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Item Type	Article
Authors	Dai, Wei
Publisher	Victoria University
Rights	With permission of the license/copyright holder
Download date	2026-11-12 07:38:46
Link to Item	http://hdl.handle.net/20.500.12424/174473

The Impact of Emerging Technologies on Small and Medium Enterprises (SMEs)

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Abstract

This paper explores the potential of emerging technologies in transforming and automating the business processes of Small and Medium Enterprises (SMEs) and enable them to engage with trading partners and customers in global networks. The technologies are associated with Services Oriented Architecture (SOA) through Software as a Service (SaaS), cloud computing and innovative application environment developed through the Phoenix research program at Victoria University. A service framework based on the emerging technologies from the Phoenix program is presented and discussed in response to the SME barriers raised in accessing those technologies.

Keywords

SME, Supply Chain, Business Process, Applications Integration, Cloud Computing, SaaS.

Barriers of ICT Engagement for SMEs

Information and Communication Technologies (ICTs) are having an increasing impact on business activities and offer unprecedented opportunities for business success. However, companies with different sizes and structures are taking up the opportunities offered by ICT at different speeds.

Research from the European Union (EU) and US shows that Small and Medium Enterprises (SMEs) do not take advantage of ICT and e-Business solutions in the way that large companies do. This makes SMEs more vulnerable to changing economic conditions as they have a relatively lower level of competitiveness (Arendt, 2008).

The nature of SMEs (due to their size) is that they do not usually commit financial and human resources for ICT investment to gain competitiveness and productivity. Most of the SMEs consider ICT as a set of tools for solving short-term operating problems instead of long-term strategic goals. On the other hand, research indicates that even though in the UK the SMEs are swiftly switching to the Internet to explore potential business opportunities, they are still slow to accept e-business as the foundation for business communications and transactions. Furthermore, even though the 1.9 million small businesses in the UK are connected to the Internet, exceeding the government's original goal of 1.5 million, the UK's Federation of Small Businesses research shows that the usage of the Internet by SMEs is still relatively undeveloped. SMEs still likely to use the Internet only to send e-mails, transfer files or documents or gather information. There is no evidence that SMEs use and invest in ICT with an intention to improve services, processes and business automation.

The "Sectoral e-Business Watch" study of the 2007 European Commission report also confirms that e-Business activities of large companies are rapidly maturing. These companies hold very strong ICT systems, which enable them to conduct business processes efficiently and deliver business benefits. However, there are still many SMEs who are struggling to get digitally connected with their suppliers and customers, and running the risks of losing emerging business opportunities as well as competition advantages with larger firms.

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The benefits for SMEs of improving business process and productivity are potentially huge. Maguire et al. (2007) explored how SMEs may use ICT to secure a competitive advantage. The key outcomes of this research were the following:

- SMEs considered ICT as a key factor in cost reduction;
- ICT could enrich product development and service quality at a very high level in SMEs;
- SMEs viewed sales forecasting, customer analysis, and pricing as the most effective ways of utilising ICT for competitive advantage.

Australia's SME sector consists of over two million firms with less than 20 employees and an annual turnover of $A2-10 million (National Australia Bank SME survey, 2008). SMEs play vital roles in new job and venture creation, sustainable microeconomic growth, emerging export markets, innovation, and business resilience.

However, barriers exist for SMEs to adopt and take advantages of ICT systems as e-business solutions. In a recent study (Task Force, 2006), the barriers were classified into two broad categories: macroeconomic and microeconomic. This article focuses on the microeconomic aspects of the barriers.

The first microeconomic barrier was the lack of awareness, knowledge and skills within the SME environments. This makes it difficult for SMEs to select the right technologies as these are changing rapidly. Hence, they often use the services of external advisors. The second barrier is that existing ICT products are not well suited to meet SMEs' needs. This therefore increases pressures on SME owners and managers to invest in employee training for future e-business readiness. It was also demonstrated that the SMEs sector was experiencing greater problems in finding e-Business solutions than large enterprises. The reasons behind this were a lack of time and the lack of internal information and knowledge. Furthermore, SMEs choose to use the existing and familiar business models to avoid the risk of transferring to the new ones based on ICTs.

