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The Journey from Computer Time-Sharing to Cloud Computing: A Literature Review

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***Abstract*— Cloud computing has attracted the attention of many computing professionals in both the commercial and the educational sectors. Constant pressure to deliver on-demand computing services in a 24/7 environment amidst increasing financial pressure has placed cloud computing out of the realm of just hype and into the business plan of major organizations. As computing gets more sophisticated, it also gets more retro because we see more of the computing functions being pushed to centralized, shared web servers, whether it's called hosted applications or application services or web computing or web caches, it looks more like the time-sharing and centralized computing of the 1970s. The aim of this paper is to conduct a comprehensive review of literature covering the topics of time-sharing and the cloud computing.**

***Keywords*— Cloud Computing, Time-Sharing, Computer Time Sharing, Centralized Computing, Cloud Computer Sharing.**

I. INTRODUCTION

Competition on global market forces, many enterprises must make use of new applications, must reduce process times and simultaneously time cut the costs of their IT infrastructure. To achieve this, it is necessary to maintain a high degree of flexibility with respect to the IT-infrastructure. In response to this challenge, the idea of cloud computing has been gaining interest lately [1]. The process of purchasing, maintaining and administering computing assets requires a large investment of financial and manpower resources for a business, government, or university. One option that can lower costs and manpower requirements for these organizations is the use of centralized computing assets provided as cloud computing.

Cloud Computing refers to both the applications delivered as services over the internet and the hardware and systems software in the datacenters that provide those services [2, p.4]. The difference with cloud computing compared to your traditional type of computing is that your servers and infrastructure is no longer hosted in house. Cloud computing allows corporations to focus on their business instead of internal support and upgrading infrastructure support high demand services. In most cases the services provided by cloud computing is access through an internet browser like Firefox, Chrome, and Internet Explorer. Some popular cloud computing service providers are salesforce.com, Google, and Microsoft, their services range from email hosting to CRM and incident tracking. The services themselves have long been referred to as Software as a Service (SaaS) [2, p.4]. Most of these services are pay as you go subscription basis. These types of clouds, which the public can access, are correspondingly called public clouds. On the other hand, private clouds which exist inside a business are created specifically for private organizations. An example of this the cloud created by Google for exclusive use by the government called gov. cloud. The next emerging services in the cloud are Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) [3, p. 2]. An example of a IaaS is Amazon Web Services, which includes storage, computing, message queues, datasets, and content distribution. An example of PaaS is Microsoft's Azure which uses Microsoft's .Net framework and SQL data services.

What the wheel and the press did for the American road system and mass distribution of newspapers, time-sharing did for the computer. The rapidly evolving technology combining computers, communications and terminals brought the computer to the home and business [4]. A time-sharing system usually consists of a large and powerful computer with up to several hundred independent and concurrently usable consoles [5]. The user is provided with the illusion that he can use the computer almost as if he were the sole user.

II. THEORETICAL BACKGROUND

A large amount of research has been performed to develop the computers and the programs required to do this highly complex time-sharing job. Very little effort has been expended, however, to explain to the layman the concept of the time-sharing computer systems and cloud computing. It is mandatory that the potentia1 user of a time-sharing system and cloud computing be made aware of the concepts in a language a user can understand readily. One of the purposes of this paper to explain the time-sharing concept and cloud computing in layman's terms, so that he/she may better understands this now area of computer development.

Overall, while there is extensive past and current research interest in time-sharing and cloud computing, one area that needs more investigation is whether the journey from computer time-sharing to cloud computing is an evolution or revolution. Time-sharing has become a generalized term to describe a class of computer systems in which power from a centralized processor is made available at remote terminals to many users (see Figure 1, below). Each terminal device sends and receives information at a rate which occupies the central computer for only a small percentage of related terminal time [4]. This great difference in the speed of the terminal and the computer allows one computer to service many terminals concurrently yet gives the impression to each terminal user that it is the sole user.

