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An Analysis upon Various Conceptual Models for Implementation of Cloud Based ERP System in Small and Medium Enterprises

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Abstract – The Small and Medium Enterprise industry is experiencing a major transformation towards cloud ERP systems. These systems can organize, and maintain data remotely, accept a pay-as-you- use method and enhance related information through a cloud computing platform. Hence, this makes the cloud ERP system crucial for their sustainability and enables them to become competitive in the market. However, the adoption rate of cloud ERP among Small and Medium Enterprises (SMEs) has been recorded as slightly low compared to other enterprise systems like Customer Relationship Management. This could be attributed to unclear adoption factors among SMEs and the lack of a theoretical model that can enhance the predictive power to adopt a cloud ERP system.

Present Enterprise Resource Planning (ERP) offers expensive models which are hard to implement in Small and Medium Enterprises (SME) due to budget limitations. Moreover, current ERP systems are associated with several issues such as mutual synchronization of multi-typed resources, limited customization, bulky upgrading cost, solution integration, industry functionality, backup hedge and technology updates. These issues render ERP systems implementation painful, complex and time consuming and generate the necessity of a massive change in ERP framework to enhance ERP systems infrastructure and functionality. Cloud Computing (CC) platforms possess the ability to overcome ERP systems discrepancies with cost-effective, customized and highly available computing resources. The goal of this research is to merge ERP and CC benefits together to reduce the factor of expenditure cost and implementation delays through a proposed framework. For this purpose, we firstly analyze the prominent issues in current ERP systems through a comprehensive comparison between ERP before and after moving to CC environment. Secondly, we propose a generic framework for "Cloud-based ERP systems" in favor of SME. The proposed framework follows multi-instance based cloud infrastructure that initiates different ERP instances for different industries.

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INTRODUCTION

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

Organizations utilize ERP systems to integrate heterogeneous organizational systems and facilitate seamless business transactions across inter- or cross-organizational boundaries. Traditionally, the development of ERP systems involves maintaining a set of hardware and network configurations, typically using a database as an information repository. However, as ERP systems are becoming an integral

component of organizational infrastructure, the complexity of these sophisticated and large-scale business applications grows rapidly. As a consequence, ERP systems are very costly to maintain. Organizations are constantly challenged to balance between sustaining competitiveness via high utilization of ERP systems and minimizing the cost of ERP systems. The emergence of cloud computing is considered to be a potential solution to this dilemma (Dutta et al. 2013).

Cloud computing represents a state-of-the-art technology that delivers IT resources via the Internet. Organizations retrieves services from a pool of virtualized IT resources, allowing for an on-demand, pay-per-use billing model. The growth rate of the market for cloud computing is forecasted to be high in the near future. The market of public cloud services is predicted to grow from US$26 billion in 2012 to US$160 billion in 2020 (Choudhary and Vithayathil 2013).

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

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

Enterprise Resource Planning (ERP) systems are the ultimate aspiration of the business community as they provide collaboration with partners, external applications and information systems. However, ERP solutions have many issues and challenges such as massive upgrading cost, integration among different components, fair utilization of resources, visibility, management change, financial performance tracking, bidding and quoting etc. Due to these problems, a radical change is required within ERP framework to enhance ERP infrastructural and functionality.

Recent trends in ERP invoke that business functions and components should be service-enabled. Since ERP applications are heterogeneous in nature, they are hard to monitor in execution phase. The employment of Service Oriented Architecture (SOA) is able to escape this discrepancy as it provides smooth continuous integration between applications, protocols and platforms. Moreover, the implementation of ERP through SOA approach provides third party support in management activities, planning, and provision of application services through virtual suppliers.

SOA can be best implemented in a Cloud Computing (CC) environments. CC is the best suited option to overcome ERP systems discrepancies. Clouds can be classified into public, private, community and hybrid clouds. In public clouds, the infrastructure and other cloud services are made available to the general public over the Internet. The cloud is owned and managed by a Cloud Service Provider (CSP) who offers services to consumers on a pay-per-use basis. Private cloud's infrastructure is owned and used by a single organization. It can be managed by the organization itself or by a third party internally or externally. In community cloud, infrastructure is shared between many organizations with common concerns such as security, policy, mission, and compliance. These clouds are managed and hosted internally or externally through a third party. Hybrid cloud is a combination of two or more cloud infrastructures that remain unique entities, but are bounded together to provide advantages of multiple cloud structure.

CC offers several services such as Infrastructure-as-a-Services (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS). SaaS provides complete applications on CC environment. With PaaS, customers can develop, test, host, deploy and maintain their applications in the same integrated environment. With IaaS, customers use cloud infrastructure according to their demands for particular time and pay only for what they use. CC environments offer many interesting characteristics that make them promising for future IT applications and services. Among these characteristics are: On-demand self-service, broad network access, resource pooling, rapid elasticity, measured services, multitenancy, scalability, economies of scale, cost effectiveness, customization, efficient resource utilization, maintainability, collaboration, virtualization, green technology, and high performance.

