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Mohsen Attaran & Jeremy Woods

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Cloud computing technology: improving small business performance using the Internet

Mohsen Attaran* and Jeremy Woods

School of Business and Public Administration, California State University, Bakersfield, 9001 Stockdale Highway, Bakersfield, CA 93311-1099, USA

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Cloud computing technology (CCT) is a revolutionary new way of leveraging the power of the Internet to provide software and infrastructure solutions to businesses around the world. 2017 is predicted to be a major breakout year for this technology, with many organizations small and large making a shift to this platform. Employing this technology empowers communication between companies and has the potential to generate significant financial and operational benefits for small businesses. The key objective of this article is to propose a conceptual model for successful implementation of CCT in small businesses. This article also examines some of the potential benefits of CCT as applied to small businesses and explores implementation challenges that can be expected. Furthermore, this study reviews key attributes of successful CCT and illustrates some of the routes that might be taken to implement this technology in small businesses. Finally, this article examines the specific application of CCT to small businesses, highlights developing technologies and trends, investigates the deployment of CCT in different types of small businesses, and provides a case example of success.

Keywords: cloud computing technology (CCT); public clouds; private clouds; hybrid clouds; community clouds; Software as a Service (SaaS); Platform as a Service (PaaS); Infrastructure as a Service (IaaS); Storage as a Service (StaaS)

La technologie de l'informatique en nuage (TIN) est une nouvelle manière révolutionnaire de mettre à profit le pouvoir d'Internet pour offrir, aux entreprises à travers le monde, des solutions en informatique et en infrastructures. On s'attend à ce que 2017 soit une année remarquable pour cette technologie, avec le transfert de nombreuses organisations, petites et grandes, vers cette plateforme. Le recours à cette technologie stimule la communication entre les entreprises et a le potentiel de générer des avantages financiers et opérationnels significatifs pour les petites entreprises. L'objectif clé de cet article est de proposer un modèle conceptuel pour assurer le succès de l'implantation de la TIN dans les petites entreprises. L'article examine aussi certains des avantages potentiels de la TIN, dès l'instant où elle est appliquée aux petites entreprises ; et il explore les difficultés pouvant être rencontrées au cours de l'implantation de la TIN. De plus, cette étude réexamine les attributs-clés d'une TIN couronnée de succès et illustre certaines des voies qui pourraient être empruntées pour l'implanter dans les petites entreprises. Enfin, l'article examine l'application spécifique de la TIN aux petites entreprises, met l'accent sur les technologies et les tendances en développement, et présente un exemple de succès.

Mots-clés: Technologie de l'informatique en nuage (TIN); Nuages privés; Nuages hybrides; Logiciel en tant que service

*Corresponding author. Email: mattaran@csub.edu

Introduction

In a highly competitive small business landscape, cloud computing enables dynamic collaboration between workers. Using web-based software, organizations can facilitate communication between suppliers, customers, and distributors and use this communication platform to make judgments about the firm's external environment (Attaran 2007). Cloud computing technology (CCT) has emerged as an exciting new means for empowering this type of communication (Xu 2012). Usually, CCT is delivered as a paid service in exchange for third-party management of IT infrastructure (Marston et al. 2011).

CCT is different historically than other technologies in that it focuses on service delivery, rather than technology per se. In CCT, technology such as storage, CPU, and networking equipment is not the product per se, but rather the building blocks of the service. Cloud computing is a general term for anything that involves delivering hosted services over the Internet. The history of cloud computing is the history of business computing and the Internet. The cloud computing concept was coined by John McCarthy in 1961. While services such as webmail and YouTube have been in use by many types of organizations for some time now, organizations did not really begin using the cloud structure to serve their broader IT needs until 2009 (Lin and Chen 2012). In the past few years, many companies have embraced CCT and are beginning to reap the rewards of having done so. Many of these companies are now using CCT to improve internal efficiencies (Folinas, Manijas, and Graham 2013; Shacklett 2010; Schramm, Nogueira, and Jones 2011; Marston et al. 2011). Cloud-based technology can spur numerous benefits for organizations such as capital investment savings, simplified operations, scalability, improved information visibility, sustainability, and faster deployment (Hackett 2016).

Cloud computing usage is expanding rapidly, finding adopters in a number of new business domains. The November 2016 Forrester Report says that cloud computing will accelerate faster in 2017 because businesses worldwide are finally starting to see the cloud as an arena in which to realize their core IT functions. The value of the global cloud computing market will top \$146 billion in 2017, up from just \$87 billion in 2015, and is currently projected to grow at a rate of 22% annually. If organizations implement CCT properly, it has the potential to enable accuracy and reliability, enhance service, and reduce costs. Therefore, 2017 will be known as the 'year for cloud-based services' (Bertolotti and Dai 2016).

There are nearly 10 million small businesses in the USA, and many of them have started to recognize the power of cloud computing. In 2014, a study conducted by Emergent Research and Intuit revealed that only 37% of US small businesses have fully adapted to CCT. The study predicted that percentage will more than double to 80% by 2020 (King, Hicks, and Reeves 2014). A recent study conducted by Microsoft Corporation revealed that 98% of small businesses which participated in the survey indicated that technology is important to their success. More than 40% of respondents said that they had no IT department (RightScale 2017). CCT is especially practical for smaller organizations because it reduces IT resources and the time spent managing them. Instead of relying on expensive hardware, software, and people to manage them, small businesses can take advantage of CCT's availability, reliability, security, scalability, flexibility, and more. According to the survey, among those small businesses that were using CCT, getting new software applications faster, reducing IT workload, and improving IT collaboration were mentioned as important benefits of moving to CCT (RightScale 2017).

According to a 2016 Gartner report, CCT is perhaps the most promising and anticipated technology to come around in a number of years (Smith 2016). For some

businesses, making a heavy move toward a cloud structure is a way to significantly cut hardware costs. For others, CCT streamlines operations and speeds up development cycles. Properly planned and implemented, CCT has the potential to drastically improve operational efficiency. Nevertheless, as with any new technology deployment, there are a number of issues to consider and overcome. ‘Going to the cloud’ is not as easy or straightforward as many users may believe. Successful deployments require in-depth analysis of users, including desired business outcomes (cost savings, speed to market, and increased service levels) and services needed (Smith 2016).

This paper discusses three stages of CCT adoption for small businesses and reviews key factors to consider when choosing a cloud platform. The ‘Cloud computing trends’ section discusses evolving technologies and trends. The ‘Advantages and disadvantages of CCT for small businesses’ section discusses the advantages and disadvantages of implementing CCT for small businesses. The ‘Obstacles to rapid adoption in small businesses’ section examines challenges which small businesses face when adopting cloud-based solution. The ‘Cloud computing deployments in small businesses’ section discusses key implementation stages necessary for development and deployment of CCT. The ‘Common uses of CCT in small businesses’ section reviews common uses of CCT in small businesses and highlights time saving tools available from cloud-based services for small businesses. The ‘Small business success in the cloud’ section lists cloud tools and service viable to small businesses. The ‘Case example of success’ section reviews how a small business successfully utilized CCT in its operations. Finally, the ‘Summary and conclusion’ section provides a summary and conclusion.

