A Path to Socio-Economic Development Using Cloud Computing

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Abstract

Micro-enterprises face numerous challenges in adopting and utilizing information technology due to lack of resources and adequate support systems. We contend that cloud computing provides an affordable option for such resource-constrained micro-enterprises in adopting technology. Significant advances in information and communication technology, and more recently in virtualization technologies have enabled the cloud computing paradigm. Cloud computing enables users to access services based on their requirements without regard to where the services are hosted or how they are delivered. Using cloud computing both software and hardware can be provided as a service over the Internet in a scalable and cost efficient manner. In this paper we describe the cloud computing paradigm and present two case studies of micro-enterprises that adopted cloud based services. The contribution of this study is in integrating micro-enterprises, cloud computing and development to show how cloud computing may facilitate socio-economic outcomes.

1. Introduction

Micro-enterprises have the potential to serve as the seedbed for industrialization [8]. Yet many micro-enterprises are hindered from growing and functioning efficiently by an inability to use information technology (IT) effectively [9], [10], [11], [18], [19]. According to the Association for Enterprise Opportunity (AEO), there are over 23 million micro-enterprises in the U.S and that number translates to 87% of all businesses in the United States. Historically, micro-enterprises have been considered the backbone of the U.S economy. The survival of these businesses remains a challenge because they are led by the one micro-entrepreneur who trades their skills and/or products to earn a living. This makes the adoption of Information and Communication Technology (ICT) difficult as the resources to purchase equipment are limited and training is often unavailable or inadequate. However when they do adopt IT, the growth of these micro-enterprises increases by a factor of 3.4 [14]. Businesses can grow at a rate of 3.4% faster in terms of sales when email is used for customer communication [14]. Similarly, 4% increase in sales as well as 5% increase in export performance was obtained when e-business techniques were adopted by Small and Medium sized businesses (SMEs) in the manufacturing sector in Canada [17]. However, while these efforts may appear to be very successful, they do not address the growth of these businesses or of the communities and regions within which they reside. This is because the adoption of IT by micro-enterprises is not straightforward. It requires assistance on a number of levels. First an assessment of their needs has to be made in order to find out how they can be assisted. Every micro-entrepreneur has very unique needs and aspirations. Second, the technology itself is often not the solution; it is the innovative ways in which the technology is used that enable the micro-entrepreneur to grow their business using IT. Third, the implementation requires a combination of training, technology and most importantly education on resources available to the business. Finally the impact of these initiatives needs to be considered in the light of economic, social and human considerations. This paper addresses the above needs through a process in which technology, training, and trust building interventions are used to assist the adoption of IT in micro-enterprises. This is called IT Therapy because it enables the micro-entrepreneurs to increase their human capital through training, technology enhances their physical capital; and the trust-building enhances their socio-cultural capital [16], [28], [29].

A new category of technologies that have recently emerged termed, cloud computing or cloud-based applications/services may serve as a promising alternative to resource-constrained micro-enterprises. In a cloud computing architecture, hardware and software services and data is stored on distributed web servers and data centers, the “clouds”, rather than
spread over single computers [3]. This allows users to access information from anywhere they have Internet connectivity. Such architecture has sociological implications. By delocalizing hardware and software resources, cloud computing changes the way the user works as he/she has to interact with the "clouds" online, instead of in the traditional stand-alone mode [3]. In this study, we investigate this new opportunity offered by the cloud computing architecture within the realm of micro-enterprises. Specifically, the research question being addressed in this study is, Can socio-economic development outcomes be achieved in micro-enterprises through cloud computing? Findings from the case studies shed insight to researchers and practitioners involved in using IT to assist micro-enterprises in underserved regions.

2. Background

2.1. Development and Micro-enterprises

Steinberg [21] suggests that the high versatility of ICTs have the potential to address a country’s development strategies - provided an enabling environment exists. In this vein, in order to investigate the achievement of development in micro-enterprises, this research will draw upon the field of Information Technology for Development (ITD). The field of ITD is built on this notion and entails the implementation, use and management of Information Technology infrastructures to stimulate human, social and economic development [15]. IT for Development research is not limited to developing countries and considers communities and regions in which people have limited access to funds, social services and education needed to sustain them. Technologies such as the cell phone which is now considered one of the most essential pieces of technology to humans around the world can be utilized in its simplest form to assist the rural poor in underserved regions. For the purpose of this research, development in its broadest sense is used. In support of this broader perspective of development, Qureshi [15] highlighted a number of effects that may come about when IT implementations intervene within a society’s economic as well as social spheres. She outlined a process model of IT for development (figure 1) that takes into account both positive and negative impacts that technology might have on development. The stated effects in the model are: access to information and expertise, competitiveness and access to markets, administrative efficiencies, learning and labor productivity, and finally poverty reduction. For the context of this study, the social and economic sphere that we are concerned with is the micro-enterprise.

