Continuing On-Premise or Adopt On-Demand?
An Empirical Study of ERP Adoption in SMEs

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Abstract. Vendors are now expanding into the small to mid-size organizational markets with simplified, less-risk, less-reward systems However, SMEs, who adopted ERP on-premise solutions before, are now facing a dilemma: continuing with ERP on-premise upgrades or switch to on-demand solutions. This study surveyed Chief Information Officers of SMEs with respect to indicators of ERP adoptions. Cost, reduced demand for own IT resources, outage/accessibility and performance were found to be the most critical and important factors to assess ERP adoptions for SMEs.

Keywords: ERP, Cloud Computing, Adoption, Upgrade, on-demand.

1 Introduction

ERP solutions have evolved from reorder point and materials management focused systems (ROP and MRP) based on mainframes   to responsive and integrated resource planning systems based on client-server architectures and web platforms. Through data standardization and process integration, ERP systems have the potential to facilitate communications and co-ordination, enable the centralization of administrative activities, reduce IS maintenance costs and increase the ability to deploy new IS functionality [11]. ERP systems are adopted for strategic, technical, and operational reasons including: providing an integrated enterprise-wide application with real-time data access available across the entire organization, simplifying and standardizing systems and business processes, and replacing legacy systems. When they are well implemented, ERP systems are able to bring operational, managerial, strategic, information technology (IT) infrastructure and operational benefits to their customers [25]. The motivations which have become more dominant include pressure to keep up with competitors on a global scale, mergers and acquisitions and the need for restructuring, and combining and integrating business processes. ERP systems have spread rapidly among organizations. According to Gartner [10], worldwide spending on enterprise application software will total $120.4 billion in 2012, with ERP the largest application software market expected to reach $24.9 billion.

The fast changes in technologies during the last decade dramatically altered the nature of the demand requiring more reliable services, rapid customization and on time delivery of goods and services, forcing many small and medium-sized enterprises (SMEs) to adjust their business strategies and to adopt a better technology to increase

the productivity of business processes. For SMEs, the advantages gained by adopting ERP systems are obvious. Gattiker and Goodhue [11] describe the ERP benefits in following aspects: (1) improving the integration of information flow between sub-units; (2) centralizing the administrative activities, such as accounts payable and payroll; (3) reducing costs of system maintenance; (4) increasing the ability to deploy new IS functionality; (5) enabling transformation from inefficient business processes to accepted best practices. With these insights, an ERP system seems to be one logical alternative to be pursued by SMEs [21]. And with the majority of large companies having already implemented ERP systems, today ERP vendors, such as SAP and Oracle, are shifting their focus towards SMEs with scaled-down (and less expensive) versions of ERP solutions.   Other important reasons have encouraged the interest of ERP vendors towards SMEs. These include the need for SMEs to be integrated into the supply chain at risk of becoming less competitive, the large market represented by the number of SMEs (90 percent of all businesses in the USA are SMEs, Sledgia-nowski et al. [26]) compared to the number of large enterprises, and the advancement in technologies with corresponding decrease in hardware costs.   Another factor in support of ERP systems is that often information visibility is an important aspect in supply chain performance and the lack of an adequate technology will debilitate the SME's ability to adapt to changes imposed by customers or suppliers with unfavorable impact in its competitiveness. However, the use of commodity software, such as ERP systems, may force a more rigid structure on a SME and thus weaken its flexibility and agility to adapt as a competitive advantage.   Therefore, it is critical to SMEs to investigate their performance after the implementation of ERP systems.

In recent years, after many SMEs adopted various ERP packages from different ERP vendors, a new technology model, called Cloud Computing, became possible for sourcing ERP systems with the potential to have a significant impact for SMEs' competitiveness. Cloud computing is an emerging business and technology concept to support an on-demand delivery of computing, storage and applications over the Internet. A recent IDC report shows global revenue in cloud software market reaching $22.9 billion and it will grow to $67.3 billion in 2016 [18]. This projection includes revenue generated by the shift from on-premise to on-demand providers as well as by the planning and architecture behind the shift.