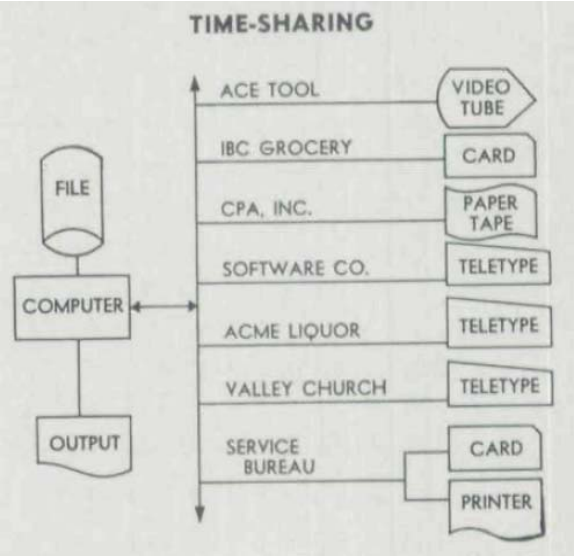

Fig. 1 Time-sharing, Source : Hakola, 1969 [4]

In general, a community is provided with a much larger system than any single member could afford. For on-line or real time systems, the hardware and software overhead associated with this additional ability can be associated with a larger number of users [6].

Before cloud computers became available, there were various precursor technologies, including thin clients, grid computing, and utility computing, used for remote access to computing resources [7]. While seminal cloud computing research was published by Chellappa in 1997 [as cited in 8], the adoption of cloud computing has been a fairly recent phenomenon [7]. This term began surfacing commonly in the literature around 2006 and refers to computing over the internet [9]. By 2008, cloud computing was receiving extensive research interest and had surpassed grid computing media interest [10-11]. Many of the initial cloud providers were Web-based companies and start-up companies [12]. As cloud computing demand expanded, the types of cloud providers extended to include public and community clouds [13]. Although the term cloud computing is relatively new, this technology had its basis in many other earlier computing methods such as computer time-sharing.

While the exact definition of cloud computing is still under some debate [14-15], this technology which was declared as a "classic disruptive technology" [16], is currently available through many vendors including Amazon, Google, IBM, and Microsoft. A disruptive technology is defined as a new and often an initially less capable technological solution that displaces an existing technology because of its lower in cost [17]. Cloud computing fits this definition in that it is poised to replace the traditional model of purchased-software on locally maintained hardware platforms [18].

Working with graduate students, Holden, Kang, Bills and Mukhtar [19] began to shape an environment with a high-level cloud computing architecture as shown in Figure 2. This included setting up a database server environment and using that environment to implement the six lab exercises required for the course. Once the environment setup is completed the user (graduate student) is ready to use the cloud services.

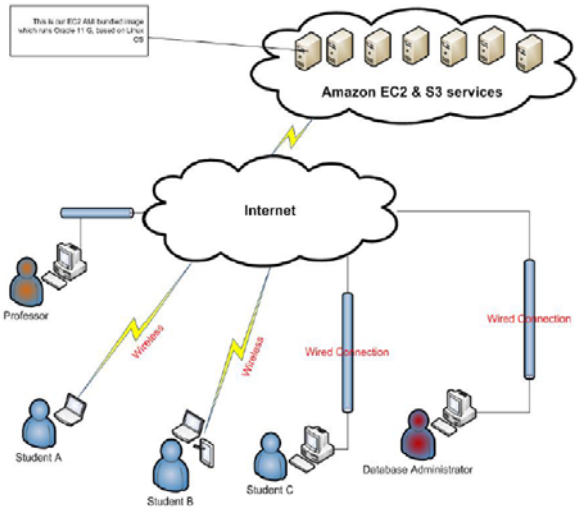

Fig. 2 Cloud Computing: High Level Architecture, Source : Holden, Kang, Bills and Mukhtar [19]

In other words, cloud computing refers to both applications delivered as services over the Internet and the hardware and systems software in the datacenter that provides those services. The datacenter hardware and software is what is designated as the cloud. When a cloud is made available in a pay-as-you-go manner to the general public, it is called Public Cloud; the service being sold is utility computing. Private computing is referred to internal datacenters of a business or other organization, not made available to the general public. Thus cloud Computing is the sum of software [2] as a service and utility computing.