Supply Chain Management from SME Perspectives

In modern e-business environments, individual business, including SMEs, cannot survive on their own. It is highly desirable that SMEs can engage effectively with its business partners and customers. Some larger firms require specific way of e-business interactions with their suppliers, putting more burdens including costs on SMEs, but at the same time offering business opportunities. Therefore electronic supply chain management is also critical to the business success of SMEs. Supply Chain Management (SCM) represents a set of disciplined approaches to effectively integrate business partners e.g. suppliers, manufacturers, and customers for improved performance of the individual companies and the supply chain as a whole (Chopra and Meindl, 2004).

Increasingly, SMEs play key roles in supply chain management as they participate in value creating activities. They supply raw materials, produce products, and distribute finished goods to customers. Through their efforts, SMEs have significant impacts on supply chain processes (Huin et al., 2002). Many studies of supply chain management focus on the practices of large firms, while small firms are treated mostly from the viewpoint of larger firms (Chopra and Meindl, 2004; Kukalis, 1989; Lambert and Cooper, 2000).

Previous studies highlighted the growth patterns of SMEs in the context of information systems (Levy et al., 2001; Venkatraman, 1991), industrial marketing (Kalafatis et al., 2000), strategic planning (Berry, 1998; Cooper et al., 1986), and integration issues (Shiels et al., 2003). More research effort is needed to study the impacts of SMEs in the context of supply chain management. Since the long-term sustainability of SMEs depends on "where they compete" and "how they compete", decisions on their chain relationship position and operational focus should be strategic.

However, accessible and low-cost SCM remains a major barrier for SMEs to achieve the economies of scale and scope for global competitive advantage. Many SMEs recognize the potential value of supply chain integration to provide a holistic view of customers, suppliers and the business value chain. However, whilst some SMEs have benefited from the SCM functionality provided in early e-business platforms they have largely been unable to achieve the promised competitive benefits due to

technology-associated high learning curves, high transaction costs and complexities in managing business partners' relationships. The existing SCM solutions were conceived for trans-national corporations; for SMEs they have high up-front costs associated with hardware, software, training and integration. SMEs consequently face entry and infrastructure barriers. Lowering entrance and participation barriers will help SMEs gain access to technologies and to help them instantaneously participate in point-to-multi-point supply value nets (Bovet and Martha, 2000).

The Emerging Technologies

Cloud computing

Cloud computing can be thought of as computing resources sharing and services delivery for users conveniences. Cloud computing particularly offers the following features to support users' needs: 1) Services on Demand: services with various purposes can be acquired anytime, anywhere; 2) Database Sources on Demand: a gathering of relevant data sources (e.g. database) in relation to the application needs; 3) Applications on Demand: delivery applications according to specialized processes; and 4) Platform on Demand: provision of application environments for users. For SME users, ICT infrastructure, platform, equipments and the majority of the application data can all be taken care through cloud computing to support individual business needs.

From the Phoenix application environment at Victoria University (url: **Error! Hyperlink reference not valid.**), depending on users' requirements, appropriate levels of computing resources are organized which lead to a cloud. The outcome of processing users' requirements within the cloud reaches the concerned users through wired or wireless Internet as cloud-delivered services.