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of applications and resources and may be offered in one of the following service models [4, 16, 17, 28, & 29]:

- Software as a service (SaaS):   providing software subscription services
- Storage as a service: providing remote storage resource services
- Database as a service: providing remotely hosted database services
- Information as a service: providing remotely hosted information services
- Process as a service: providing business processes based on remote resources
- Testing as a service: providing testing services for local or remote systems
- Platform as a service (PaaS): providing a complete platform to support application development, interface development, database development, storage, information and testing
- Infrastructure as a service (IaaS): providing a service to access computing resources remotely

- Security as a service: providing core security services remotely over the Internet
- Integration as a service: providing a complete integration stack service

Specifically for ERP systems, Beaubouef [2] indicated that are three cloud models for adoption:

- Software as a service (SaaS): a subscription model for small customers who share hardware.
- Hosted ERP: a typical solution for large customers who have separate hardware and instances.
- Hybrid ERP: a combination solution that maintains on-premise software as well as integrated a degree of on-demand services.

As high-speed internet has become more accessible to businesses, cloud models have helped businesses with limited IT resources take advantage of technology to improve business processes. Typically, a firm would rent licenses or access the software from an application service provider (ASP) that actually runs on servers or devices owned and maintained by the ASP. These large datacenter facilities with redundant layers of power and data security are often too expensive for SMEs to have under the on-premise model. Also, the ASP is generally responsible for maintaining and updating the software, and often includes some level of support for users in the monthly fee. This model has certain benefits for SMEs that can attenuate some of the problems associated with maintaining purchased software in-house. For example, SaaS allows ASP to maintain their offerings consistently by automating testing, monitoring, maintenance and upgrades without sending out constant updates that need to be applied by end users. Also, SaaS allows smaller firms with limited (or no) IT staff to benefit from the economies of scale and efficiencies implemented by the ASP. Equally important, SaaS allows companies to pay to use the software they need, without making a huge investment in IT infrastructure for servers, software, etc., by "renting" access to what they need and paying monthly, quarterly or annually.

Additionally, according to Gartner's report [1], more and more companies are considering on-demand services in different applications (Figure 1).
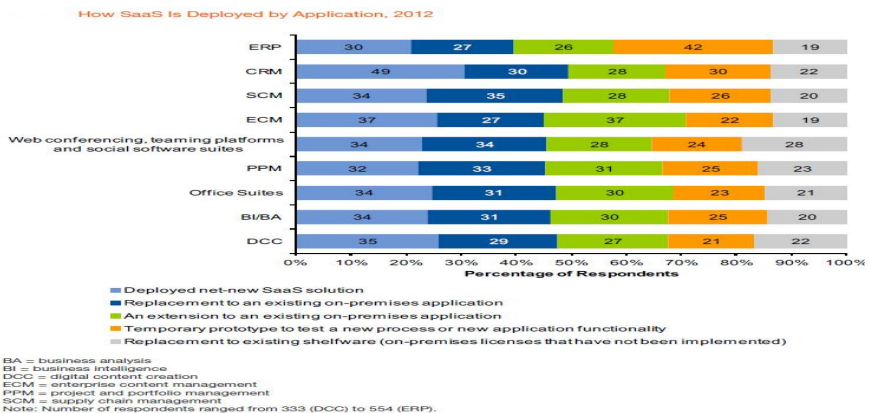

Fig. 1. How SaaS Is Developed by Application

Consequently, SMEs with existing ERP on-premise packages will be facing a new challenge when a new version of the on-premise ERP is released or when they require a substantial IT infrastructure investment. The question for management is whether it will decide in favor of the ERP upgrade or switch to an on-demand ERP. To date, there is no empirical research that has been done to evaluate and compare the two options for SMEs. Therefore, the purpose of this study is to investigate the on-premise and on-demand options for SMEs sourcing ERP solutions and summarize the key factors influencing decision making of the ERP future solutions among CIOs and IT managers.

