The ICT Age

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Edited by

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EDITORIAL

We are living through exhilarating times and constant changes. Notwithstanding challenges faced, the world is on an exceptional ride towards advancement in every facet of life largely driven by the unprecedented developments in ICT over the past 3 decades. This book comprising 9 chapters covers the latest developments in cloud computing, game-based learning and virtual environments. We hope these chapters will help the reader to get a grasp of the ICT age in these 3 areas, as well as provide the background knowledge to extend this to other areas that are relevant to the reader. As this book is a collection of state-of-the-art research findings which were developed into chapters, it is not for programmers or developers or technologists looking for technical guidance or programming tid-bits. The intended audience for this book are academics, researchers including PhD students and practitioners.

First this book presents developments in Cloud computing technology and how we process and communicate such information. Cloud is increasingly being used in high-performance computing, where computer servers can be accessed and used over the cloud. Files and backup services are another area. We can store, modify and retrieve information anytime, anywhere, both securely and in a scalable manner and these are a few benefits mentioned as the vision of cloud computing to be the fifth utility. Challenges in cloud technology and its impact on the ICT age are emphasized in this book.

Next the emphasis is on game based learning in the ICT Age. Traditionally, game based learning and gamification, had little or no place in the learning curriculum. However, today, in classrooms, a range of game based technologies have found their way into the learning space, and are now being used to help make teaching and learning experiences that were considered demanding and challenging to become more appealing to the learners. This is transforming the way we teach and engage with learners, as young and old learners find game based learning more motivating. This is because of staged learning through different levels, through problem solving as well as engaging in critical thinking and decision making. Furthermore, in game based learning through ICT,

learners engage actively through community development, not only within the classroom, but through global interaction.

The book also discusses virtual environments. ICT helps represent the virtual worlds through shape models, their behaviour and through interaction. The aim is to create a real life experience, but through the medium of ICT. Models can be created that mimic the real world objects, or even objects that cannot be seen in the real world.

We thank all the authors for the chapters they have contributed to this book. We also thank the staff at GSTF and CSP for all their hard work in making the coming together of this book on ICT Age.

We hope the book will help to widen the understanding of cloud computing, gaming and virtual environments and for readers to become more involved in these technologies whether as researcher, developer, practitioner, user or in any other capacity.

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CLOUD COMPUTING ADOPTIONS IN PUBLIC SECTORS

FAN ZHAO

Abstract

Despite the number of benefits cloud computing technology has to offer all organizations, both public and private, risk elements to consider still remain. Previously, these elements were used in evaluating if an organization would move towards the cloud or not. Today, it is no longer a question of if, but a question of when. The task of evaluating the benefits and risks is now part of the gap analysis used to determine which vendor to contract with. In the public sector, government entities face a different set of rules and higher scrutiny when it comes to data security and budgeting. By evaluating what steps early adopters have taken in their investigation and analysis processes prior to choosing a vendor, this paper explores the essential information about cloud computing adoptions in public sectors and provides some guidelines that governments can use in their decision making process when considering cloud services.

Keywords: Cloud Computing, Public Sectors, e-government

1. Introduction

Cloud computing represents a change in the way organizations do business with regards to technology. It provides flexibility and cost savings to an organization in that they no longer need to invest large amounts of capital to get a software project up and running.

With its growing popularity over the last few years, many people have offered a variety of definitions for the "Cloud" (Buyya, 2008; Wang, 2008; Vaquero, 2009; Geelan, 2009). Some of the key words and phrases used to describe the cloud pulled from such definitions include: on-

demand, pay-as-you-go, virtualization of resources, outsourced, web-based and elastic. In an effort to provide potential consumers with a "tool" to compare cloud services and deployment strategies, in 2011, the National Institute of Standards and Technology (NIST) published the following working definition of cloud computing (Brown, 2011):

> "Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management efforts or service provider interaction (Mell & Grance)."

The definition goes on to define the essential characteristics of the cloud deployment models and the cloud delivery models.