Figure 1. Model of Information Technology for Development (Qureshi 2005).

Micro-enterprises contribute to economic development through the creation of jobs, as well as to social development through self-development and skill enhancement of poor and disadvantaged segments of populations. Micro-enterprises are a form of small business. Small firms differ from large firms in various ways. In terms of technology, micro firms tend to primarily use technologies such as email, web and simple accounting packages as opposed to medium and larger sized firms that used more complex applications such as CRM, and other similar technologies [5]. Dandridge [6] mentions that organizational theories that were developed as a result of studying large organizations, do not explain the true structure and management principles actually encountered in small businesses. Welsh and White [27] state that “a small business is not a little big business” and show that with respect to financial management practices (cash flow, break-even analysis, return on investment, and debt-equity ratio), the analytical models applicable to large businesses do not apply. Small businesses also face greater risks when investing in technology [20]. The skills, time, and staff necessary for planning are not major issues in large businesses, yet these same issues represent most of the difficulties in small businesses [23]. Subsequently, these issues are more prevalent in micro-enterprises. A study by Street and Meister [22] has shown that Information Systems (IS) play a major role in small firms looking to grow. One of the key findings in that study is that in order to support the internal transparency of the firm during its growth phase, there is a need for an appropriate IS to be incorporated at a very early stage – even before many of the other structural or organizational changes are initiated. In a study by Matthews [11], it was shown that ICTs play an important role in the expansion of SMEs. The results showed that there is an increasing
awareness and desirability of small firms looking to grow to use the potential of Internet communications to reach a larger market for their products and services. Matthews [11] also discovered that lack of confidence in technology was a major inhibiting factor for SMEs looking to grow and suggests that training along with making small business owners aware of product and solution knowledge will improve their confidence in the use of ICTs to help support their business. There have also been some studies that have investigated the effects of vendor-approach as opposed to consultant-vendor approach in the implementation of information systems in small businesses and found that small business owners favored the vendor-approach in implementing operational systems such as accounting systems, inventory control, sales order processing, sales analysis, payroll, and purchasing [24], [25].

It then appears that micro-enterprises face numerous obstacles in adopting information technologies and facilitating growth. However, an emerging technology - Cloud computing, may provide an affordable yet powerful option for such resource-constrained micro-enterprises to adopt technology. Significant advances in information and communication technology, and more recently in virtualization technologies have enabled the cloud computing paradigm. Cloud computing enables users to access services based on their requirements without regard to where the services are hosted or how they are delivered. We discuss the cloud computing paradigm in the next section.

2.2. Cloud Computing

The Internet has changed the way in which we work, communicate and conduct business today. However, the Internet’s increasing ubiquity and centrality, and the need for supporting new and increasingly distributed applications has brought about a number of challenges for which the current Internet architecture is ill-suited. Significant changes to the Internet architecture not only require changes in routers and host software, but also require Internet Service Providers (ISP’s) to jointly agree to any architectural changes. The rapid development in networking technologies, as well as the significant improvement in information storage and processing has made computing resources cheaper, powerful and more available than ever before. These advances have promoted the emergence of the cloud computing paradigm, which provides substrate network resources such as CPU, storage, bandwidth etc., and delivers them to customers in a manner similar to traditional utilities such as electricity, water, gas and telephony.

The National Institute of Standards and Technology [12] defines cloud computing as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. In other words, cloud computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the data centers that provide those services. The data centers hold tens to hundreds of thousands of servers that concurrently support a large number of distinct services. Cloud computing uses server and network virtualization technologies that can help diversify the Internet and fend off Internet ossification by providing a flexible environment to support a variety of services for users to run their applications. The cloud model is composed of five essential characteristics outlined below.