Cloud computing trends

This section provides a general description of CCT, including a definition of cloud computing, its basic characteristics, advantages and disadvantages of CCT over traditional IT infrastructure choices, CCT service models, and CCT deployment models.

Cloud computing technology

In many different forms, cloud computing has become an integral part of the IT world. The term ‘cloud’ is used to refer to different types of platforms for distributed computing – a cluster of servers, network, software, interface, etc. which users require to execute particular tasks. ‘Computing’ refers to the delivery of this package as a service which users can utilize as they wish (Mell and Grance 2011). The user no longer needs to put up a large up-front investment to own the IT infrastructure. Rather, the user can utilize a similar infrastructure, owned by a third party, and pay only for the amount of computing they actually use. This pay-per-use model allows for convenient, on-demand network access to a shared pool of configurable computing resources such as servers, storage, applications, and services. Clients can connect to available physical or virtual environments using different entry points. The user accesses information online in a 24/7 format from a variety of devices – desktop, laptop, tablet, and smartphone (Bask 2015).

Wikipedia defines cloud computing as the concept of using the Internet to allow access to technology-enabled services that can be rapidly provisioned and released with minimal management effort and without control over the technology infrastructure which supports them (Wikipedia 2017). As demonstrated in Figure 1, cloud infrastructure is an umbrella which covers both the hardware and software necessary for 24/7 pay-as-you-go service. Applications are delivered as services to users in a software-as-a-service (SaaS)



Figure 1. Cloud computing technology.

model via the web. The system hardware and software are used to run applications that users access online.

Cloud characteristics

CCT is based on several IT innovations, including virtualization, the increasing capacity of the Internet, and the growing sophistication of Internet-based technologies. The National Institute of Standards and Technology (NIST) describes five characteristics of a cloud computing model. These are paraphrased in the following (Mell and Grance 2011):

- (1) On-demand self-service. Server time, network storage, and other computing resources are obtained as needed. No human interaction with the service provider is required.
- (2) Broad network access. Resources are available over a network and accessed through standard devices (e.g. mobile phones, tablets, laptops, and workstations).
- (3) Resource pooling. Resources are pooled to serve multiple users. Physical and virtual resources are assigned and reassigned dynamically according to demand.
- (4) Rapid elasticity. Resources scale rapidly up and down with demand, since they are elastically provisioned and released.
- (5) Measured service. Metering is used to automatically optimize resource use (e.g. storage, processing, bandwidth, and active user accounts).

Cloud deployment models

There are four cloud computing deployment models described in NIST Special Publication 800-145 (Mell and Grance 2011), are shown in Figure 2 and described in the following:

- (1) Public clouds. Cloud infrastructure is made available to the general public or a large industry group and is owned by a third-party organization. Public cloud services are sold on demand, usually by the minute or hour. Customers pay only for the CPU, storage, or bandwidth they consume. This is a cost effective way to offer IT solutions, especially for small- and medium-sized businesses. Google

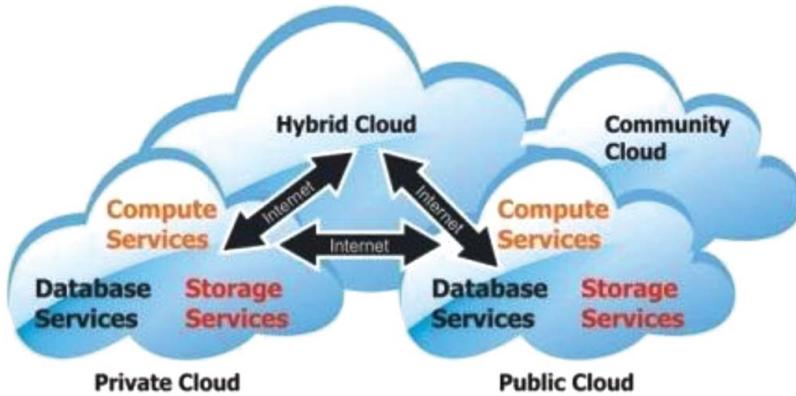


Figure 2. Types of cloud deployment model.

Apps is a good example of a public cloud used by many organizations large and small. Some of the leading public cloud providers include Amazon Web Services (AWS), Microsoft Azure, IBM SoftLayer, and Google Compute Engine.

- (2) Private clouds. Private cloud infrastructure offers many of the same benefits as a public cloud, but it is run exclusively for one organization. The cloud may be managed either by the organization or by a third party, and the infrastructure may exist either on-site or off-site. Private clouds provide greater control over the cloud infrastructure and are often ideal for larger organizations.
- (3) Hybrid clouds. This is a composite of a public and a private cloud, with orchestration and automation between the two. A public cloud is utilized for non-critical information and peak workloads that must scale on demand, while sensitive information is kept on a private cloud controlled by the organization. A hybrid cloud structure allows users to tap into the flexibility of the cloud while still taking advantage of the benefits of a traditional IT infrastructure.
- (4) Community clouds. This structure is a shared cloud computing environment available to a limited set of organizations or employees (such as banks or the heads of trading firms). Members of the community often share similar security, privacy, performance, and compliance requirements.

Small business cloud service models

There are five main models for the delivery of cloud computing services: SaaS, Platform as a Service (PaaS), Infrastructure as a Service (IaaS), Storage as a Service (StaaS), Desktop as a Service (DaaS). Summaries and examples of each of the models are outlined in the following (Matsumoto 2012):

- (1) Software as a Service (SaaS): Applications are offered over a network (internet), accessible via browser or program interface. Since applications are delivered via on-demand software, they can be deployed quickly. This leads to ease of use and financial benefits. Examples of providers offering this type of platform are Google Apps (email, calendar, and documents), Salesforce.com, and Intuit's QuickBooks.

Most small businesses only need to use SaaS tools. In case, they have more complex IT requirements, the following categories of CCT might be used:

- (2) Platform as a Service (PaaS): This service model provides an agile development environment that enables quick development and instant adoption of applications. The wait for suitable hardware and software for the application is eliminated. Users can employ the platform to build applications using languages, libraries, services, or tools supported by the platform service provider. Examples of this type of service provider include the Google App Engine and Windows Azure.
- (3) Infrastructure as a Service (IaaS): This service model provides general purpose infrastructure support services, including database, storage capacity, networking, and other computing services. Users have control over operating systems and deployed applications. Examples are AWS, CenturyLink, and Rackspace.
- (4) Storage as a Service (StaaS): This service model provides users with a data storage interface and charges them based on the amount of storage used. The storage interface can be used by SaaS, PaaS, or IaaS platforms or can be accessed directly by users. An example of direct storage is Amazon's really simple storage commercial.
- (5) Desktop as a Service (DaaS): This service model allows for a desktop operating system (usually Windows) and applications to be delivered securely via remote infrastructure.

Cloud computing trends

In 2017, an annual survey of cloud computing trends was completed by RightScale. The survey asked nearly 1000 professionals, where 50% of the respondents represented small- and medium-sized businesses, about their adoption of CCT. The study found that 72% of over 1000 IT professionals said they are using private clouds, with 89% using public cloud services. The remainder planned to implement some form of cloud computing within the next 12 months. Sixty-seven percent of respondents also said they were adopting a hybrid cloud model. Public cloud adoption remained the same, while private and hybrid cloud adoptions fell from 2016 (Figure 3).