III. Discussion

Our household cable television or satellite broadcasting systems are offering a monthly service providing the capability for customers to select a movie, download and pay for it as a line item on their monthly bill. The cable or satellite provider is the host with equipment and content residing on their site or within their network. A customer does not need the equipment (the server/DVD, etc.) or the content (the movie), rather it is a monthly fee, pay-as-you-go model.

While organizations debate the value of teams, businesses use technology as a matter of survival. Motivated by competition and high cost, business leaders have created a new culture based on shared risk and reward. Decision-making is no longer the sole responsibility of the few at the top but is shared within and between most segments of an enterprise. Decision makers now need to capitalize on this potential by becoming more focused on steering innovation through strategies that assist in development both of the technologies and of the individuals who are to use them. It's no secret that virtualization, a technology long associated with mainframe computers, has been transforming data centers due to its ability to consolidate hardware resources and reduce energy costs. But in addition to its impact on data centers, virtualization is emerging as a viable technology for smart phones and virtual private networks, as well as being used to re-conceive agile and cloud computing [20]. This approach is almost similar to the cable television and time-sharing pay-as-you-go model.

A. What is it?

In the early days of computing, organizations could not execute an IBM 370 software program on a Digital Equipment micro VAX computer. Every software code had to be written for a specific operating system, which often requires usage of hardware. A little later this was changed by time-sharing and even today's business world all that has changed, thanks to the evolution of technology to cloud computing.

Time-Sharing: Time-sharing. There are almost as many definitions for this data processing technique as there are computer systems. However, three capability characteristics identify and explain computer time-sharing: the processing system has the capacity to handle several programs concurrently (multi-programming), permits on-line interaction between user and computer and provides real-time response [21]. The system components (see Figure 3) include the operating system software, the hardware, and the user.

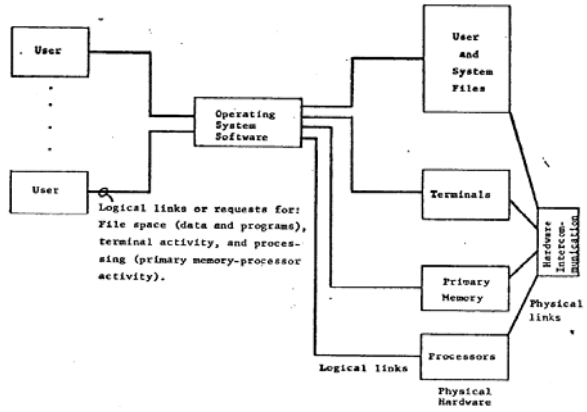

Fig. 3 Logical organization of time-sharing computer components, Source : Bell, 1968

Executing a series of non-interactive programs at a pre-defined time is called batch processing. These batch jobs can be stored and then executed during the evening or whenever the computer is idle. Time-sharing by linking the computer directly to the user, creates an environment and capability markedly different from "batch-processing" systems. Figure 4, below, illustrates the elements or steps which separate the customer or user from the computer in both environments. The important difference between the two is "time" - the delay in batch systems versus the timeliness of real-time systems.

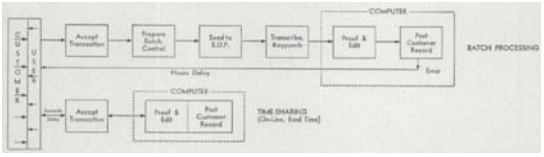

Fig. 4 Batch & Time-sharing,Source : Hakola, 1969 [4]

Cloud Computing: A cloud computing entity contains parallel and distributed resources from a group of connected and virtual computers that are exhibited as one combined system [22-23]. These systems are made available based on service-level agreements between the provider and the user [22]. The key features of a cloud computing entity are massive scalability to meet user needs, the existence as an abstract entity to deliver multiple service levels to outside users, economy of scale, and dynamic configuration of services on demand, often by virtualization [23]. Delic and Walker [24] portray cloud computing to be the third wave of internet advancement, following the internet as the first wave and the web as the second wave. From a different perspective, Hayes [25] compares cloud computing to computing fifty years ago when service bureaus and time-sharing systems gave users access to mainframe computers. These computing advances were fostered by earlier precursor technologies.