Cloud-based ERP systems facilitate extra ordinary benefits with valuable cost reduction by reducing the need for IT support team, technical IT labors, requirements gathering and project management efforts. The core motivation of this work is to gain the cost effectiveness of cloud architecture with optimal implementations of industry functionality and solution integration challenges. Many SME are willing to

increase their computing resources, but they lack this advancement due to expensive solutions. CC with its on demand, pay-per-use infrastructure facilitates promising cost effective solutions to these SME. Enterprises always look forward to scale up and upgrade their masses, therefore, CC with its scalable, high performance resource pooling offers them a blessing approach to smoothly scale up and upgrade.

This research aims at proposing an ERP framework based on SaaS concepts to multitude different applications. The charm of an ERP is to interoperate applications from different domains; therefore, the same is needed to be implemented using a SaaS concept. The most prominent motive of this research is to minimize the cost of infrastructure and hardware resources through a framework that tackles industry functionality and solution integration challenges. The proposed framework is especially designed to overcome current ERP issues through the employment of ERP within the CC environment. The solution against industry functionality and solution integration with affordable cost requires the public cloud to have different ERP instances for each industry. Any SME can confidently implement our proposed framework to overcome these issues. While the utilization of the proposed framework is a good deal for cost reduction, some CC issues that cannot be neglected such as security have to be addressed before the initiation and implementation of our proposed cloud-based ERP framework.

Cloud based ERP is one of the advanced paradigm in Information and Communications Technology (ICT). It is a blend of technology and business process. 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. Now a days, organizations
have three ERP deployment strategies: on-premise, hosting and on-demand (SaaS). The different tools available under the cloud computing provides the lowest cost working environment and is suitable for the developing economy. The huge amount of research is going on to integrate the ERP with cloud. In the present scenario many organizations today are turning to the cloud based ERP systems in their business. There are many reasons of choosing the cloud
based ERP. Some of these reasons are:

- Becoming more complex, and challenging to manage the ERP.
- Not to buy the servers, in-house software development and not to hire the skilled IT professionals.
- Top management doesn't want to spend it on traditional ERP system.
- Organizations have complex ERP system need something easier and more economical.

Cloud based ERP systems are the hardware and software systems that support the core processes in the business process. Cloud services have been recently the ultimate solution for companies seeking to achieve both efficiency and cost cutting. The pool of Cloud Service Providers (CSP) largely available globally. Now. it becomes a challenge for the SMEs to select a suitable CSP that meet the requirements of the organizations. Building high Quality cloud applications becomes an immediately required research problem in cloud computing technology. Non-functional performance of cloud services is generally described by Qualitv-of-Service (QoS). To acquire QoS values, real-
world usage of service are generally required. At this time, there is no framework that can allow' users to estimate cloud services and rank them based on their QoS values. The aim of the present paper it to build a framework and a mechanism that measures the quality and ranks cloud services for the users.

CLOUD ERP

One of the main advantages of cloud ERP is the low cost of entry. Businesses don't have to purchase expensive equipment or make sure that they have sufficient infrastructure to handle the system. They simply download a software application onto your computers and allow a hosting company to provide the service. Cloud ERP also has very low IT support requirements. The physical hardware is kept at the hosting company, so businesses don't have to worry about testing the system on a regular basis and making sure that all of the equipment is in working order.

The ERP hosting company performs this service for its customers. On the negative side, on-demand ERP may not necessarily integrate with legacy systems. This can be a significant problem if your office uses a lot of old computers. If businesses have obtained a dedicated cloud service then you should be all right, but a shared system probably won't have that capability.

Another drawback about on-demand ERP is that it is fully reliant on the internet to function. If your wireless router should malfunction or internet provider be unable to offer service for some reason, you will lose access to all of your ERP data until the system is restored.

Many organizations today are turning to the cloud ERP systems in increasing numbers. There are

many reasons why they are choosing the cloud. These are the reasons we hear

- Do not want to buy the servers and hire the IT resources.
- Becoming more complex, and challenging to manage.
- Organizations have complex ERP system need something easier and more economical.
- Top management doesn't want to spend it on an ERP system.

Above reasons might lead organization adopt cloud ERP, some other reasons keep them away from ERP. Some problems have need to notice for adopt cloud ERP.

CLOUD BASED ERP SERVICES FOR SMALL AND MEDIUM ENTERPRISES

The principles of cloud ERP is originated from the term cloud computing. To explain what cloud ERP means, it will be compulsory to first classify cloud computing and its significance.