Small businesses run more than 80% of workloads in the cloud with 50% in public cloud and 33% in private cloud (RightScale 2017). According to the same report, companies that provide cloud computing services are also growing rapidly. For example, AWS

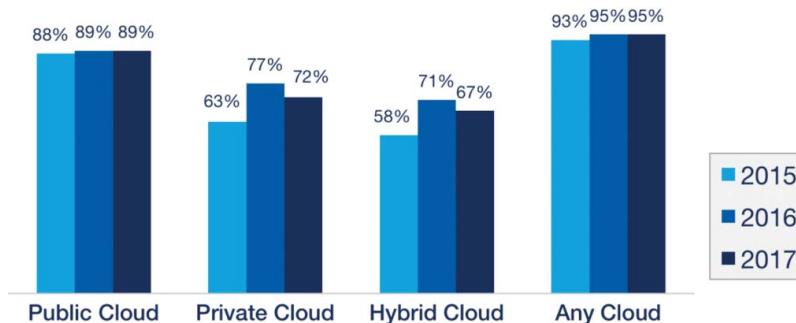


Figure 3. Cloud adoption 2017 vs. 2016.

spurred the first wave of cloud computing services with some simple computing and storage services in 2006. A decade later, AWS operates as an \$11 billion run-rate. AWS holds a significant lead in adoption at 57% of respondents. Adoption of Microsoft Web Services (Azure) grew to 34% and Google Web Services grew to 15% to maintain third position (RightScale 2017).

According to a 2017 report from Gartner, the worldwide public cloud services market is projected to grow 17% in 2018 to total \$287.8 billion, up from \$246.8 billion in 2017. The highest growth will come from IaaS, which is projected to grow 32% in 2018 to reach \$45.6 billion. SaaS is expected to grow 19% to reach \$55.1 billion. Over the next few years, the SaaS market is expected to experience a lower growth due to maturity of SaaS offerings and the acceleration in the buying of popular products such as Customer Relationship Management (CRM) and financial applications (Gartner Report 2017).

Advantages and disadvantages of CCT for small businesses

Several studies have identified reasons for small businesses to migrate to cloud and described the impact of cloud technology as it is progressively adapted by more smaller businesses (Lavoie 2015; Bask 2015; King, Hicks, and Reeves 2014; Truong 2010; Smith 2009; Hayes 2008). The main finding is that CCT 'Democratizes' IT implications for small businesses in the following ways:

- Makes it cheaper and easier to start and scale a business
- Lowers costs – variable instead of fixed costs
- Enhances flexibility at workplace
- Improves workplace collaboration
- Improves data security
- Provides scalable resources
- Enhances customer acquisition service and support
- Enables resources to be purchased with operational funds rather than as a capital expenditure
- Allows small businesses to shorten the delivery time and start the operations earlier
- Provides resources that were once limited to major enterprises accessible and affordable
- Enables a company to shift its business to another company offering better cloud service or lower price

The following sections discuss benefits of CCT for small businesses in more detail.

Benefits for small business

CCT is easy to adopt, with simple and up-to-date architecture. Cloud computing drastically lowers capital investment levels for hardware and software in small- and medium-sized companies. These companies can acquire IT resources that were not possible in the past. Cloud computing allows most software sectors less resource-intensive ways to get the applications they need to run in their businesses. For small businesses, the cost of deploying software applications such as customer relationship management (CRM), enterprise resource planning (ERP), project management (PM), and other sales, marketing, and accounting applications on the premises is expensive. It is more cost effective if you have these applications in the cloud. Another big advantage of using cloud for small

businesses is that they do not pay for the resources they have not used. Cloud vendors allow the flexibility of payments based on usage of resources (Hosseinian-Far, Ramachandran, and Slack 2018; Bask 2015).

The replacement of on-site solutions with the cloud computing model has the potential to deliver immediate benefits to users, including no server to maintain, no IT infrastructure to set up, no up-front licensing fees, and no software programs to buy, install, and maintain (Lavoie 2015). Getting more IT storage space has traditionally required more hardware and more expense. The cloud has more flexibility. CCT offers virtually unlimited storage space for small businesses. One can store a massive amount of data cheaply and acquire resources on demand. Companies can scale up or down depending on demand, eliminating the need for massive investments in local IT infrastructure. Managing resources is easier in the cloud. Computing resources can be deployed very quickly, bringing ease of use and financial benefits. The technology gives users the ability to choose IT resources in a way that can grow over time or change instantaneously, as needs change. Moreover, utilizing cloud services allows small businesses to receive automatic updates of software and applications. They are freed from the burden of managing software and can focus on the core of their businesses.

Cloud computing also improves collaboration for small businesses that have employees in different geographic locations. It allows dispersed groups of people to meet virtually and share information, which enhances employee and organizational productivity. Another big advantage of the cloud is that it allows for provision of reliable services, delivered through data centers and built on servers. Often, the cloud appears as a single point of access for all of a consumer's computing needs. In addition, cloud computing provides for better business continuity planning by protecting data and systems. Cloud service providers have advanced strategies to ensure that mission-critical data is backed up and protected in a secure and safe location. Cloud storage gives small businesses the ability to conduct business in a way that minimizes down time and loss of productivity (King, Hicks, and Reeves 2014).

Cloud computing is also environmental-friendly and economical. It has less environmental impact (reduced carbon footprint) and saves a lot of energy and space. According to several studies, cloud computing data centers, on average, produce 95% less carbon compared to on-premise data centers (Pillai 2011).

Additionally, it is argued that CCT features and resources such as customizability, alignment, and inter-connectivity will enhance competitive advantage through innovation and collaboration for small businesses. Small business owners need to understand how to use cloud computing wisely and how to exploit computing resources distinctively to make themselves different from competitors and to create and sustain competitive advantage (Truong 2010).

There are also other potential advantages to implementation of cloud technology for small businesses, including built-in disaster recovery capabilities and expertise, predictive cost modeling for a growing organization, easy customization, improved chance of competition, and leverage of Big Data analytics. Figure 4 shows the benefits of cloud computing for small businesses (King, Hicks, and Reeves 2014).

Disadvantages for small business

Cloud computing helps organizations achieve major benefits in two main categories of business and technology efficiency – accelerated time to market and increased business agility. However, these evolving cloud technology approaches can create security gaps



Figure 4. Compelling advantages of CCT for small businesses.

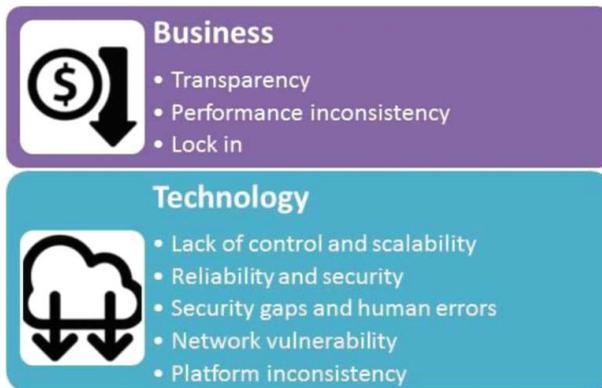


Figure 5. Disadvantages of CCT for small businesses.

and human errors. There are also other potential disadvantages to implementation of cloud technology in small businesses, including platform inconsistency, network vulnerability, data unreliability, and business discontinuity (RightScale 2017). Figure 5 summarizes the findings.