Some of the precursor technologies to cloud computing include Service-Oriented Architecture (SOA), distributed computing, virtualization, and grid computing [9, 11, 26]. Cloud computing is an approach that provides computing resources to a large number of users or organizations while concentrating the overhead for providing, maintaining, and administering the computer systems on a central provider. Additionally, it is being investigated as a way to minimize costs, maximize reliability, and meet organizations' needs for computing resources, while maintaining security for the systems and the data stored on them [7].

B. Who is doing it?

If you don't think many organizations, including government and academic institutions, are using cloud computing, you may be right. But if you think that's the way it will remain forever, you are wrong. In this section, we will briefly discuss who is doing time-sharing and cloud computing.

1) Time-Sharing: As early as 1970, IBM championed a concept called "time-sharing." Users shared common IT resources and applications on a mainframe computer simultaneously with other users for variable fees that were dependent upon usage and consumed resources. Time-sharing systems resembling public utilities are already in operation and many more are planned. These systems are often referred to as information utilities. This type of service is quite similar to public utilities in that service may be rendered to many users for a service charge based on actual usage. Services being sold include the collection, storage, processing and display of information [27].The earlier time-sharing systems were limited primarily to scientific and engineering applications. These systems had limited data storage facilities but had powerful mathematical processing capabilities by using relatively small amount of data [28]. Raymond [29] noted in his study the use of computer time-sharing in business planning and budgeting functions too. A corporate survey conducted by Allen [30] revealed rapidly growing popularity of computer time-sharing for business management decisions. Allen [30] concluded in his research article in saying that today's executives are not only utilizing time-sharing to facilitate their problem study and analysis, but many managers are taking full advantage of these new computer systems to expand the services their companies have to offer. Fine and McIsac [31] conducted a time-sharing system simulation and provided vehicle for the evaluation, prediction and applicability to various work-load environments successfully.

Cloud Computing: There are several companies that are now offering cloud computing services. From large companies like Google and Amazon, to smaller companies like Go Grid and OpSource. Depending on which provider you go with

there are several different packages and options available to custom fit a cloud computing service to your needs. As shown in Figure 5, a growing demand for cloud computing organizations is to move the capabilities onsite, thus allowing the user to have more control and virtually eliminating the previous issue of infrastructure. What would the difference then be between cloud computing and an in-house server network? The cloud computing companies could install server base in your location and rent out whatever you are not using. Therefore, you get a higher level of service, maintain control of your server, limit infrastructure issues and know where your data is. Of course, the requirements would then be that you maintain a bigger contract and surely pay a significant premium to the cloud manager, or meet minimum monthly service fee requirements.

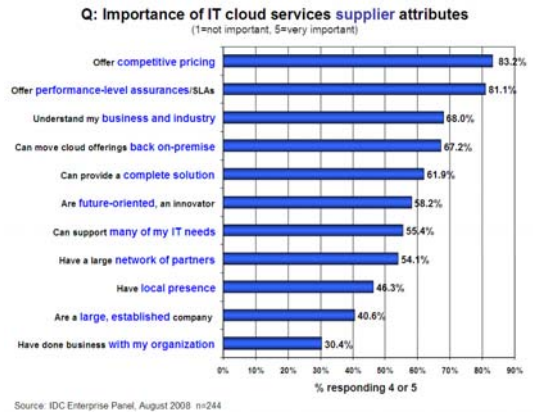

Fig. 5 Cloud Services Supplied Attributes Time-sharing, Source : IDC, 2008 [32]

Cloud computing systems require a large information technology investment, both financial and manpower. Although the investment is large, multiple benefits are offered and these features are attractive to organizations with limited resources and the need to use their resources wisely.