1.1 Cloud Benefits and Concerns

Following the rush to define the cloud, the literature shifted to a review of its benefits and shortcomings/concerns in terms of organizations moving to the cloud. A survey of 137 federal government technology professionals revealed that among the participants, the number one business driver of cloud computing was lowering IT costs, while the top concern was cloud security (Biddick, 2011). The literature indicates that some of the key advantages of cloud computing include lower up-front costs to implement new technology, rapid implementation, scalability, low to no maintenance costs, and energy efficiency/green technology (Gruman & Knorr, 2008; Armbrust, 2009; Martson, 2011; West, 2010). Areas of concern included security, lack of control (data and applications are stored off site), compliance, integration, and reliability (Armbrust, 2009; Paquette, 2010; Martson, 2011; Schwartz, 2011). Many of these security issues are now being addressed (Kundra, 2010).

1.2 Moving to the Cloud

As the benefits become too great to ignore and the shortcomings are worked out as the technology evolves, current literature focuses on how organizations, both public and private, can take advantage of what the cloud has to offer through case study analysis and predictions for the future of cloud computing. In early 2011, realizing that the size of the federal IT budget could be reduced drastically by utilizing cloud computing, the U.S. Chief Information Officer released his "Federal Cloud Computing Strategy" report which discussed the newly implemented "Cloud

First" policy. This policy requires federal agencies to "evaluate safe, secure cloud computing options before making any new investments (CIO Council, 2011). The strategy sped up the process of federal government agencies moving toward the cloud, thus provided researchers many case study opportunities (Wyld, 2009; Biddick, 2010; Kundra, 2010; West, 2010). Many of the cloud case studies that have been previously published are reviews of what the organizations have implemented and how they have benefited. The case study literature lacks in reviewing the steps taken in the analysis and investigation stage of the process, prior to choosing a vendor. This paper aims to fill that gap.

Cloud computing is adopted based on the essential characteristics of the cloud deployment models and the cloud delivery models. The delivery models include Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). IaaS allows consumers the ability to deploy and maintain their software and operating systems using equipment housed at the provider's site. Consumers also have the ability control select networking elements. This eliminates the need for the consumer to purchase and maintain the equipment that runs their applications. In the PaaS model the hardware and operating systems are housed and maintained at the service provider's site while the consumer controls their deployed applications. This allows consumers the ability to develop and test new software applications without investing a large amount of capital for the hardware to run those applications. In the SaaS model, consumers access applications through a web environment. The service provider houses and manages the entire system and related software. Because the application is hosted, there is often nothing to install on the local machine thus alleviating the burden of maintaining the software the consumer would otherwise face. Web-based email is an example of SaaS. This paper will focus on the Software as a Service (SaaS) model which has been referred to as the core of cloud computing (Erdogmus, 2009).

Cloud computing is an emerging business and technology concept to support an on-demand delivery of computing, storage and applications over the Internet. A recent IDC report shows global revenue in cloud software market reaching $22.9 billion and it will grow to $67.3 billion in 2016 (Mahowald & Sullivan, 2012). This projection includes revenue generated by the shift from on-premise to on-demand providers as well as by the planning and architecture behind the shift. Cloud computing is a

model for enabling convenient, on-demand network access to a shared pool of applications and resources.

1.3 Structures of Cloud Computing

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

For enterprises, Cloud Computing can be adopted as one of the following services:

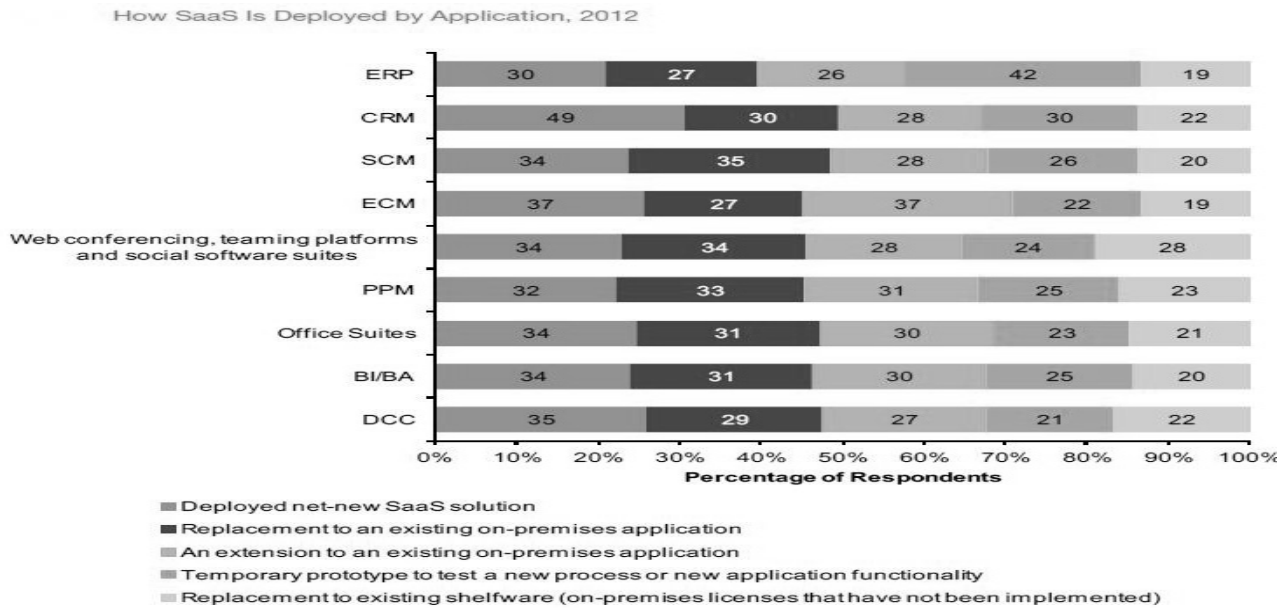
- Software as a service (SaaS): providing software subscription services
- Storage as a service: providing remote storage resource services
- Database as a service: providing remotely hosted database services
- Information as a service: providing remotely hosted information services
- Process as a service: providing business processes based on remote resources
- Application as a service: also known as SaaS
- Testing as a service: providing testing services for local or remote systems

- Platform as a service (PaaS): providing a complete platform to support application development, interface development, database development, storage, information and testing
- Infrastructure as a service (IaaS): providing a service to access computing resources remotely
- Security as a service: providing core security services remotely over the Internet
- Integration as a service: providing a complete integration stack service

According to Beaubouef (2011), there are three Cloud Models of ERP adoption:

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

Additionally, according to Gartner's report (2012), more and more companies are considering on-demand services in different applications (Figure 1.1).



BA = business analysis
BI = business intelligence
DCC = digital content creation
ECM = enterprise content management
PPM = project and portfolio management
SCM = supply chain management
Note: Number of respondents ranged from 333 (DCC) to 554 (ERP).

Figure 1.1. How SaaS Is Developed by Application

As the benefits become too remarkable to ignore and the shortcomings are worked out as the technology evolves, current literature focuses on how organizations, both public and private, can take advantage of what the cloud has to offer through case study analysis and predictions for the future of cloud computing. In early 2011, realizing that the federal IT budget could be reduced drastically by utilizing cloud computing, the U.S. Chief Information Officer, Vivek Kundra, released his "Federal Cloud Computing Strategy" report which discussed the newly implemented "Cloud First" policy. This policy requires federal agencies to "evaluate safe, secure cloud computing options before making any new investments (CIO Council, 2011). The strategy sped up the process of federal government agencies moving toward the cloud, thus provided researchers many case study opportunities (Wyld, 2009; Kundra, 2010; West, 2011). Many of the cloud case studies that have been previously published are reviews of what the organizations have implemented and how they have been benefited. The case study literature lacks in reviewing the steps taken in the analysis and investigation stage of the process, prior to choosing a vendor. This paper aims to fill that gap.