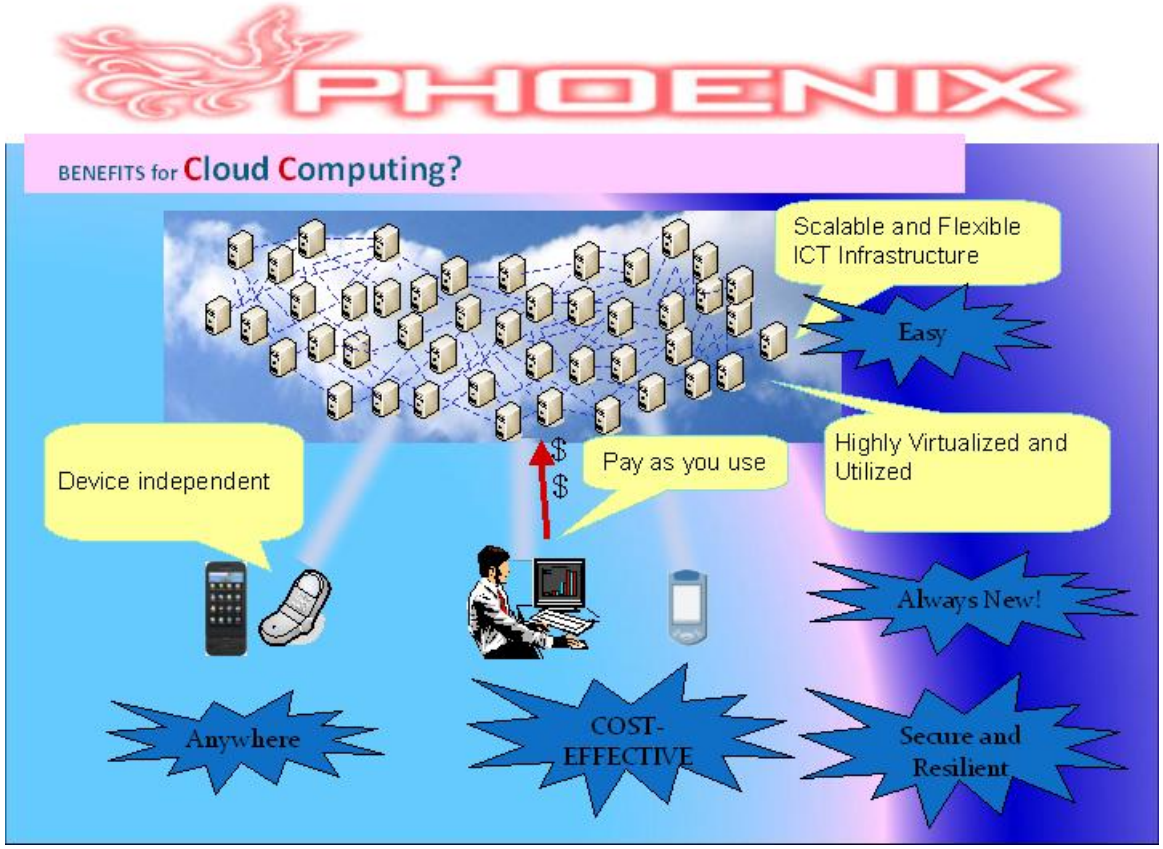


Fig. 1: Cloud Computing Benefits

One of the big advantages of cloud computing is that small businesses can access best of breed of software infrastructure and resources without making upfront investment. Particularly, (as illustrated in figure 1), SME staff can access the required software services and support using conventional devices and equipments such as a mobile phone or a PC regardless of time, place, communication

protocols or standards imposed, therefore allowing SME staff focusing on core business activities such as sales, ordering etc.

Software as a Service

To provide cost effective services to business, and especially SMEs who do not have resources for high-end computing facilities and a training budget, a Software as a Service (SaaS) model is studied and adopted for a proposed services framework that is positioned specially for the SME sector. Under SaaS, the service framework (mainly consisting system services) is no longer running on premise on a customer's IT infrastructure but is hosted in a SaaS provider's data centre and accessed over a network such as Internet. Customers can subscribe to or unsubscribe from the service framework as they desire. The main advantage for the customers is that they can use the service framework on demand (i.e. when they need it) without the need to provide the necessary computing infrastructure to run the software. Providers also profit from the SaaS model by offering applications as a utility to their customers. Similar to traditional utility providers such as water or power providers, SaaS providers can exploit economies of scale. They can offer the same physical application to different customers, thus, the provisioning of the necessary hardware and middleware is needed only once and can be used for different customers over and over again.

Software as a Service (SaaS) is the term used for delivering software applications across networks such as Internet. SaaS can help remove the need to purchase expensive server infrastructure. The SaaS model is being used to provide a whole host of software applications from email to enterprise mobility solutions (Liao & Tao, 2008).

The traditional model of packaged software application requires customers to pay upfront. As the software may include many features that customers will never use, in many situations, it may not represent a cost-effective investment particularly for SME users. By creating an environment where the IT spending is on based services that are actually needed, businesses such as SMEs can be better off in their cash-flow positions. This also gives rise to an immediate tax deductable expense instead of having to factor in depreciation on big upfront costs as well as removing complexity and cost involved in on-site systems maintenance (Godse and Mulik, 2009).

Innovative Solutions

This article investigates a new generation solution framework for SMEs through innovative use of the emerging technologies discussed above. The framework is based on the services orientation paradigm to provide integrated e-business integration that brings benefits to both individual SMEs and their partners. In order to better support business activities among business partners and their partners, Services Oriented Architecture (SOA) offers integration infrastructure and support among services on behalf of various business entities.