Obstacles to rapid adoption in small businesses

There are numerous challenges in applying CCT for small businesses in a way that allows for its significant and rapid growth. The 2017 state of the cloud survey conducted by Rightscale identified lack of resources/expertise, lack of time, difficulty of managing

costs, and security concerns as the most important cloud challenges facing small businesses (RightScale 2017). The following section summarizes these challenges:

- (1) Lack of sufficient internal resources – lack of training/expertise is one of the biggest hurdles to rapid adoption of CCT in small businesses. Small business owners tend to make decisions in isolation without the benefit of advice from competent IT professionals (Feltham, Feltham, and Barnett 2005). Such firms often do not have advanced IT support staff in-house, and it is rare that small business owners deviate from insular decision-making to listen to the advice of outside IT professionals. It is also the case that small businesses typically do not have the financial resources to hire advanced IT professionals in-house.
- (2) Lack of time to implement new initiatives – lack of sufficient time is also a major hurdle to rapid adoption of CCT in small businesses. Small businesses are often understaffed and overextended (Mazzarol 2003), leaving very little slack time to implement new initiatives. Even though cloud computing could bring small business considerable benefits, implementation is often passed on due to lack of time for the firm’s leaders to even consider the prospect.
- (3) Managing costs – there are other hurdles to rapid adoption – in particular the costs of maintaining the cloud and the speed of uploading files. Cloud costs can increase rapidly, especially for customizations to meet business needs. Large files can take a long time to upload, generating frustration and inconvenience for day-to-day business operations. Other hurdles include governance and control, the complexity of building a private cloud, and performance issues.
- (4) Security concerns – another hurdle to rapid adoption of CCT in small businesses is security/data control. The cloud is, by its nature, an open and shared resource. It is a potential target of cyber attackers. Three of the top cloud security issues facing small businesses are legal issues, compliance, and loss of control over data (Gonzalez et al. 2012). Other studies have identified a number of other security issues, including the following (Hemalatha and Manickachezian 2014; Winkler 2011a, 2011b):
 - Trusting a vendor’s security model
 - Loss of physical control
 - Quality of service guarantees
 - Potential for massive outages
 - Malicious insiders and abuse of cloud services
 - Service traffic hijacking – phishing, buffer overflow attacks, and loss of passwords
 - Reliability of the cloud provider’s service
 - Governance – data control, security control, and lock-in
 - Network security – transfer security, firewalling, and security configuration
 - Data security – cryptography, redundancy, and disposal

Cloud computing deployments in small businesses

Today, global economy is going through a series of changes that are reshaping economic landscape. In this environment, many small business owners are using the power of CCT to create new innovative models that work for their needs (King, Hicks, and Reeves 2014). Implementing an effective cloud computing strategy requires time and effort. Many parts of the company will be impacted, there are complex decisions to be made, and various stakeholders need to be involved. Many companies have failed with the

deployment of cloud computing because of the failure of developing a cloud strategy rooted in the delivery of IT services which are linked to business process outcomes. Furthermore, many businesses do not know how to initiate their cloud projects. Before deploying cloud services in an organization, the place where cloud services will add business value needs to be identified. Thereafter, a scalable deployment approach needs to be planned.

Conceptual model for implementation

Gartner recently conducted a 12-month long survey of enterprises with cloud management strategies and identified the three phases of cloud adoption strategy described in the following and summarized in Figure 6 (Smith 2016).

In phase 1, companies learn about cloud technology and perform detailed analysis of their applications and of the services they need. Cloud computing focuses mainly on services, not on technology. Services can range from automated IT tasks, to IT services, to automated business processes. Delivery of CCT services to users is based on what they need. Consumers of the service place service requests, and they are billed for what they use. The most impactful deployments start with users fully understanding their desired business outcomes and then identifying the services that will be offered via a public and/or private cloud. Questions such as what services users need, how much of each service will be consumed, when each service will normally be consumed, which users will consume each service, and what is a reasonable price for each service need to be answered.

In phase 2, users need to document and analyze the internal processes that will be affected by the selected cloud services. During this analysis, users should study the internal processes involved with offering the relevant cloud services. This might bring to light the need to flatten, reconfigure, realign, refine, or eliminate inefficient processes and target repetitive manual processes for automation. The types of security that will be applied to the deployment must also be addressed.

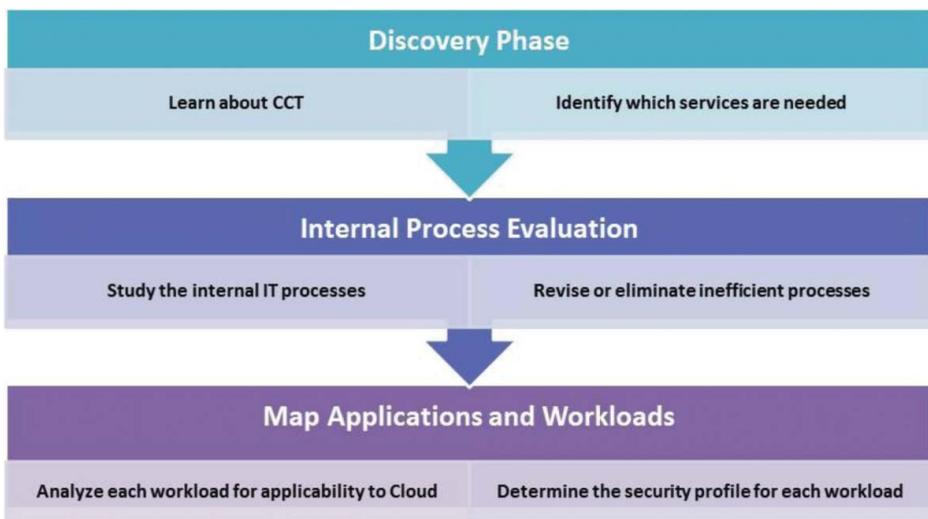


Figure 6. Cloud computing deployment phases.

In phase 3, users should map applications and workloads to associated cloud services. Each workload should be reviewed based on its applicability to cloud computing and its location environment. Next, a detailed review of the overall architecture of the workloads that make up an application is necessary. Finally, users need to determine the security profile of each workload – for example, can it reside off-premises and does it need to be encrypted? After users analyze the workload, decisions need to be made regarding what cloud computing deployment model is best for the organization’s applications and workloads. Should the workload run in a public cloud, an on-premises private cloud, or both? [Figure 6](#) shows a summary of deployment phases.

