloud provider.

By answering the flowing questions, we can find out why CloudERP is important for organizations, especially small and midsize organization that we call them SMEs.

- How we can improve organizations capabilities to use ERP?
- How we can improve ERP mobility and agility?

To answer these questions, first, we should find out what the cost of ERP implementation is, these costs include software, hardware, advisor, training, implementation and maintaining. The reduction of these costs depends on the reduction of organization's IT infrastructures costs. These infrastructures include software, hardware, storage, network and other infrastructures. We can outsource hardware's and software's. Outsourcing is a depositofcontrol, maintaining and providing IT infrastructures needs by some company outside of an organization. Some of its infrastructures are SoftwareincludingApplications, Management, ServicesandHardware includingComputingPower, Storage, Backup and Networks.

How can we outsource?

In the first way, thehardware and software are provided by companies outside of an organization and these companies do all works about maintaining and management.Organizations can access these services by using dedicated line provided by telecommunication companies or using VPN connection over the internet.Thesecond way is using services that are provided by Cloudproviders. CloudERP is nothing more than provided ERP by Cloud providers. In business world, we have two kinds of Cloud ERP, in the first one,ERPsoftwareis presented as a collection of software in theSaaSterm. These services are called ERP on SaaS, and because oflow investment cost in this service, SME's or small and midsize Enterprises that have financial problems can use the benefits of ERP on SaaS.On the other hand, we should consider the limits of this kind of services. In this kind of implementation, organizations are faced with limitation on business process re-engineering in organization and customization of ERP. It is highly recommended to do BPR (BusinessProcessRe-engineering) by using service providers experience and standards to ensure the organization process flow and ERP structure match.Besides, because providers have access to all organizational data, we are faced with security and privacy problems. Some of these problems include reputation fate sharing, access to information for some problems like sanction and disasters. Nevertheless we can ignore the highly recommended benefits of such service and further we recommend some parameters for organizations to help them choose what type of service they can choose depending on their limits and constraints. Among some companies that provide these services we can name SAP by design, PLEXONLINE, Sale force, Infor and NETSUITE.

In second implementation strategy ERPisimplemented on IaaS provided inside an organization or IaaS provided by Cloud service providers.In this situation, such service can be located geographically inside an organization or in place thatanimplementer or provider is hosted.In the first type (inside an organization) we have high security and availability but on the other hand, the organization is faced with high expense of implementation and maintenance. This type in situation that organization or Enterprise needs high security or have branches that need to connect and use organization IT infrastructure is effective.Inthe second type (hosted by a provider) or strategy, we accept security concern to decreasethe implementation costs. In both types, because of using IaaS,ERPlicense should be bought by the organization and implemented by implementers, so customization and flexibility will be increased.In most companies that provide this type of service, ERP also will be provided.

In Table 1 different aspects of traditionalERP and CloudERP have been compared, in Deployment[2 , 13] , traditional ERP will be implemented on Local Server, on the other hand,CloudERP will be implemented on Cloud Servers , this factor will affect data availability[8,14] , because all data will be stored and supported ina third party organization, using third parties of these services needs internet connection for access[13] , so web security[15], Privileged user access [16], espionage risks[15] and, privacy[14]issues will be added to CloudERP security problems. Cloud Computing and CloudERP servers and databases may be located in differentlocationsgeographically, so sanction and data location [8, 14, 16] are important factors in CloudERP implementation.Cloud Providers will provide all servers, databases and services that users needand because of these providers are serving more than a customer, so these will cause a reduction of server and IT staff costs [2].Business flow [13] in traditional ERP will be defined by ERP provider based on the organization's business specifics in using BPR techniques; on the other hand, it'll be defined by both ERP developer and business organization.

In traditional ERP, organizations need extra costs for servers, network, backup systems and other IT infrastructures, otherwise, for implementing such system in CloudERP, all this infrastructures will be provided by Cloud Providers and these providers , provide these services with lower cost than implementing these infrastructures inside an Enterprise. SowithCloud Computing technology, the implementation costs will be reduced.These services will be managed and supported by expert system manager inside theCloudproviders and you will pay per usage and not for hardware's failures, so traditional ERP has relatively high and CloudERP has low ongoing costs. [13]

Nevertheless because of the management of these services by Cloud provider, the control over ERP in CloudERP is relatively tough. The CloudERP providers support customization, integration and module updates so customers can customize their own ERP system and update module they need easily [13]. Customers need internet connections and web

browsers to connect to CloudERP and this is an extra costs.The importance and performance of Cloud ERP can be shown by factors in Table 1.

3. RESULTS AND DISCUSSION

Other researches about Cloud Computing and it's usage in ERP implementation, only focused on advantage of Cloud Computing.In [10] some advantage of Cloud Computing is discussed. In [13] different aspect of traditional ERP and Cloud ERP is compared. In [7] different implementation method of ERP system on Cloud Computing is focused. But in none of them disadvantage and barriers of Cloud Computing that will be affect this new technology is discussed.

On contrast Cloud Computing has security & privacy issues that limits its application so our suggestion is focused on using advantage of Cloud Computing while with consideration it's problem and suggest a new way for enterprises and company to choose this new technology.

Cloud Computing has lots of problems in security, because this technology is new and we can see that lots of problems will be appeared in feature. Data availability or business continuity [8, 14] is one of the most important problems in Cloud Computing environment. In table 2, we mentioned some problems and compared these problems between traditional ERP and Cloud ERP.