- **On-demand self-service.** A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.
- **Broad network access.** Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).
- **Resource pooling.** The provider’s computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.
- **Rapid elasticity.** Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.
- **Measured service.** Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts).
Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

Based on the aforementioned characteristics, cloud computing offers several technical and economic benefits. In terms of technical advantage, it is possible to use the processing power of the cloud to do things that traditional productivity applications cannot do. For instance, users can instantly search over gigabytes of e-mail online, which is practically impossible to do on a desktop. One of the greatest advantages is that the user is no longer tied to a traditional computer to use an application, or has to buy a version specifically configured for a phone, PDA or other device. Any device that can access the Internet will be able to run a cloud-based application. Regardless of the device being used, there may be fewer maintenance issues. Users will not have to worry about storage capacity, compatibility or other related issues.

Cloud based services can be categorized into three fundamental service models: (i) Infrastructure as a Service (IaaS), (ii) Platform as a Service (PaaS), and (iii) Software as a Service (SaaS), with the IaaS model being the most basic model, and the PaaS and SaaS models abstracting from its details. These three models form the basis on which cloud computing solutions are delivered to end users.

In the IaaS model, the capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control of select networking components (e.g., host firewalls, virtual and physical servers). Examples of IaaS include: Amazon CloudFormation and underlying services such as EC2, Rackspace Cloud, Google Compute Engine and RightScale.

The PaaS model provides a framework and tools for developers to build their own applications. The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment. Online content management systems and website building services are examples of this model. More specific examples include the Google App Engine, Microsoft Azure and Amazon Elastic Beanstalk.

In the SaaS model, the capability provided to the consumer is to use the provider’s applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings. Examples of applications running on a SaaS model for personal and business use are Google Apps, and the online versions of MS Exchange and QuickBooks.

The three service models described above may be offered through four different deployment models as follows: (i) Private cloud - The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises, (ii) Community cloud - The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises, (iii) Public cloud - The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider, (iv) Hybrid cloud - The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).

The various cloud computing models along with the different deployment methods provide enterprises the opportunity to achieve more efficient use of their IT hardware and software investments: it increases profitability by improving resource utilization. Pooling resources into large clouds cuts costs and increases utilization by delivering resources only for as long as
those resources are needed. Aymerich et al. [3] mention that cloud computing is particularly beneficial for small and medium businesses, where effective and affordable IT tools are critical for helping them become more productive without spending a great deal of money on in-house resources and technical equipment. This can be particularly attractive to small businesses or micro-enterprises that cannot afford to pay for technology upfront. Micro-enterprises with innovative ideas can now use and pay for technology as they grow and no longer require the large capital outlays in hardware to deploy their service or the human expense to operate it. The following section outlines the research design used to investigate the adoption of cloud-based applications in two micro-enterprises.

3. Methodology

Action Research using an inductive interpretive case study approach was used as the primary method to address the research question for this study [4], [26]. The action research method involved applying innovative IT interventions within two micro-enterprises in the Western New York region. The results from both the micro-enterprise cases were then analyzed. The action research strategy can be understood as a cyclical process comprising of four major phases or activities. The plan phase involves the researcher meeting the micro-entrepreneurs to understand the context of the business and the technology needs and problems facing the business. To obtain such an understanding, the researcher asks the micro-entrepreneur questions relating to their current business conditions, and what is currently obstructing them from reaching their business goals. The researcher also asks the owner as to how he/she feels towards technology and what if any form of technology they have used in their business. The next phase, which is the act phase, involves the actual technology-based implementations/interventions to solve any immediate IT problems that the micro-enterprise is facing. The observe phase involves the action researcher assessing the outcomes from implanting the interventions during the previous act phase. The final phase is the reflect phase, which deals with the action researcher reflecting on the impact that the IT interventions had on each micro-enterprise and whether their IT bottle-necks were cleared or not. This phase serves as a feedback loop for any necessary modifications that might need to take place in subsequent iterations of the action research cycle.

The following sections report on two comparable studies that show the effects of the process outlined above in two micro-enterprises. These were selected because they are representative of the challenges faced by micro-entrepreneurs.

4. Case Studies

4.1. Case 1: Hair Salon - JK

4.1.1. Plan. JK owns and manages her salon. She started off just cutting and styling her friends and families hair. In, 1997, she began her very own salon. JK runs the salon out of her home singlehandedly. She has taken classes and is well knowledgeable in this line of work. Her salon specializes in everything from hair cutting, hair styling, hair coloring, facials, and nails. The phone and social media website - Facebook has been major tools for her to communicate with her clients. JK wishes to reach out to more customers through other means. She hopes to continually expand her salon venture.