2. Literature Review

Cloud computing is an emerging business and technology concept to support an on-demand delivery of services over the Internet. To break down what cloud computing is, we need to start from the concept and structure of the cloud. We will start with the cloud architecture where cloud computing is divided into three types: private, public, and hybrid. A public cloud is described as resources dynamically provision on a fine-grained, self-service basis over the Internet, via web applications/web services, from an off-site third-party provider who shares resources. In less technical words, it's an outsides vendor that provides on-demand service that stores and process data for business; the business has less control but it can also have its benefits, will explain later. While, a private cloud is describe as data and process managed within the organization without the restrictions of network bandwidth, security exposure and legal requirements that using public cloud services across open, public networks might entail (Hoefer & Karagiannis, 2010). A private cloud is basically a public cloud, except it is made within the business resource and takes any risk of security breach or failure. A Hybrid cloud is the environment consisting of multiple internal or external providers; it's the combination of both private and public cloud, something that many companies are really considering moving towards.

The virtualization management is the technology that abstracts the coupling between the hardware and operating system (Hoefer & Karagiannis, 2010). By separating the logical resources away from their underlying physical resources in order to improve agility, flexibility, and reducing cost to enhance business value. There are different types of virtualization that suits a dynamic cloud infrastructure. One of them is server virtualization, the mapping of single physical resources to multiple logical representations or partitions (Hoefer & Karagiannis, 2010). It's what dynamically create, expands, shrunk or moved data as demand varies. This is why virtualization provides great advantage towards sharing, managing, and isolating the information in the cloud.

Now that we have a bright idea of what cloud computing is built upon, there is still a few questions to ask. What if there's a malfunction or failure with the server? Well, they are has been some outage in the past that it really causes problem to business and the vendors. For example, Microsoft Azure had an outage of 22 hours in March 13^{th}-14^{th} of 2008 this one of thousands of other failures that has happen before. Microsoft Azure did apologize and recognize the outage, but still believe and stands by its quality service. They know things like this happen affecting their customers but they provided a 33% credit to all customers for the month of the when the outage occur (Miller, 2012). A good solution for the servers is that they now back-up the information not only once but twice in different storage servers providing a more secure trust in with your data. There will a hot backup instance of the application which is automatically ready to take over without disruption also known as the failover. Security is also main concern because by accessing Cloud Computing, you're giving the vendor the power to handle your data or information. But securing cloud computing data is a contractual issue as well as technical (Hoefer & Karagiannis, 2010). In other words, you tend to trust the vendor to keep your data safe, by always checking on them and making sure that they are actually keeping the data safe, based on the contract signed. It also depends on which Cloud your business is running on, many say, a public cloud is less safe than a private cloud. But it all depends how well you take care of your cloud and must be really on top of your vendors to keep them secure.

Other issues that concern adapting the cloud computing are load balancing and scalable data storage. Load balancing is used to implement failover which continues the service after the failure of one or more components.

Where components are monitored manually, and when a server does not work properly, the load balancer is informed to stop sending traffic to the outage component. This feature is inherited from the grid-based computing for cloud based platform (Hoefer & Karagiannis, 2010). With the proper load balancer you will reduce the server cost and conserve some energy, becoming a greener enterprise.

The greater issue that we should be concerned about is the scalable data storage. Meaning that when data is thrown into the cloud, it should properly be organized otherwise there would be some trouble accessing the data. Vertical scalability is related to resources use, much like the old mainframe model (Hoefer & Karagiannis, 2010). If an application does not follow the vertical scalability will have trouble accessing the data causing to increase the cost because of the increase of demand to compute the data.

It is important for a company to understand the benefits and risks before they decide if cloud computing fits their company needs. As mentioned before the main benefits are sustainability, scalability, infrastructure, flexibility, lower cost, and availability. According to Gheorghe and Lupasc (Gheorghe & Lupasc, 2012), cloud ERP solution will save about 30% project time after analyzing the critical path of both classic and cloud ERP solutions. Table 2.1 summarizes the benefits derived from cloud computing ERP systems.