Factor	TraditionalERP	CloudERP
Deployment	Local Server	Cloud Server
Reduced server costs	Low costs	High costs
Reduction in IT staff	None	High
Defining business flow	Defined by ERP developer and business organization specific.	Define by both, ERP developer and Business organization.
Implementation costs	High	Low
Ongoing costs	Relatively high	Low
Control over ERP	Easily controllable	Relatively tough to control.
Customization	Not open for business organization	Open for business organization
Support costs	Relatively high	Low
Integration	Dependent on vendor	Can be supported centrally
Licensing costs	High	Low
ERP module update	Costly	Low cost
Internet needed	No	Yes
Version controlling	Complex	Easy

Table 1: Traditional ERP and Cloud ERP Comparison

Some other obstacles that organization should be faced by implementing Cloud ERP are including the connection costs for both network and internet and the lack of appropriate security structure for Cloud Computing.

On the other hand, SME's or small and medium size organizations have limitations in the amount of investigation in ERP, so they can move to use Cloud ERP. Other factors are about the security issues in organizations. The organization that has critical information cannot use all Cloud ERP benefits. Based on the advantage of Cloud ERP, the size of organization and the importance of information security, organizations can choose between each of this implementation based on diagrams 1 and 2.

Risk Factor	Traditional ERP	CloudERP
Data Availability (Business continuity)	Low	High
Data confidentiality	Low	High
Attacks targeting shared –tenancy environment	Low	High
Web security issues	Low	High
Espionage Risks	Low	High
Privacy	Low	High
Privileged user access	Low	High
Data locations and sanctions	Low	High
Recovery	High	Low
Long term viability	High	Low
Unknown risk profile	Low	High

Table 2

These diagrams are based on this fact that based on security rate, investigation amount and organization size, we can use each of these three models.

TraditionalERP that is mentioned before can be used when an enterprise has sensitive and important data that are needed for business continuity or big size Enterprises that can undertake extra costs for ERP implementation. On the other hand, small or medium size Enterprises (SME's) that cannot undertake high investigation can use two other CloudERPimplementations.ERP on private IaaS can be used by SME's with limited investigation amount or security issuesand because of ERP as SaaS is nothing more than ERP software provided in Cloud that is hosted by Cloud providers so it will be so cost effective but will lower security.

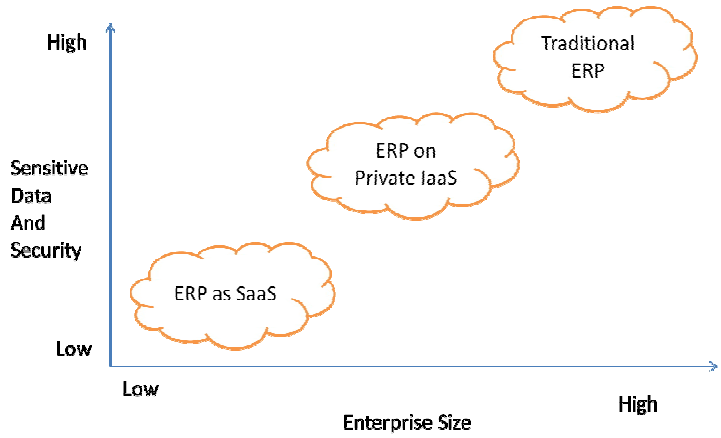

Diagram 1

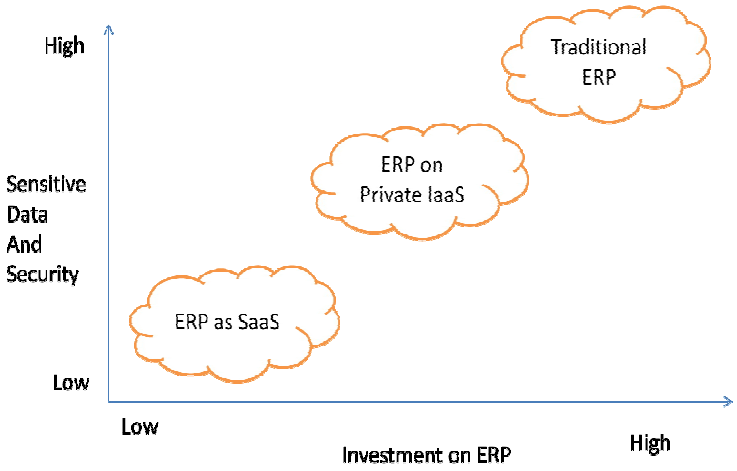

Diagram 2

4. Future work

In future, we will work on the implementation of this new technology on Iranians SME's and tries to answer the following questions:

How can we use Cloud ERP in Iran?
What are CloudERP implementation factors in Iran?
How sanction can affect the implementation of Cloud ERP?
How can we use national Cloud providers for implementation?
By answering these questions, we will try to propose a new model for implementing Cloud ERP in IRAN.

5. Conclusion

Information Technology is affected in different aspects by CloudComputing; one of theseaspects is EnterpriseResource Planning (ERP).

ERP, including a wide range of different activities,leads to improve performance of an organization and all data and processes of organization are collected in a single CloudERP is nothing more than ERPsoftware that had been implemented on Cloud.

This new technology has some advantages and security problemsthat affect the organization decision to implement Cloud ERP.

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