Cloud computing are based on the computer terminology Cloud which is seen to be several computers (thin & thick client) and servers connected through World Wide Web (WWW) or internet. Computers can be personal computers (PDAs, Mobile Devices) or network servers; they can be public, private or hybrid.

The term cloud computing means access remotely to computing services offered by third parties (vendor of offering cloud based services).the term Cloud computing was evolved due to the revolution of internet. Researcher published that cloud computing gets its name as a symbol for the internet (as World Wide Web is life line for cloud services).

Cloud has been used traditionally as a synonym for the internet based services. Most of scholar & researchers agree that cloud based services has three layers. A group of researchers explained these three layers as three inter-related stacks:

SaaS web services and business applications (apps) are designed for end-users, delivered over the www or internet PaaS is the set of web services and tools structured to make coding and deploying those services and applications rapid and proficiently IaaS is the Information Technology Infrastructure (hardware and software part) that empowers the organization to outsource these non core activities related to IT Infrastructures e.g. operating systems, storage, routers, distribution systems, servers and networks to third party. Now, Organization can be focused in to core business processes.

CaaS – It is another flavor of cloud which facilitate the organization by outsourcing all the communication need of particular business activities.

There are many advantages if we look cloud ERP as a software project. Group of researcher believed in these advantages when they recommend applying cloud computing to project management.

These advantages consist of faster ERP implementations, minimal operating costs with superior flexibility, scalability, profitability, malleability and consistency to the organization´s business and dependent activities.

Cloud services are a type of web applications or software; it provides solutions that can be accessible at any time, in any location with no physical boundaries in the world and by any person with accessing rights.

Now we can acknowledge that cloud services will change the way of working patters of different ERP users around the globe, they will not be limited by working location or time as long as they are connected to web.

Quality is a multidimensional word which uses to measure the satisfying level of consumers/clients. In relation with enterprise services if a package of cloud services improves return on investment (ROI) then the package is having higher quality as compared previous product. So it means it is a qualitative term for judging any services or products.

So, to facilitate the service companies and manufacturing firms standards of quality are set in the form of Quality certificate. This is an effort by intellectual communities for measuring quality in quantitative manner. Outcome of these efforts are certificate like six sigma, CMMI, ISO certification etc. Two famous Quality Standards are: Capability maturity Model Integration (CMMI) for software industry Six Sigma for Manufacturing Industry When strategy is designed by lead firm to outsource IT services from vendors then alignment of business process quality is measured and equate with vendor's quality of service (QoS).

In current competitive business scenario every successful organization wants to achieve quality in their products and services. Better quality products can be success formula for any existing or new business. To achieve this, organization use to outsource their non-core activities from third party and some time it become reason for collapsing the whole organization. If outsourced business processes

are not compliance with quality standard then how they will give better result to lead firm. So there should be matching of quality standard in both the partner. As example a six sigma compliance manufacturing firm can procure services from Level-5 compliance IT vendor.

METHODOLOGY

Complex and expensive implementation, solutions integration, industry functionality, customization cost, backup hedge and technology updates are the prominent issues with ERP implementation. ERP offers a limited customization, therefore, large modifications are not feasible due to cost and time issues. This situation demanded the need to dynamic business logic to handle integration among applications, module and data. Industry functionality or functional requirements mostly varies from one organization to another, therefore, several required functionalities need customization that results in expensive and time consuming implementations. Due to these issues, ERP packages are considered too complex and their implementation becomes painful. In contrast to ERP systems, the cloud technology offers several benefits such as no daily backups, cost reduction, no hedge of technology updates and high processing power. However, cloud solutions for ERP are limited to public clouds and are in early development stages yet as compared to established ERP suites that have been evolving from last decade. Medium and small size organizations always have budget limitations; therefore, traditional ERP option is not feasible for them. In this situation moving ERP to the cloud environment is a good deal with cost reduction, optimal industry functionality, and effective solution integration. This research discusses all positive and feeble characteristics associated with Cloud-based ERP systems through a comprehensive comparison of ERP before and after migration to cloud computing environment. The purpose of this comparison is to show how the idea of ERP is significant whiling running ERP on cloud platform as compared to an individual ERP package. Another objective is to propose a generic framework for Cloud-based ERP in favor of SME community. The third objective of this work is to test the feasibility and efficiency of the proposed framework through a case study of Awal IT Service Company in order to overcome prominent issues such as industry functionality and solution integration with affordable cost.