Table 2.1. Benefits of On-demand ERP solutions

Benefits of on-demand ERP	Reference
Short implementation cycles	(Gheorghe & Lupasc, 2012); (Karabek, et al., 2011);
Low entry costs	(Marston, et al., 2011); (Karabek, et al., 2011); (Bhardwaj, et al., 2010)
Reduced demand for own IT resources	(Karabek, et al., 2011); (Bhardwaj, et al., 2010)
Elasticity/Flexibility of services	(Marston, et al., 2011); (Karabek, et al., 2011); (Rittinghouse & Ransome, 2009)
Scalability	(Marston, et al., 2011); (Gartner, 2012)
Focus on core business	(Karabek, et al., 2011)

Governments, who are planning to implement e-government strategies, have begun to adopt cloud computing technologies in their IT systems. According to the report from Federal Chief Information Officer (Kundra, 2010), more than 24 government departments and state government agencies in United States adopted cloud computing solutions in various IT services. Paquette (2010) summarize four sections of current adoption of cloud computing technology by the United States federal government as following:

1. Early Use: the early adoption of cloud computing starts from informal use of personal applications, such as instant message and portal services by government employees, agencies, departments, and contractors. At this stage, government is trying to define the cloud computing technologies in public sector environment and identify the essential characteristics of the cloud computing applications (Wyld, 2009).
2. Formal, strategic direction: IT directors at different government levels realize the benefits of cloud computing and try to explore cloud computing as a strategic component in government transformation. President Obama (2009) emphasized the adoption of cloud computing by the Federal IT for a more transparent government to the public, advanced technology of government IT, and a better innovation environment.
3. Current applications for information sharing: today, cloud computing applications adopted by public sectors are more focused on information sharing and communications, such as using YouTube hosting services and mobile cloud services.
4. Applications and information processing: recently, the federal government is attempting to utilize cloud computing applications in data/information processing rather than just data storage or data sharing. For example, The Air Force is a 3-D virtual recruiting and training application on cloud (O'Hara, 2009).

Government acceptance of cloud computing has been growing fast. Wyld (2009) lists 10 benefits of cloud computing on e-government, such as rapid scalability, low maintenance/upgrades cost, improved resource utilization, improved economies of scale, improved collaboration capabilities, usage-based pricing, reduced IT infrastructure needs,, computational power, green-friendly factor, and improved disaster recovery capabilities. Pokharel and Park (2009) also identify "Expertise" as one of the benefits of cloud computing on e-government. At the same time when we talk about the advantages of cloud computing on public

sectors, there are researchers who concern the risks of the technology. Outage/Accessibility is rated one of the highest factors (Kim, 2009). It is obvious that system outage is closely correlated with on-deman adoptions. After the outage issue of Microsoft Azure, CIOs realized the importance of system accessiblity for on-demand solutions. Security is another emphasis concerned by several researchers in their studies of cloud computing (Kim, 2009; Paquette, et al., 2010; Saeed, et al., 2011).

Most of the current studies about cloud computing applications in e-government have been focused on benefits, concerns and challenges of cloud computing adopted by government. There are several studies emphasizing on architectures of cloud computing in e-government (Zissis & Lekkas, 2011) and policy issues of cloud computing applications (Shin, 2013). However, relatively little research attention has been given to the early stage of cloud computing adoption by public sectors, such as assessment and planning processes. This study seeks to provide a better understanding of system analysis and selection during the early age of cloud computing adoption for public sectors.

3. Research Methodology

Carr et al (1996) propose a useful system adoption model for a successful Information System. They advocate a four-step process which is designed to assess the present position, decide on an appropriate change process, establish a sound theoretical framework for the change and ensure that aims are shared and personnel are involved and committed. This is achieved through the stages of:

- Assessment: justification, objectives and broad characteristics.
- Planning: the entire change process is laid down.
- Action: commitment, dissemination, training, change.
- Renewal: monitoring, feedback and evaluation.