2   Theoretical Background

The primary purpose of ERP upgrades is to take advantages of new technologies and business strategies to ensure that the organization keeps up with the latest business development trends. Therefore, the decision to upgrade ERP is usually not driven by code deterioration or anticipated reduction in maintenance costs alone. According to an AMR research [27], 55% of upgrades were voluntary business improvements triggered by the need for new functionality, expansion or consolidation of systems; 24% of upgrades were triggered by technology stack changes; 15% of upgrades were forced by de-support of the running version of software to avoid vendor support termination [7]; and 6% of upgrades were triggered by bug fixes or statutory changes. The cost of ERP upgrades is high [20]. Swanton [27] mentioned that the cost of each upgrade includes: 50% of the original software license fee and 20% of the original implementation cost per user, which means over $6 million dollars for a 5,000-user system. Typically, each ERP upgrade requires eight to nine months of effort with a team the equivalent of one full-time employee per 35 business users. The ERP-adopting organization does not have to develop and re-write the ERP system itself but rather it replaces (or upgrades) the old version with a readily available new version from the ERP vendor. However, a lack of experience may cause the costs and length of the upgrade project to approach or even exceed those of the original ERP implementation effort. Every three years, a major ERP upgrade and several small upgrades are typically needed to keep the system running smoothly. Organizations will spend a significant amount of money on each ERP upgrade project, which may place the system out of reach (or postponed) for many SMEs with limited financial resources and shortage of skilled personnel.

However, cloud computing supports an on-demand delivery of ERP over the Internet with competitive implications for SMEs. Typically, ERP functions will be served out of the cloud, and the license fees and/or maintenance fees will be charged based on the use of the software, such as number of users and ERP functions/modules. Companies will no long need to purchase the software and to keep IT staff, which will make the initial investigation of EPR less expensive. This means SMEs now can access the same technology until recently only available to larger firms, and provide the same or superior level of services than larger competitors with the on-premise

ERP classic model. According to Gheorghe and Lupasc [12], cloud ERP solution will save about 30% project time after analyzing the critical path of both classic and cloud ERP solutions. Table 1 summarizes the benefits derived from cloud computing ERP systems.

Table 1. Benefits of On-demand ERP solutions

Benefits of on-demand ERP	Reference
Short implementation cycles	[12]; [13];
Low entry costs	[19]; [13]; [3]
Reduced demand for own IT resources	[13]; [3]
Elasticity/Flexibility of services	[19]; [13]; [23]
Scalability	[19]; [10]
Focus on core business	[13]

However, there are also several challenging issues for the   adopters of on-demand ERP, and cost is always an important one. Although companies can adopt on-demand ERP solutions at a much lower initial cost and lower total cost of ownership comparing with the traditional ERP solutions, the on-going monthly or annual payment will result in a higher budget cost because of the subscription payment method [22]. Therefore, the subscription method is of critical importance for this technology model to be sucessfuly adopted and widely accepted by SMEs. Table 2 summarizes the challenging issues derived from cloud computing ERP systems. As more companies who adopted on-premise ERP solutions are considering on-demand solutions, a research study is needed to give guidelines to SMEs when they are faced with this dilemma.

Table 2. Challenging Issues of On-demand ERP solutions

Challenging Issues of on-demand ERP	Reference
Outage/Accessibility	[15]; [22]
Security	[15]
Performance	[15]
Integration	[15]; [22]
Cost	[15]; [22]
Control of the system	[22]
Flexibility of customization	[22]

This study seeks to provide a comprehensive understanding of two ERP solutions: on-premise and on-demand, collecting CIOs' perspectives in different SMEs according to their experiences from their organizations' adoptions of ERP solutions.

3   Research Methodology

The survey questionnaire was sent to CIO/IT managers in 272 SMEs, who are currently using on-premise ERP solutions. Company size is measured by the number of employees [6]. The objective is to conduct an analysis to confirm the underlying structure of the factors involved in the on-demand and on-premise ERP adoption decisions.   In this study, an SME is one with fewer than 500 employees.   A total 63 survey responses were obtained after removing 7 incomplete questionnaires. The distribution of the respondents was as follows: gender (male: 76%, female: 24%), current EPR systems in use come from many vendors, such as SAP, Microsoft, Syspro, NetSuite, etc. The number of employees range from 36 to 483 (64% small companies and 36% mid-size companies). A wide variety of industries were represented in the responses (shown in Table 3).