To fulfill the first objective, previous work in ERP is analyzed and issues are identified. Cloud based ERP is investigated in the light of cloud characteristics. A comparison between the two technologies is made in tabular format to illustrate the benefits and the cost of Cloud-based ERP and to decide when migration is beneficent. To achieve the second goal, an elegant framework is proposed in order to handle industry functionality and solution integration challenges. Multiinstance-based cloud infrastructure is suggested to initiate different ERP instances for different industries. Common applications such as accounts, CRM modules, MIS systems, Invoice, HRM systems, CMS etc. will be operated under SaaS to deliver their models. Almost all enterprise application companies will add SaaS as their major stratagem. Finally, for the third objective, we study the current discrepancies, challenges and future needs of "Awal IT Services" Company. More than one visit has been conducted to observe their working environment through unplanned interview sessions with the relevant company employees. The company infrastructure, services, remote connectivity, budget, client's feedbacks are studied from the company documentations to predict current issues and challenges associate with the company. Our framework is examined against these challenges.

ANALYSIS –

The first objective of this research is to conduct a comprehensive comparison between ERP systems before and after moving on to Cloud. For this purpose, a variety of technical and research studies are reviewed to point out the prominent issues that can be solved by moving ERP onto CC environment. Our goal is to conclude how much the idea of moving ERP onto Cloud is significant? What are the benefits of shifting ERP onto Cloud and what are the discrepancies associates with ERP while running on the CC environment? This comparison is shown in Table 1

ERP Characteristics	Before Moving to Clouds	After Moving to Clouds
Need for Technical IT Support for Fail over environments	✓	X
Need for ERP Development Team	✓	X
Need for extra hardware and software Resources and licenses	✓	X
Need to configure latest technology updates	✓	X
Need to arrange own extra power and cooling	✓	X
Lack of computation and accuracy Trust	X	✓
Lack of confidentiality	X	✓
Lack of trust on security policies and access control rules	X	✓
Daily Storage and Backup burden	✓	X
Huge cost	✓	X
High speed Internet connection	X	✓
Subscription and registration charges	X	✓
Need for requirement gathering and Elicitation	✓	X
Need for Project Management	✓	X
Need for Coding	✓	X
Need for Testing	✓	X
Need for Deployments	✓	X
More Loss of control of any application or resources risks	X	✓
Conflicts between opposing goals of different clients , either play it together if not need to separate them	X	✓
Higher risks of Resource availability and failure	X	✓
Lack of trust in data alteration before storing	X	✓
Denial of Service attack in critical server health situations	X	✓
Higher risks of Stress, load and congestion	X	✓
Difficult to audit	X	✓
Monitoring of client logs and information by third party	X	✓

Table 1: Comparison of ERP systems before and after moving on to Cloud.

As Table 1 shows, Cloud appears to be a promising future environment for ERP systems and it offers several benefits. According to the Table 1, hiring new development and technical support teams is a quite budget consuming process. On the other hand, the subscription charges of getting services from cloud are too low as compared to the charges of hiring new teams. Similarly, the cost of hardware arrangement, extra power, cooling, and accommodation can be significantly reduced after moving ERP onto Cloud. Furthermore, new technology updates and daily backup management burden are omitted after moving ERP onto cloud environment. According to our analysis, the share of cost (budget) reduction after moving ERP onto cloud is 50% and the reduction of daily backup burden is about 15%. These shares cannot be neglected in any case and clearly invokes the justification of shifting ERP onto CC environment.

CONCLUSION

Cloud computing technologies may seem like a relatively new concept because of the rapid-fire adoption of late, but they are actually an improvement on existing concepts that have been present in business for some time. ERP is among the more logical choices to maintain in a hosted environment because of the added levels of control and security that business will be able to implement.

Is the cloud ERP right for any organization? There is no one-size-fits-all scenario. To answer it, some factors should be evaluated. They are resource availability, functional requirements, IT infrastructure, data security, Internet connection, and the total cost. If companies require deep functionality, have specialized requirements that require customization need to maintain complete control of the software, don't have a reliable and fast Internet connection, or have a strong IT infrastructure and support, then on-premises ERP are most likely to be the best fit.

This review paper presented an overview of the research papers associated with the study to explore a list of factors that lead to cloud ERP adoption, and discusses the preliminary findings of research attempting to identify the best CSP among the pool of CSPs available globally. In this context, this work presents the systematically compare the performance and cost of cloud providers along with other dimensions that matter to customers. The findings show that most of the primary studies have focused on IaaS, and different frameworks have been developed based on different mathematical techniques .The focus of majority of the past studies has been on objective cost performance analysis and benchmark testing while the subjective assessment of the actual cloud users haven't been given adequate attention. The results also show that currently, there are no unified or defined metrics/evaluation criteria for comparing cloud service providers. In conclusion, current research in the area of service selection in cloud computing has concentrated on mainly the quantitative criteria in their evaluation and selection process wliile the qualitative criteria are yet to be adequately considered.

In this paper, we investigated the issue of how CC technology can be employed in ERP systems in favor of SME which have limited budget. We have conducted a comparative analysis for ERP before and after moving to CC environment and proposed a framework for Cloud-based ERP.

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