Key factors to consider

Cloud computing deployments in small businesses must keep a number of factors in mind. These include consultation with management, business process planning, and cost. Consultation with management is crucial because small businesses are often highly dependent on a single individual or small group of individuals who make all strategic decisions (Feltham, Feltham, and Barnett 2005). Failure to consult with management would run the risk of completely missing the business goals of the organization. Business process planning is important because the organization likely has processes and information resident in various parts of the firm.

Failure to do business process planning would run the risk of omitting key elements of business operations from the new cloud infrastructure. Cost is important because many small businesses are cash-strapped. Failure to consider the costs of a cloud computing adoption could result in serious financial difficulties for the firm.

The following section further discusses key adaptation factors:

- (1) Consultation with management – as mentioned above, consultation with management is crucial for cloud deployment success in small businesses because of the decision-making power which most small business owners have over their firms. Such leaders have many key details about the operations of their companies (including their cloud-relevant IT processes) in their heads, and it is crucial to get these details out of their heads and into external documentation. They also exercise key decision-making authority over any move toward a cloud configuration.
- (2) Business process planning – in addition to consultation with management, business process planning is critical for cloud implementation in a small business setting. Perhaps even more so than larger firms, small businesses often have no formal documentation of their business processes and how these processes impact their IT practices. In order to properly identify business issues and their implications for a cloud implementation, small businesses need to complete a thorough inventory of their business practices and processes. The tasks of individual workers and the flows of information through the enterprise need to be properly reflected in the new cloud infrastructure.
- (3) Cost – finally, cost is an important factor to consider for cloud implementations in a small business setting. Small businesses are often cash-strapped, so the potential cost of a cloud implementation can be daunting for many of them. Careful consideration of the cost of individual elements of the cloud implementation can prove valuable for small businesses looking to implement cloud infrastructure as economically as possible. Consideration of the scope of the project can help contain overall costs so that they do not spiral out of control.

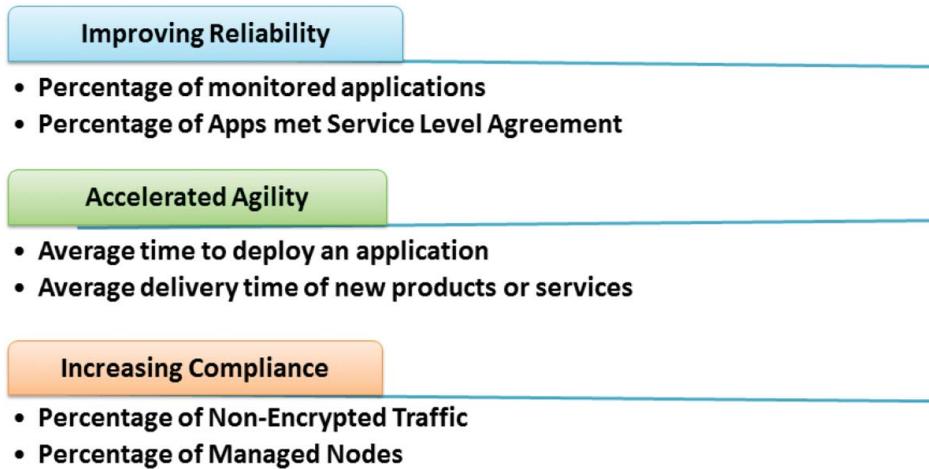


Figure 7. Performance metrics and recommended measurements.

Measuring the business impact of the cloud

IT spending on cloud technology is booming. According to International Data Corporation (IDC) forecasts, one out of every three dollars spent on IT infrastructure is spent on cloud technology. The same survey predicts that spending on the public cloud will reach 160 billion in 2018 and top \$277 billion by 2021 (IDC 2018). With ever increasing cloud spending, organizational leaders will need more spending accountability. The biggest cloud challenge for many small businesses may be ‘measuring return on investment (ROI).’ It is easy for organizations to focus on technology implementation projects, but much more difficult to understand operational benchmarks and track financial metrics. What metrics can small businesses use to measure performance? Some companies are using a methodology known as Value Engineering to produce value metrics. Other companies are using financial metrics to measure cloud technology’s ROI.

In an article published in 2013, Chau recommends four performance metrics that companies should consider when adopting a cloud strategy. The first two are considered important metrics for showing ROI. These two metrics prove that the cloud can maintain and improve performance benchmarks (Chau 2013).

Figure 7 summarizes these performance metrics and recommended measurements that can help establish benchmarks after a transition to the cloud.

Common uses of CCT in small businesses

Common uses

CCT in small businesses has several common uses (Martinez 2018; Aland 2017; Bailey 2017). These include data storage, shared applications, and remote user cooperation. Each of these uses has the potential for making a critical positive impact on small business operations.

- (1) Data storage – one common use of CCT in small businesses is data storage. Given the challenges of sharing files across multiple individual machines, cloud usage offers the advantage of providing access to files for all users regardless of

location. It also provides secure, centralized backup and protection of all company files. Small businesses can engage in much more flexible, potentially more secure operations when utilizing cloud technology.

- (2) Shared applications – another common use of CCT in small businesses is shared applications. Applications can be utilized to maximum efficiency by centralizing them, rather than having them located piecemeal throughout the organization. Expenses for applications can be considerably reduced by only utilizing apps when needed, rather than paying for full ownership of the application. This is important for small businesses, which are often under-financed and looking to save money wherever possible.
- (3) Remote user collaboration – a third common use of CCT in small businesses is remote user cooperation. Part time or remotely-based workers can easily cooperate with those in the main office without the need for costly remote infrastructure. Workers within the same location can also easily cooperate without the need for conference room space or for sending files back-and-forth. In general, CCT brings together workers in a virtual work environment ideal for the achievement of team goals.

Cloud-based tools used by small businesses

Cloud-based services have also made possible a wide array of time-saving tools and applications for small businesses that make performing business tasks a lot easier for them. For example, tasks such as sending invoices, managing sales tax payments, marketing, and sales are faster and more efficient using cloud services. Top business applications currently offered in CCT use (Martinez 2018; Aland 2017; Bailey 2017)

- Office tools/productivity
- Collaboration and communication solutions
- Web/E-Commerce, email
- Marketing and CRM
- Financial and accounting (record keeping)
- Help desk and IT support and security
- Sales automation software
- Operations and HR services
- Project and product management
- Backup and recovery

Applications of CCT in small business

Cloud deployments can vary depending on the type of small business in question. Three good examples of this are service firms, manufacturing firms, and retail firms. Each is examined in turn in the following:

- (1) Cloud deployments in small services firms – small service firms are particularly impacted by the capacity of cloud technology to enable cooperation among workers. Service firms offer as their main product the productive efforts of staff members. Enabling these staff members to cooperate without regard to physical location unlocks the potential of better service delivery to customers.

- (2) Cloud deployments in small manufacturing firms – small manufacturing firms are particularly impacted by the capacity of cloud technology to share application usage. The ability to share application usage can significantly streamline manufacturing processes. This leads to superior product quality.
- (3) Cloud deployments in small retail firms – small retail firms benefit in particular from the data storage capacity of cloud technology. Retail operations maintain relatively extensive records of inventory and customer information. The ability to store all these records in a safe, central cloud location is a major benefit for these firms.