Under the SOA paradigm, a service is basically a well-encapsulated business function or process with a clear identity and programmatic accessible interfaces. These services are typically implemented using Web service technology, although services under other platforms such as OSGi (www.osgi.org) are also gathering momentum. SOA is a way to integrate business with a set of linked loosely coupled services. These services can work together in an on-demand mode, i.e. in response to arising business needs. Because SOA utilizes a service-orientation principle to create an enterprise IT architecture that addresses the business problems, the service identification, granularity, and construction need to match business process characteristics. Driven by business processes, the service patterns, service rules, and service defining methods that need to be subsequently established, constitutes a technology roadmap of SOA.

The Phoenix research program at Victoria University shares the vision of integrated e-business solutions with traditional Enterprise Resource Planning (ERP) systems (Figure 2).. The research framework presents itself as an integrated web based solution used to manage a company's resources. It aims to provide real-time service oriented applications to meet dynamic e-business requirements, and has the potential for offering integrated solutions to SMEs in a more flexible, dynamic and cost-effective way. If compares advantageously with existing ERP systems adopted by the larger firms.

Phoenix adopts cloud computing as its software packaging capability and SaaS as its services delivery model.

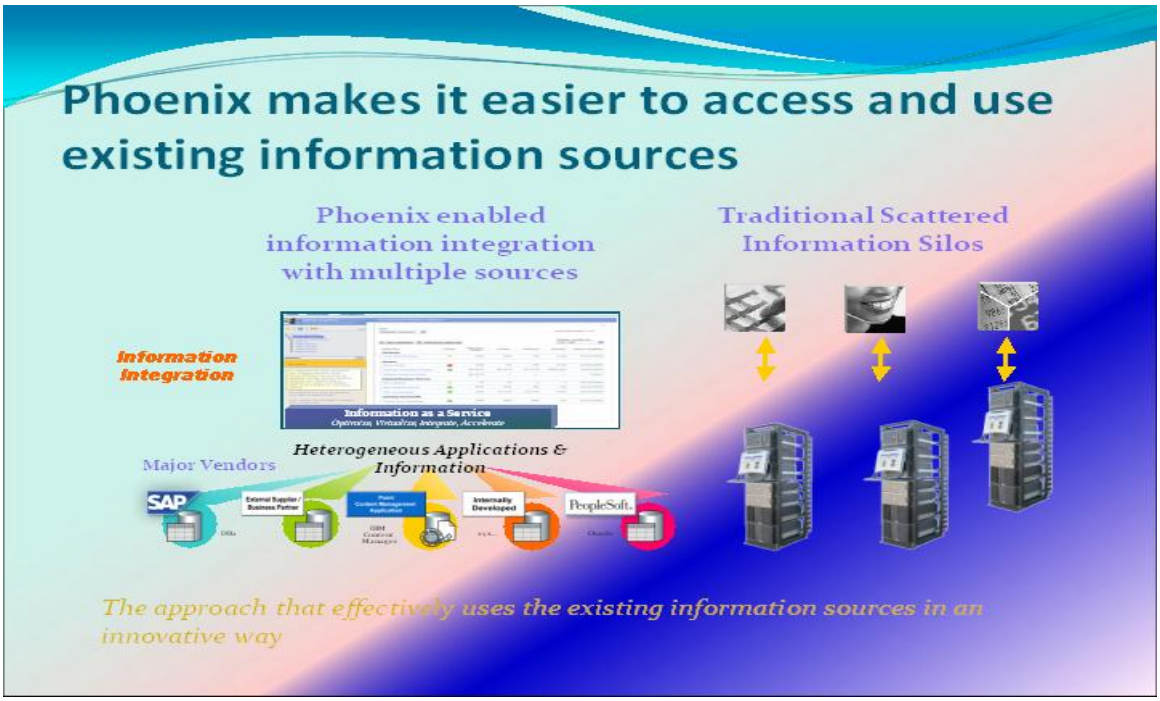


Fig. 2: Information Sources Integration

Services Management

The goal of serving business effectively is accomplished through services management that coordinates and applies the relevant services to meet users' requirements. The services fall into two broad categories: system services and business services.