JK believes that using IT can further improve her business. However, the owner does have rather hesitant feelings in using IT and currently isn’t a heavy user of IT. The owner finds herself using IT tools for word processing, networking with Facebook, communications with email, research, managing accounting and personal leisurely amusement. The owner states that the use of spreadsheets on her business finances is easier and more organized compared to her past paper based methods. She had an accountant friend help setup and showed her how to use a spreadsheet for her business finances. The owner created a business page on Facebook to better network with clients and possibly future clients. Her phone is her primary method for communicating and coordinating appointments with clients. The owner stated that she does feel hesitant at trying new technologies. The owner stated that her computer skills are very basic and that the few IT skills she has acquired have been from friends and self teachings through trial and error. The owner does not often try new technologies, believing that she will make a major mistake with the use of a new technology. She also states that her time limitations are possible reasons for her refraining from employing new IT tools. The owner has never taken training or educational courses for IT and again, feels that her time limitations would prevent her from doing so. The owner strongly feels that if she is shown how to use a piece of technology, then perhaps continued use of that technology would be very feasible in her business. She states that there are no factors that are beyond her control that determines her use/adoption of IT and she strongly
feels that her lack of knowledge in IT does limit her business and her as a person. The owner believes that her use of IT may possibly provide her access to new markets and more customers with the use of Web pages, advertising, and overall more involvement in networking.

4.1.2. Act. After learning of the various ways that JK conducts business in her salon and the technology related issues she faces, it was apparent that the salon is in need of a better strategy at networking and advertising the business. A website other than her social media page should be an effective means at satisfying her current needs. The website would have to be first, financially feasible and most importantly, be managed by the owner who currently possess little technical know-how. JK also desired to back up her business financial data from her old computer to her newer one.

Based on the needs identified, the following interventions were then carried out for JK:

1. Backing up business data: The plan was to first search for her business data files from the old desktop. Next, a decision could be made as to what media was best for transferring the data. The two available options were either to use email or a USB flash drive.

2. Setting up the website: This was done using an online content management system called, Weebly.com. It is a website for users who wish to create their own website relatively easily. Weebly offers numerous tiered pricing packages, however their basic package is free to use and all packages provide a simple drag and drop interface to make it simple for inexperienced users of IT to employ. JK signed up at Weebly and could start building a basic web page, and explore the available designs and layouts available. Over time, the owner would become familiar with Weebly’s interface and be able to added content as desired. The owner was taught how to update and maintain the site on Weebly by the researchers.

4.1.3. Observe and Reflect. Following is a description of the observations made by the researchers as the interventions were being carried out.

During the IT intervention process which involved the backing up of data and creating a website with Weebly, JK became more comfortable using technology. The essentials of how a USB flash drive works were explained to the owner, and she realized that it was a much simpler process than what she had expected. This realization made her feel more conformable using the technology. The same outcomes were evident as she used Weebly to create her own site. It was observed that the more see used and pushed herself to try new options, the more comfortable with the IT tool she became.

- **Becoming more conformable with technology:** Prior to the IT interventions, JK had stated that she was very hesitant when using technology. The few IT tools she had used were as a result of friends and families helping out. For example, the MS excel spread sheet was created by one of her friends who had also taught her how to use it. Another example was her Facebook business page which was shown too her by one of her daughters. With the IT interventions provided by the researchers, the owner learned and realized that her USB flash drive is easier to use than she thought and that it is ok to try new IT tools. Another instance of this was, when she was forced to try to add a slideshow element onto her page on Weebly, the owner was pleasingly surprised of how easy it was and how the final outcome made her website look more professional.

- **Ease of technology use facilitated improved customization:** Weebly offers users to tailor their website to their liking easily. Even the free package from Weebly offers great options for sufficient variation which is what the owner desired. During the IT intervention, JK tried different options and tools that Weebly had to offer. The owner used the design tab of Weebly to find a layout she sought, changing the color schemes and adding pictures to her liking. The owner was pleased to see numerous options available to her and being the creative person that she is, enjoyed unlocking the opportunities Weebly offered.

- **Improved attitude towards IT adoption and use:** The owner has changed from being a rather hesitant user of IT to a more comfortable user. Over a span of ten weeks, her attitude towards IT transformed. Her change in attitude was observed while the owner was learning basic computer operations such as, selecting text, cutting out sections of text, copying text and pasting text in documents using keyboard commands. The owner never knew of these four simple commands and now that she knew them, she stated that it made her feel much more comfortable while using her new computer. She occasionally became baffled while using the different interfaces with the mouse to do these commands. Overall from this IT intervention, her willingness and desire to use more IT improved.
4.2. Case 2: Grocery Store - IA

4.2.1. Plan. IA is the owner of a retail and grocery store which was established in 1994. The store sells produce, Indian goods and has a movie rental service which may be discontinued shortly. Produce brings in the greatest revenue for the store and is the area where the owner wants to expand the most. The owner has a very basic website for his store which is in dire need of updating and currently isn’t aiding to his store’s sales. IA wishes to reach out to more customers through other means and desires to post his produce from his store online to sell for additional sales.