Small business success in the cloud

Different cloud generations

A 2014 study conducted by the Intuit focused on how cloud computing is transforming small businesses. The study argued that CCT, like any new technologies, tends to go through three broad generations as shown in Figure 8. The first generation of cloud occurred after a technology was first commercialized and brought efficiency gains for early adopters. CCT democratized IT implications for early adopters by providing resources that were limited to major enterprises. The replacement of on-site solutions with the cloud computing model delivered immediate benefits to users. Examples of a first generation cloud products are Microsoft, Google, and Amazon's Web Services, which are still heavily marketed as a way to reduce IT costs (no server to maintain, no IT infrastructure to set up) and increase the speed and ease of deployment (Small Business Labs 2014). The study argued that CCT is rapidly moving to an entirely new phase (second generation) since the technology is driving a comprehensive transformation of digital assets in organizations. In this phase, the technology is destined to prove far more transformative and disruptive than the initial phase of cloud deployment. IT decision-makers begin to view the emerging cloud technology as a proxy for the transformation of IT itself. During

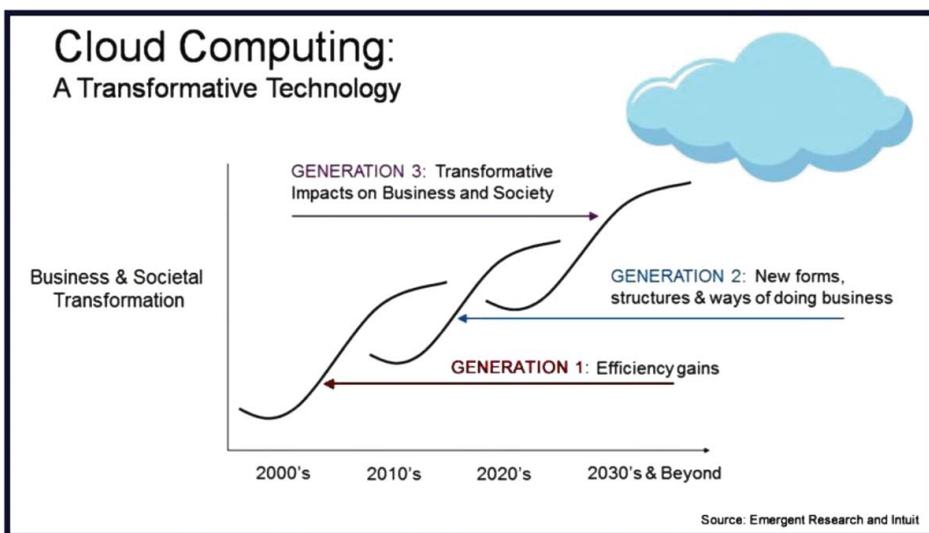


Figure 8. Three generations of CCT.

the second generation, people and businesses have adapted to the new technology, created new ways of doing business as well as new business forms and structures. CCT has also revolutionized the software paradigm where cloud resources and software are offered as a service. Small businesses have increasingly adapted to the cloud by taking advantage of software services that can be seamlessly integrated into back-office and front-office operations. In the next section, we have listed several cloud services for small businesses, covering software tools from communications, and finance to CRM and marketing.

Popular cloud tools and services available to small businesses

Building an IT platform can be complex and expensive for many small businesses. In recent years, software companies have taken this into account and have developed tools that are specifically designed for small business. There has been a huge growth in low cost and free cloud based technology for social interaction, publishing, collaborating, editing, content creation, computing, etc. These platforms are cloud-based, simple, and could get small business started with minimum efforts.

Several companies are providing cloud services for small businesses including Microsoft (Microsoft Azure), Google (Google Cloud), and Amazon (Amazon Web Services). Many small businesses are using Microsoft products including Office 365, office Web Apps and Business productivity online suite for many more years. Similarly, many small businesses are using Google Apps (email, calendar, and documents) for communication and collaboration. Amazon cloud is being used for creation of flexible IT infrastructure in these institutions.

The following section lists tools that provide reduced costs and increased efficiencies for small businesses. They might not be the best in their respective classes, but they are best suited for the small markets (Martinez 2018; Aland 2017; Bailey 2017; Wood 2017; Schenker 2016; Evans 2015; Nazar 2013).

- (1) Collaborations and communications – software services in this category make teamwork easy, more fun, and inexpensive. They are easy to set up and provide collaboration tools such as shared desktops, white boarding, and in-app private chat. One can easily create chat rooms for employees, create email templates that help send emails quickly, and run and manage robust and easily automated email campaigns. Email marketing tools can be used for sending promotions, announcements of new features or services, and discounted coupons to customers. [Table 1](#) provides a list of some of the cloud services available for communications and collaborations.
- (2) Social media marketing and commerce tools – *Google Analytics* is one of the most popular social media analytics tools available. It provides easy tracking and report for website traffic. One can sift and sort website visitors with dozens of dimensions. *Sprout Social* is another social media analytics tool that provides a clean design-making sorting and discovering data easy. *AdWords* is Google's pay-per-click (PPC) advertising system and is one of the most measurable and flexible of online advertising. It is transparent, providing tons of metrics that allow any small business to see what online advertising works and what does not. *Shopify E-Commerce* is an online shopping cart that can be used for web-based storefront. The platform provides many templates and tools to make online business easier to oversee. It is easy to use and requires little technical expertise to set up. Finally, *Microsoft Power BI* is a free Business Intelligence tool that lets one

Table 1. Cloud services available for communications and collaborations.

Software tools	Service providers	Solutions
Teamwork	<ul style="list-style-type: none"> Asana 	Make teamwork easy and fun-free version supports up to 15 members.
Voice Over IP (VOIP)	<ul style="list-style-type: none"> Citrix Grasshoper 	Provides access to basic phone systems such as call routing, faxing, and voicemail.
Video conferencing/ online meeting	<ul style="list-style-type: none"> ClickMeeting Microsoft Teams Skype 	<ul style="list-style-type: none"> Provides inexpensive collaboration tools such as shared desktops, white boarding, and in-app private chat. Skype allows professionals to collaborate through screen sharing, instant messages, video conferencing, audio conferencing, and file sharing.
Chat-based communication	<ul style="list-style-type: none"> Slack 	Allows users create chat rooms, private chats with small groups, and one-on-one private chats.
Email marketing	<ul style="list-style-type: none"> MailChimp 	It provides a rich, free plan and many email templates that help you send emails quickly.
Campaigner email marketing	<ul style="list-style-type: none"> Campaigner 	Enables you to run robust and easily automated email campaigns.
Managing social campaign	<ul style="list-style-type: none"> Hootsuite 	Enables you to manage your social campaigns. It offers tools for listening, publishing, and third-party integration.
Surveys and campaign monitoring	<ul style="list-style-type: none"> SurveyGizmo GetFeedback 	<ul style="list-style-type: none"> Helps one build, style, test, share surveys, and examine the results. Help solicits feedback from people who are using mobile devices.

drag, drop, customize, and analyze data, up to 1 GB. There is a monthly charge if you decide to increase your data tenfold.