Table 3. Industry Summary

Industry Sector	Number of companies
Manufacturing	18
Information technology	19
Retail	5
Health Services	16
Insurance	5
Total	**63**

To substantiate our measurement model for the factors identified from the literature (Tables 1 and 2), content validity was evaluated by a group of experts. Six experts from two universities and four organizations were asked to read the survey and decide whether in their opinion it measured what its name suggested. The survey questionnaires were improved according to comments from the experts. The final survey was returned to the experts and approved by all.   The coefficient alpha [8] to measure the internal consistency reliability of the survey instrument ranged from 0.73 to 0.85, indicating good reliability according to the acceptable level (0.7) suggested by Bryman [5]. An item-to-total correlation was conducted to evaluate the convergent validity. The literature suggests that a measurement variable may be considered for removal if the item-to-total correlation is less than 0.4. One question was removed because the item-to-total correlation was lower than 0.4.   Construct validity is one of the most significant scientific advances of modern measurement theory and practice [14]. It measures how well the instrument measures the concept of interest.   Confirmatory factor analysis (CFA) was conducted to examine construct validity. All but one construct that emerged from the factor analysis showed high construct validity. The overall results of the analysis confirmed the factors in the ERP adoption solutions presented in the literature.   Additionally, the survey asked the respondents to rank the factors in order of importance.   The results are explained in the next section.

4   Results and Discussion

Survey results focused on factors involved at ERP adoptions between on-premise and on-demand solutions. For each factor, a brief description and a 5-level rating scale ranging from extremely critical and important in ERP adoption evaluation to neither critical nor important in ERP adoption selections was provided. The numerical anchors for the 5-level rating scale are indicated in Table 4.

Table 4. Survey Averages by Factor

FACTOR	AVERAGE (1 – 5 scale)
Cost	4.93
Reduced demand for own IT resources	4.51
Outage/Accessibility	4.46
Performance	4.07
Control of the system	3.85
Elasticity/Flexibility of services	3.78
Short implementation cycles	3.49
Security	3.24
Scalability	3.03
Integration	2.70
Flexibility of customization	2.46
Focus on core business	2.23

According to the average rating in Table 4, the results indicate that there are top four factors, which is extremely critical and important in ERP adoptions for SMEs, identified by CIOs facing to the options of on-premise or on-demand solutions: cost, reduced demand for own IT resources, outage/accessibility and performance. The second group, which is critical and important, includes five factors: control of the system, elasticity/flexibility of services, short implementation cycles, security and scalability. The rest of the factors, integration, flexibility of customization, and focus on core business, receive low rating from CIOs.

There are several important results summarized from data. First, besides the three factors (cost, reduced demand for own IT resources, and performance) that are commonly regarded as critical success factors in ERP selection,   outage/accessibility is rated as one of the highest factors. It is obvious that system outage is closely correlated with on-demand adoptions and may represent a high concern for SMEs with intentions of adopting this ERP solution. In fact, after the outage issue of Microsoft Azure, CIOs realized the importance of system accessiblity for on-demand solutions. Second, security was emphasized by several researchers in their studies of cloud computing [15, 24]. However, according to our data, CIOs only rated security in the second importance group. Third, most of the small companies prefer adopting on-demand solutions while mid-size companies are more hesitante to switch from current system to on-demand ERP.

The results of this study provides SMEs with valuable knowledge that might prompt them to make significant changes in their current ERP-related processes and the acquisition of enterprise packaged software, which could result in substantial benefits. The findings have important theoretical and practical implications. Our understanding of the ERP related issues in SMEs helps both researchers and practitioners understand how ERP system adoption and implementation impact the competitiveness of SMEs. To researchers, this study shows the relationship between on-premise and on-demand ERP adoptions and give the possibility in future research to expand the model. To practitioners, this study shows some critical issues of ERP adoption for SMEs. It allows CIOs and other IT managers to think thoroughly before they make decisions in ERP adoptions. Additionally, guidelines are provided to IT managers regarding the ERP adoption issue between on-premise and on-demand models. Furthermore, the ERP vendors will benefit from this study in developing better ERP solutions tailored to SMEs specific requirements, and improve the cost structure of their cloud models for higher adoption rates among SMEs.

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