In this study, we believe the first phase is extremely useful to explain and guide what we need to complete in system analysis and selection of cloud computing for public sectors.

In *Assessment phase***,** for the manager, the change process begins when questions are asked about what the originators of the proposal actually want to do. At this stage, no one is looking for answers to all of the questions, and the process should not begin with consideration of the

change itself. It begins with a general review of the organization, and it is relevant to organizational health, which is itself to do with motivation. Starting with examining motives, managers should identify both positive and negative reasons for introducing change by asking all kinds of questions related to the change, such as what are the desired outcomes? What are the problems? How does the project fit with the strategy of the organization? What is the likely effect on the organization? What is to be the role of the manager? The organization has to investigate the details of the proposed change:

- Identify what changes are required
- Analyze changes
- Identify resources required

In the case study analysis in section V, we will adopt this model to discuss and identify the issues and challenges during the cloud computing adoption processes in the two case studies in section IV.

A Case study is a qualitative and descriptive research method to explore issues and factors from an individual or small number of participants and draw conclusions only about those participants or group in that specific context (Yin, 2014). This method is an ideal methodology when a new concept or system needs holistic and in-depth investigation (Feagin, et al., 1991). It has been proven a useful research tool in investigating system adoption studies (Kerimoglu, et al., 2008; Mackrell, et al., 2009). Therefore, in this study, we use the case study method to identify important factors during cloud computing adoption processes in public sectors from the following two cases.

3.1 The City and County of San Francisco

3.1.1 Background

The City and County of San Francisco, CA was established by charter in 1850 and is the only legal subdivision in the State of California with the governmental powers of both a city and a county. A Board of Supervisors exercises the City's legislative power and the Mayor exercises the executive power (Rosenfield, 2011). In 2008, the Citywide IT Plan: Current State Assessment for the City and County of San Francisco reported that the City consisted of more than 50 departments in addition to other organizations. It also reported that the city had seen a movement

away from a central IT shop with a number of departments maintaining their own IT staff. In addition to the complex technology organizational structure, the city had a complex technology governance structure as well with a Committee on Information Technology (COIT) made up of 11 members and 4 subcommittees made up of 37 members, charged with providing the necessary technology policy, procedures, and oversight to ensure that the City meets its goals and objectives.

3.1.2 Feasibility/Strategic Email Study

The 2008 COIT Email Policy stated that the Department of Technology and Information Services (DT) was in charge of managing all email systems with the exception of the City Attorney's Office. Six other departments were noted as maintaining their own e-mail systems. Following the adoption of the email policy, the city began a Citywide Strategic E-Mail Study with three goals: (1) confirm the City policy of single e-mail standard, (2) determine which City entity should manage the central system and (3) select a single standard. At the time the city email setup consisted of a mix of Microsoft Exchange and IBM Lotus Notes email systems. The citywide email options outlined in the study consisted of:

- maintain the current hybrid approach
- migrate all departments to Lotus Notes
- migrate all departments to Microsoft Exchange
- migrate all departments to a hosted solution

The hosted solution was listed as a future option. After reviewing the study, the COIT Director stressed that the fundamental issue at hand was whether there should be a single citywide email system or whether departments should be allowed to use independent email systems. The City CIO asked the Architecture and Standards Sub-Committee (ASSC) to make recommendations for the city's e-mail platform based on the four options listed above.

3.1.3 Investigation

The Citywide Strategic E-Mail Study provided the City with four email options to choose from, one of them being to continue operating as they had in the past. In order to make a recommendation to the COIT the ASSC had to develop system functional requirements and a performance metric. To accomplish this, the Committee sent out an e-mail requirements survey

to all the city departments. Based on the responses of 16 departments, representing approximately 15,000 users, the ASSC developed a list of tentative requirements on each of the survey items. They then compared the list of recommendations to the offerings of the potential service providers, IBM and Microsoft. The combined results indicated that there were not many functional differences between the competing vendors. The ASSC also developed an Email Evaluation Metrics based on the survey responses. The Metrics showed that, on average, the ability of the selected email systems to meet the functional requirements was most important, followed by the ability to meet the service requirements, annual costs and finally start-up costs. The ASSC then proceeded to obtain cost estimates for the following options: (1) Lotus Notes maintained by the City; (2) Lotus Notes hosted by IBM; (3) Microsoft Exchange maintained by the City; (4) exchange hosted by Microsoft and (5) Google's enterprise email system hosted by Google. Initial cost analysis indicated that the hybrid environment was the most expensive option. Cost analysis for the Google option was not presented at that time.