- (3) Managing business projects – small businesses can use numerous cloud-based applications and services available for managing business projects, such as human resources, accounting, invoicing, and even document storage and sharing, and online backups, at affordable cost. [Table 2](#) highlights some of these SaaS-based services for small businesses.

Case example of success

In this section, we discuss case example of a small business that has successfully migrated to cloud-based infrastructure and have been using various cloud services throughout its company for many years.

Interactive Educational Services, Inc. (IES) was founded in 1994, in Bakersfield California, to provide expertise in developing and managing online educational activities, certificate programs, and professional designation programs ([IES Web Site 2018](#)).

In 2002, the company changed its direction and started offering a full range of web development packages and e-Business solutions to private and nonprofit organizations all around the USA. IES is developing new tools, teaming with Web specialists, and forming new alliances that keep it at the forefront of the web technologies movement ([IES Web Site 2018](#)). One of company’s platforms called ‘Cyberschool’ is being used by more than 1000 schools nationwide. It is a great platform for improving communications throughout

the school district and reaching the community at large. With more than 2000 customers in 48 states, IES is the biggest web and Mobile App development company between San Francisco and Los Angeles. IES efforts have been recognized in Forbes and Entrepreneur magazines. In 2008, the company was the Recipient of Goldline Research awards for ‘The Most Dependable Web Designers’ in California (Goldline Research 2008) and in 2009 and 2010, IES was the recipient of the ‘Leading Web Provider’ of the Western United States (Goldline Research 2009, 2010).

IES has helped many companies increase productivity, reduce costs, and improve customer loyalty by optimizing their web presence. At the same time, the company has combined effects of emerging Internet technologies, increased computing power, and fast, pervasive digital communication to spawn new ways to manage talent and assets as well as new thinking about organizational structure. As the technology landscape has continued to evolve, IES made CCT at the core of its technology upgrade. During a February 2018 site visit, Mike Diaz, IES project manager mentioned that since 2002, the company has been using a series of Web-based cloud services for e-mail marketing, video conferencing, CRM, financial analysis, creating documents and spreadsheets, bypassing capital investment in servers and software licenses.

Since the introduction of CCT, operating costs have reduced and efficiencies have increased. IES has experienced a noticeable increase in office productivity. For example, between 2014 and 2017:

- The time that it takes to design and develop a custom web site decreased by 30%.
- The cost of IT support and customer service decreased by 40%.
- The office productivity increased by 35% as measured by fewer number of employees.

SaaS enabled IES to access many services at a low cost. More specifically, the company is using the power of CCT in the following ways:

Communications and collaborations

- Voice Over IP (VoIP) – IES is using *Asterisk* to gain access to basic phone systems features such as voicemail, call routing, faxing, call recording, and dial-in conferencing for its 15 employees.
- Video conferencing and meeting management – IES is using *Zoom* for video conferencing and *Go-to-Meeting* for meeting its customers online for demonstration of its platforms or for providing customer support. Features such as shared desktops, white boarding tools, and in-app private chat enhance communication with customer.
- Email marketing – IES is using email marketing service provided by *Send Blaster* effectively for sending promotions, announcements of new features or services, and discounted coupons to its customer. IES takes advantage of email analytics feature provided by the module to find out whether its messages and/or promotions are effective or are falling flat.
- In-house and online chat with customers – *Rocket.Chat* provides IES employees with an easy-to-use and a powerful communication platform. This chat-based communication tool is designed for teams of all sizes to communicate with one another through the workday. IES employees create chat rooms, private chats with small

Table 2. Cloud services available for managing various business activities.

Software tools	Service providers	Solutions
Human resources (HR)	<ul style="list-style-type: none"> • Zenefits Z2 • InteliUs 	<ul style="list-style-type: none"> • This HR and Management System software offers benefits administration. It can integrate with most of the industry's popular payroll tools. • Run a background check on prospective employees, browse criminal records and other information.
Contract management	<ul style="list-style-type: none"> • Agiloft 	Offers unlimited customization to handle contract management. It offers an easy way to automate and simplify how to create, manage, and store contracts.
Accounting	<ul style="list-style-type: none"> • Intuit QuickBooks Online Plus • Xpenditure Small Business • FreshBooks 	<ul style="list-style-type: none"> • Provides inexpensive accounting package with a comprehensive set of features for small businesses. It features flexible contract records, transaction forms, and report templates. • Helps with expense tracking. • Provides on-the-go invoicing, PayPal and credit card processing of invoices, and expense logging.
Payroll	<ul style="list-style-type: none"> • SurePayroll • Intuit QuickBooks 	Allows users create and manage employee payment records.
Email marketing	<ul style="list-style-type: none"> • MailChimp 	It provides a rich, free plan and many email templates that help you send emails quickly.
Document management	<ul style="list-style-type: none"> • Ascensio System OnlyOffice 	Provides you with business document management, file sharing, online editing, project management, and calendar integration.
Backup storage	<ul style="list-style-type: none"> • IDrive 	Provides 1 TB of online backup storage. The tool features an easy setup, unlimited access, continuous backup, disk image backup, folder syncing, and more.
Customer relationship management (CRM)	<ul style="list-style-type: none"> • NutShell CRM 	Specially designed for small businesses, the software automates sales processes, simplifies contact management, and provides reports and analytics.
Web hosting	<ul style="list-style-type: none"> • Site Ground • DreamHost 	<ul style="list-style-type: none"> • Provides limited storage and data transfer and backups. This web hosting tool is very easy to install and manage. • Offers unlimited disk storage space, domains, emails, and monthly data transfers.

(continued)

Table 2. (Continued)

Software tools	Service providers	Solutions
Employee time tracking	<ul style="list-style-type: none"> • TSheets • Chrometa 	These two-time tracking solutions provide deep customization options, user friendly navigation, and passive time tracking option.
Helpdesk	<ul style="list-style-type: none"> • Happy Fox • Vivantio Pro 	<ul style="list-style-type: none"> • Provides a combination of automation and self-service tools that reduce help desk's ticket workload. • Allows IT managers to create custom forms and track task progress.

groups, and share files. The online feature enables IES to communicate with prospects while they are browsing the company's web site.

- Help-desk and customer service ticketing – IES staff provides phone, email, and/or help desk support on an ongoing basis. Technical support technicians are available to work with clients to resolve any and all issues that may be experienced. In order to streamline support requests and better serve its customers, IES utilizes *OS Ticket*, a support ticket platform. It features a combination of automation and self-service tools that reduce ticket workload in order to provide fast customer service. Every support request is assigned a unique ticket number which can be used to track the progress and responses of customers online. For each reference, the platform provides complete archives and history of all customers' support requests.

Security and network monitoring

According to Robert Mann, the company IT director, IES provides web hosting services, with solid security and data protection, to all of its more than 2000 clients. In addition, IES uses private cloud infrastructure. All servers are located in a building off premises and are managed by the *CenturyLink*, a secure management service. Private clouds provide greater control over the cloud infrastructure and are ideal for IES customers. IES servers are run on a secure, high-end redundant computer network. The hosting service offers a secure state-of-the-art data center with 24-hour, year-round monitoring system to ensure maximum uptime and system protection along with daily backups, redundant Internet connections and on-site generators with battery backups. IES also employs the following cloud software services for the security and maintenance of its CCT:

- Network monitoring – *Site 24 × 7*
- AntiVirus – *Kaspersky* and *Malware Bites*
- Server backup – *Storage Craft* and *Home Written Scripts*, for providing automatic backups and delivering excellent security.