Currently, IA finds himself using IT tools such as a cash register coupled to an electronic credit card device, desktop computer which he uses for online research, Microsoft Power Point, Excel, and QuickBooks. The owner was provided with a database few years back, which was developed by students from a local College so that IA could manage his video rental service. Also few years back, the IA had a friend build him a website for his store. The website was very basic and was missing a lot of details with regards to promoting the grocery products. Additionally, the website created for him wasn’t very user-friendly to the owner which resulted in him having trouble updating and adding content to it. IA believes that being able to update and sell his own goods through the website would be a great benefit for his business. Also, the owner wishes to open and run an eBay account to sell specialty Indian rugs. However, the owner does have some limitations and reasons for not currently executing these IT tools for his business. The owner stated that his lack of skills and financial resources were the primary reasons why he has not yet attempted to use IT in his business. He hasn’t setup his cash register to his computer due to the great financial expenses it would require. With help, the owner said that he would make an effort to apply IT in his business since he feels that he has the time and the right attitude towards IT and most importantly, he feels it will better his store. He stated that he doesn’t feel hesitant regarding the adoption of new technologies. The owner believes that his use of IT will provide him access to newer markets and more customers. He states that with IT, his day-to-day business operations will also function more efficiently.

IA faces IT related challenges with his business. His current IT tools which he has used many times over the years offer him no concern. However, the owner does feel hesitant about integrating any new IT tools into his business. He is worried to make a mistake, for instances, the owner wishes to create an eBay account to sell his unique Indian rugs. If the owner makes a mistake setting up the account or communicating with other eBay members, he may possibly lose out on a large sum of profits. Another example is the setting up of the cash register to his computer. Again a possible mistake could cause sales to not to go through leading to loss of sales and administrative inefficiencies. Financial constraints bring limitations to the owner as well. The owner’s biggest IT desire for the store is to update his current website or start from scratch so that he can sell his grocery goods online.

4.2.2. Act. Based on the needs identified by IA, it was apparent that the owner needed a website and the necessary skills to be able to easily update it. As in Case 1, here too weebly.com was the answer as it allows users to create and manage their own website for free, thereby addressing the financial constraints IA specified. The owner also would like to setup and post his specialty Indian rugs on eBay for sale.

The following interventions were carried out:

1. Setting up a website: This was done using an online content management system called, Weebly.com. Very similar to the case of the hair salon described in Case 1, Weebly.com was used to create the website for IA’s store. In addition, IA was taught how to manage the new site on his own without having to depend on others for technology assistance.

2. Setting up eBay: The plan of action was very similar to setting up the Weebly site; the owner would sign up with eBay and setup his account, exploring the available settings available. Next he would be walked through how to post an item on eBay. With time, the owner would become familiar with eBay and be able to post items solely when he desires too.

4.2.3. Observe and Reflect. Following is a description of the observations as the interventions were being carried out.

A major obstacle that was encountered while working with IA is the lack of time available to devote to learning the IT skills being taught by the researchers. This subsequently slowed his progress of learning the components of Weebly and eBay to achieve his goals.

- **Becoming comfortable with technology**: It was observed that the owner’s mind set has changed from being a bit hesitant in using IT tools to feeling more comfortable. The owner always stated that he had an open mind set to using IT but was hesitant with new technologies never seen or used by him before. From the sessions with the
owner, especially the last session, it could be observed that he was fairly aggressive at attempting new IT tasks on his own. While using Weebly, instead of asking how to complete a task, he undertook the chore solely without guidance.

- **Ability to customize:** Weebly has designed their site to attempt to offer the ability for users to tailor their website to their liking with ease. Even the free package from Weebly offers great opportunity for variation. Presently, this free package from Weebly is what the owner is using to manage his site. During the IT intervention, the owner of the store was pushed to attempt various alternatives and tools that Weebly had to offer. The owner used the design tab of Weebly to find a layout he sought, altering the colors schemes and adding pictures to his desire.