3.1.4 Recommendations

Based on their overall analysis, the ASSC provided the following recommendation to the COIT:

- All City Departments should be on one e-mail platform
- The platform should be managed by a central entity

At the following meeting on February 25, 2009, after watching presentations delivered by IBM and Microsoft and detailed discussions of both systems, the ASSC unanimously voted in favor of recommending a hosted Microsoft Exchange system. The sub-committee members' average ranking for each option is located below in Table 3.1.

Table 3.1. Committee Rankings

Committee Rankings (ASSC, 2009e)

	Lotus Notes		Exchange		Current
	On-Prem	Hosted	On Prem	Hosted	Hybrid
Arch SC Member Group average	3.5	3.1	2.8	1	

Following that recommendation, the COIT determined that "within the next 2 years, general and non-general fund departments (will) move to a hosted Exchange solution" (COIT, 2009). In a February 2010 meeting the justification for choosing Microsoft was explained by the Acting City CIO, Jon Walton in response to questions from the public.

Once the decision had been made to go with a hosted Exchange solution, the focus switched to a needs analysis in an effort to decide who would host the system. In November, 2009, the ASSC decided to request a quote for consulting services that would provide the email technical business requirements necessary to construct the Request for Proposal (RFP) for the new hosted exchange systems. The basic scope of the project was defined to include email only for approximately 22,000 users with 25GB of space per box and needed to include training and current mailbox conversion. They had specifically decided against any advanced collaboration feature as in the LA Google Deal.

In the requirements and gathering stage, the COIT worked closely with the staff that managed the behind-the-scenes technical requirements on email in order to get their input. They wanted to make sure that the email administrator understood what systems they were getting or giving up. The COIT also decided to create a pilot program that the Police Department would be a part of in order to identify security issues. The goal was to have the pilot program for the conversion up and running by the end of the fiscal year. The Police Department was later pulled out of the pilot and replaced by the Department of Technology.

3.1.5 Hosting

In a March 2010 meeting, a proposal was made to have the Airport host the citywide email system creating a Center of Excellence. The following arguments were made in favor of this proposal:

- Quicker implementation in that they could avoid the RFP Process and start immediately
- Reduction in costs compared to outside vendors
- No consulting or professional services required
- High probability of success due to the fact that the Airport had previously migrated from Lotus to Exchange
- Existing investments in software and hardware protected

The following month, in analyzing the Airport Hosted option vs. the vendor Hosting option, the committee discussed the costs associated with each option as well as the capital involved. It was mentioned that many of their current systems had no recovery or refresh plans and that the aged equipment they were running had more downtime. The COIT Director also pointed out that one of the reasons a hosted model was considered was to get out of the business of owning equipment and licenses.

When comparing the two options side by side, the committee summarized that the Airport option relied more on in-house staff to implement the projects and had a large capital investment that required ongoing equipment replacement charges, while the vendor option relied more on professional services and had had a relatively constant cost over time. In addition, a side by side comparison of per mailbox cost indicated that the vendor option would be more cost effective over time. Industry standard was also considered noting that more governments are going with hosted vendor options.

Based on their analysis, the COIT decided to begin the RFP process in the search for a vendor hosted solution. The Airport was still able to compete in the RFP process.

After months of security testing and working with Microsoft to amend their standard agreement, the City and County of San Francisco announced on May 18, 2011 that they had signed a contract with Microsoft to host their Exchange solution.