System services

System services provide the fundamental functionality to ensure the smooth and effective operations on a Services Oriented Architecture (SOA), e.g. operations in relation to services management from services registry and repository, services coordination and execution. These typically contain no intrinsic business logic, but are used to provide service-based access to existing operational systems. Often referred to as *atomic services* (as they generally don't depend on any other services), they are usually provided directly by the underlying operational system—although it may be custom built using whatever interface mechanisms are available. The methods exposed are typically general purpose and fine-grained, as they are primarily designed to be reused by other services. Whilst this interface could be accessed by the ESB, best practice is to allow this to occur only if the service interface is sufficiently generic and does not introduce an element of tight coupling between consumer and provider. The framework provides such system services in form of knowledge management Information services, data management services, communication services and task management.

Business services

Business services are those directly associated with business functions and processes, e.g. issuing purchase order, credit checking etc. These services contain the business logic that will be used by the business processes, and are often referred to as *composite services*, as they may delegate processing to a number of other businesses or IT services. Unlike IT services, the methods exposed are generally coarse-grained and typically relate to a specific business activity.

The key in delivering the complete services to SMEs relies on integration of systems services with business services (Dai, 2009).

Engaging with SME Users via Services

From an architectural perspective, SOA is an architectural style that supports service orientation. From a technology perspective, SOA is supported with standards-based infrastructure, programming model, and technologies, such as Web services. From a business perspective, SOA consists composite applications and a set of agreements between service consumers and service providers who specify the various metrics concerning business and users including the description of quality of service. A composite application is a set of related and integrated services that support a business process built on an SOA. To scale it up, depending on the nature of the application tasks, Enterprise-SOA is proposed by major software vendors, which is a higher level of business application environment with the focus on business processes using standard interfaces (Datz, 2004).

To engage SME users with the modern services oriented framework, two styles of interactions i.e. demand driven and event driven as shown in Figure 3 are recommended and discussed below.



Fig. 3: Improved business agility through flexible services delivery.

Demand-Driven SOA

According to Malatras et al (2008), the main technical barriers to the wide-spread adoption of ICT systems by the business users were the tight coupling of services to implementation and inflexible infrastructure The services delivered are therefore too expensive and can only fulfil the partial needs for the business community. The inflexible infrastructure also led to a very limited usage of available resources. The framework aims to improve the SOA latency in response to arising demands from users.

Latency within SOA has a direct correlation to how well the infrastructure can respond to customer's demand. The latency and responsiveness of an SOA infrastructure are specifically related to business tasks that may come in many forms and are often unpredictable. The tasks are generated according to business situations and needs such as preparing budget report, generating purchase orders etc. Solutions delivered from the framework are specifically related to the tasks.

Event driven SOA

An Event-Driven Architecture (EDA) provides a means for systems to respond dynamically as events occur, e.g. low inventory of products, special advertised business offers etc. For systems to be most responsive, they must be able to quickly determine the necessary actions when events are triggered. To this end, events should be published and consumed across all boundaries within the SOA (Phippen et al, 2005). Essentially, events are signals that something has occurred or in some situations a representation that something has not happened when it should have (Granebring and Revay, 2007).

Events can be high-level and business-oriented, or low-level and technical in nature. As events are detected under the Phoenix event driven services delivery mode, SME users can be alerted in time to deal with arising situations that may have business impact.

The service framework will allow SMEs to continuously monitor changing circumstances in business environments in order to have early opportunities to respond to arising situations that may materially impact their operational effectiveness. Event driven applications are particularly effective with data that are high volume and frequently changing. The discovery of events will allow SMEs to know what has happened, where it is happened, and when.

The environment in which the business operates demands the capability to respond quickly to conditions that impact the business. When conditions change, the events that reflect that change must be analysed as soon as they happen. Otherwise, the opportunity to take action may be lost. An event-based system, powered by Phoenix, can monitor the events and respond to a triggering event (or pattern of numerous events) as soon as it happens. Furthermore, event driven service delivery can, through its available knowledge, respond to a new change of situation in customer environment and give recommendations to the customers.

Conclusion

This article attempts to link SMEs with ICT solutions. It analyses the barriers for SMEs to access to advanced and high-end computing capability. Considering the existing barriers and emerging technologies, a service framework that can be easily and cost-effectively adopted by SMEs has been presented. It aims to overcome the existing barriers and open up business opportunities and increase productivity for SMEs.

Acknowledgement

The author would like to thank Ms Neelu Sharma whose MBA minor research project has contributed towards the development of this article.

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