5. Case Study Analysis

From the two cases described in this paper, it is apparent that both the micro-enterprises had very similar needs with regards to reaching out to new markets and customers. Another common element in both micro-enterprises was the fact that the micro-entrepreneurs possessed very little technology skills and needed a cost effective solution to help address their needs. What is interesting is the notion that the nature of the technology solutions that were applied were – with the exception of one regarding backing up of data - all Internet-based or in other words, cloud-based. The website development intervention provided the support for a development framework that aligns with the PaaS service model. On the other hand, being able to post an item on eBay is seen as an online auction intervention and this aligns with the SaaS service model allowing businesses to utilize it as a marketing service.

Neither of the businesses needed to purchase any form of stand-alone applications in order to meet their business marketing needs. By utilizing applications on the Internet platform such as online social networking sites as well as online content management systems, the micro-entrepreneurs that had very limited IT skills and no prior website development skills, were able to set-up and develop customized website for their respective businesses within a very short amount of time. These two case studies show strong preliminary evidence of the benefits of cloud computing applications for resource constrained small businesses. With cloud based technologies, system maintenance and reliability issues are in the hands of the service provider which has a technical staff whereas in a standalone PC based environment, the technical issues are in the hands of the business owner. The business owner may not have the technical expertise required nor financial resources to provide their business with the much needed security, reliability, and maintenance support.

The greatest benefits offered by cloud computing to micro-enterprises come in the form of cost effectiveness, scalability and flexibility. For example, if the resources required by the micro-enterprise/user are large then the size of the corresponding request to the cloud computing network will be larger so as to request that many resources from the cloud. Furthermore, the size of the network request can change dynamically to accommodate the changing needs of the user. Based on the user’s Quality of service (QoS) requirements (e.g., short delays, high fault tolerance/redundancy) the network request is mapped on to the underlying infrastructure accordingly (e.g., use shorter/faster paths to communicate and/or paths that have good fault tolerance and backups) to take into account the corresponding constraints. To save on costs users do not use more resources unless they actually need those resources, and since these resources are allocated on-the-fly there is no upfront cost or resource wastage. If certain resources are not used (given-up) by one user they can be used by other users, thus contributing to resource usage efficiencies, which further decrease cost of resources.

Thus the cloud computing network infrastructure provides micro-enterprises the ability to grow without the need to worry about hardware and software upgrades. With tiered pricing models that many cloud services provide, barriers to entry are reduced thus giving micro-enterprises quality software and services at an affordable rate. As more and more applications transfer to the cloud, costs related to IT purchase and maintenance will drastically reduce thereby facilitating micro and small businesses to join the bandwagon of their larger counterparts in benefitting from the efficiencies that IT can create making them more competitive in the economy. Taking into consideration the various obstacles micro-enterprises face in adopting technology, cloud-based applications and services serve as a viable option for easy and cost effective adoption of technology.

In both the cases described in this study, it was observed that the micro-entrepreneurs were able to learn new technology skills in a very short amount of time. The systematic approach that was used in applying the technology interventions coupled with the nature of the technology implementations, i.e. cloud based, facilitated improved learning of new skills. Through their newly learned skills, the micro-
entrepreneurs are now in more control of their business through the use of technology. In terms of socio-economic development, this outcome aligns with the learning and labor productivity effect in the model of Information technology for development [14]. Improved learning also has implications for human development through empowerment. In addition, both micro-enterprises were able to get access to new markets through their newly developed websites. This ability has the potential of exposing the business to customers beyond their local geographic regions and generating revenue resulting in economic development. Subsequently, results from these two case studies provide evidence of how a very context sensitive approach used to enable IT adoption using cloud based services, are a suitable solution to assisting resource constrained micro-enterprises in achieving socio-economic development.

6. Conclusion

This paper detailed two case studies of micro-enterprises to show how cloud computing applications are amenable for adoption through a very contextualized and systematic approach. This approach entails understanding first how the micro-entrepreneur perceives or views IT and then understanding the business, forms the foundation on which appropriate IT interventions need to be designed and applied to create the most impact. For this study, majority of the IT interventions were fully cloud-based and results from the cases reveal that such applications allow micro-enterprises to quickly and economically adopt and use IT to bring about efficiencies.

With more proliferation of cloud-based applications and services, micro-enterprises will have a wider variety of technologies to take advantage of moving them towards industrialization. Future research will investigate different microenterprises to address cloud-based application adoption issues such as; whether the type of industry would have an impact, the type of customer base being served, and various risks associated with cloud-based applications.

7. References