Mobile communications and social media marketing

- Mobile communications – Mobile communications are essential when it comes to engaging K-12 digital parents and keeping them informed about school events and activities while they are at work or on the road. A branded mobile app can deliver

the most often requested school information and news updates. IES develop Mobile App for its k-12 Cyberschool clients. The company uses two frameworks, *Ionic* and *CF Wheels*, for developing hybrid Apps. Both frameworks offer a nice selection of templates and fields to help guide IES through the creation process.

- Web analytics – IES is using *Google Analytics*, one of the most widely used web analytics service on the Internet. Using this free software analytics, IES' clients can track and report website traffic for their web sites. The analytics give clients insights into how users find and use their websites. They can sift and sort their visitors with dozens of dimensions. They can also track ROI for their online marketing.
- Social media marketing – IES is using a healthy balance of social media marketing channels, including organic search, email marketing, events, social media, and other lead sources. Moreover, IES is using *AdWords* – Google's PPC advertising system for its own web site because AdWords delivers measurable ROI. Compared to traditional marketing channels such as TV and magazine advertising, online marketing is highly measurable, and AdWords is one of the most measurable and flexible of online channels. It is transparent, providing a multitude of metrics that allow you to see what works and what does not.

Financial tools and employee time tracking

IES uses a host of online software for handling of its financial needs. For example, IES uses *Approveme* to handle its contract management. The software tracks activity and capture signatures in minutes. It enables IES to automate and simplify creation, management, and storage of the contracts sent and signed by clients. For its payroll, IES is using Intuit *QuickBooksPayroll* that enables the company to create and manage employee payment records. In addition, IES is using an RFID reader for time tracking where employees can Clock in/out using a Key Fob. The Reader integrates with QuickBooks and provides a report for quickly understanding and tracking employees' timesheet. Additionally, IES uses both *PayPal* and *Authorizes.net* for merchant gateways for processing of customers payments in various forms (credit cards, debit cards, PayPal, and PayPal Credit).

Web design and social media integration

IES creates engaging, interactive websites using social media features such as blogs, forums, wikis, news and announcements, event calendars, media galleries, RSS syndication, sharing and bookmarking toolbars. These features provide technology solutions to help implement a social media strategy by 'engaging audience' and distributing content across various social platforms. According to Viking Mann, Marketing director at IES, the company uses Adobe Suite, including *Photoshop* for editing and compositing of photos, web, and mobile app designs and *Dreamweaver* for design and development of modern, responsive websites.

Social media platforms such as Facebook, Twitter, LinkedIn, and YouTube are great communication and marketing tools. They allow customers to give instant feedback on products and services. IES uses many social media tools in order to reach a broader audience and expand its online presence. The company selects the right channels to boost its leads, and then drive engagement in its web content through conversation and community.

Summary and conclusion

The digital revolution is helping organizations transform their businesses to better engage and stay connected with customers, suppliers, and employees. The internet and services related to it create an interactive working environment for users. Through the Internet, effective cooperation is possible whenever, wherever, and with whomever. Cloud computing emerges as a quickly evolving technology that ever more companies are willing to adopt in order to improve collaboration. Advantages such as increased IT infrastructure flexibility, computational power, the opportunity to use an existing infrastructure on a pay-per-use basis as well as leverage that infrastructure for big data analytics, better information visibility, and disaster recovery cost effectiveness make cloud technology a viable choice for many companies.

Cloud-hosted servers are providing a significant savings for small businesses. By utilizing PaaS and SaaS structures, small businesses can gain benefits and improve productivity and security. CCT enables IT infrastructure of small businesses to evolve quickly and allows companies to save time and focus on new opportunities. Small businesses now have the ability to access the same types of high quality enterprise IT services utilized by larger organizations at a cost and scale that is affordable for businesses of smaller size. CCT enables small businesses to store the company's most important data in a secure cloud-based system. Not only are cloud-based services cheaper than traditional ways of managing in-house IT for small businesses, they are also safer for data storage and disaster recovery. As discussed in this paper, small businesses can use numerous SaaS-based applications and services available for managing business projects, document storage and sharing, marketing, and accounting at affordable cost. The study also discussed example of a small business that has successfully migrated to cloud-based infrastructure and has been using various SaaS-based applications and services to reduce operating costs and to increase productivity.

This study concluded that cloud computing introduces both challenges and new possibilities to many aspects of Internet architecture, protocols, services, and applications. This technology will affect many people in the organization and has a significant impact on IT investment and costs. Moreover, this paper used the three phases of cloud adoption strategy and proposed a conceptual framework for implementation of CCT in small businesses. Furthermore, this study identified security as one of the main stumbling blocks to wider CCT adoption for small businesses. As discussed in this paper, CCT systems are a major target for cyber attackers. These vulnerabilities show the importance of protecting cloud platforms, infrastructures, hosted applications, and information and create demand for higher-level cloud security management and centralized management of security in cloud environments. Other major concerns of IT managers are compatibility of the cloud with company policies, the IS development environment, and business needs. Implemented properly, cloud technology has real potential to enable accuracy, reliability, service enhancement, and cost reduction for small businesses. The challenge for IT experts today is to understand the role of CCT and develop strategies that exploit its potential. They should complete the prerequisites (the three phases of cloud service adoption strategy) before making the technology decisions necessary for successful, service-centered CCT strategies.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on Contributors

Mohsen Attaran is the 2004–05 Millie Ablin Outstanding Professor of Management at California State University, Bakersfield. He obtained his Ph.D. in Systems science with specialization in Operations Management and Technological Forecasting from Portland State University. He is the author/co-author of three books, over 100 peer-reviewed research papers, and ten commercial software packages. He is a three-time recipient of the Meritorious Performance and Professional Promise Award for outstanding performance in teaching, research and community services. In 2006 and 2016 he was nominated by CSU-Bakersfield for Wang Family Excellence Award and in 1996 he was honored as recipient of the El Paso Natural Gas Faculty Achievement Award. Professor Attaran has been a consultant for public and private organizations and has conducted numerous in-house workshops and seminars for Fortune 1000 companies. He is the founder and president of IES, Inc. a web and Mobile App Development Company with more than 4,000 clients in 48 states. He has founded, launched and managed several businesses in his career in a variety of technological fields including a Telehealth Doctor Visits; a subscription based virtual business, and a non-profit organization with the aim of closing the gender gap in coding.

Jeremy Woods is an international business development scholar, educator, and consultant with over 20 years of experience. He is an author and coach in the areas of small business executive decision-making, entrepreneurial project implementation, lead generation, and sales management. Mr. Woods has been a key player in a number of educational, consulting, and business expansion projects in North America, Europe, and Latin America. His research is focused on strategic decision-making in family- and privately-owned entrepreneurial businesses. Mr. Woods is an assistant professor at California State University Bakersfield's College of Business and Public Administration.

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