C. Why is it significant?

The availability of time-sharing and distributed computing resources is not very crucial to success. But the cloud computing present organizations with a fundamentally different model, which will provide a centralization of computing and information management functions, providing economy of scale, efficient resource usage, and the availability of the resources to a large user base [2, 22]. Sometimes, this is a success factor.

1) *Time Sharing:* Time-sharing systems have evolved mainly because of the high costs of powerful central processors and the high imbalance between the speed of input/output devices and the speed of central processors. An additional advantage of time-sharing is that the user has at his disposal the processing power of a large scale computer without competing with others for time on the computer [33]. Commercial time-sharing services offer numerous potential benefits to their users. Some of these benefits, indeed, are so compelling that many companies with large computer systems of their own are also heavy users of commercial time-sharing networks. Here are some of the principle reasons for using time-sharing services: 1) Flexibility, 2) Ease of Use, 3) Man / Machine interaction, 4) Fast turnaround, 5) Choice of languages, 6) Application programs, 7) Networks and data bases, and 8) Dedicated services [34].

The chief advantages offered by the time-sharing system are its greater processing capacity and the greater timeliness of its information yield. These capabilities gave management more reliable data for decision, from the standpoint of both quality and quantity. Intuition, while still a necessary attribute for a good manager, is no longer a major element in decision making because of this capability [21]. Because time-sharing can make computer time available on a company wise basis, all managers must learn to relate company operations under their direction to the computer system's capabilities. For example, manufacturing organizations can use the time-sharing capability for closer monitoring and control of production. Where sales orders are filled from stock, the computer can be used to interrelate order writing with inventory control and shipping procedures [21].

The time-sharing service itself requires no long-term commitment on the part of the user. In most cases a 30-day cancellation notice is all that is needed if the user elects to terminate the service. Time-sharing firms usually break service charges down into three types of charges so that users can accurately evaluate their usage. The user is charged for 1) the amount of time that the terminal is turned on, 2) use of the computer itself, which takes into account the usage of the various units of the computer system, and 3) the amount of computer memory used by the customer in storing programs [35].

Gold [36] conducted an experimental comparison of problem-solving using timesharing and batch-processing computer systems. Gold [36] found that statistically and logically significant results indicate equal cost for usage of the two computer systems; however, a much higher level of performance is attained by time-sharing users. There are indications that significantly lower costs would have resulted if the time-sharing users had stopped work when they reached a performance level equal to that of the batch users. Gold [36] concluded by saying that the users' speed of problem-solving and their attitudes made time-sharing the more favourable system.

In summary, selecting and using time-sharing services demands a well-managed development effort and close attention to the factors that affect efficiency and costs. With an orderly, controlled, and responsibility-oriented approach [37], a company can realize its full potential benefit from use of a timesharing system.

2) *Cloud Computing:* Cloud computing addresses the computing as a service model. One attractive cost issue is the ability to pay for services as-you-go avoiding large up-front expenses for computer system purchases [7]. Additionally, another attractive aspect of cloud computing is the savings on space, utilities, and maintenance staff which can be realized by outsourcing computing applications to a cloud computer provider. This practice can also be attractive to organizations interested in green issues, enabling efficient use of power and other utilities by shared use of computing resources.

According to Healey [38], about ten per cent of recent IT purchased to support green initiatives went to support services contracts, such as cloud computing. Also providing very large scale commodity computing resources at low cost

locations has been the key enabler for cloud computing. Armbrust et al., [2] claims that this can produce cost reductions of a factor of five to seven times in areas such as electricity, network expenses, operations, and software and hardware expenses due to the economy of scale. Since the cloud computing providers combine both cost savings and higher system utilization compared to individual organizations, this allows individual customers to save money while the cloud computing provider realizes a reasonable return on investment. Another additional factor is the convenience of performing large computations quickly upon demand can save an organization both time and money because a capability to deploy large number of processors on a cloud rapidly. McDougall [39] predicted the energy costs are to be about sixty per cent lower when performing computations on a cloud system. Even though this is a smaller savings than predicted by Armbrust et al., [2], but it is possible that the higher utilization on cloud computers compared to individual systems could lead to the anticipated five to seven times reduction in electrical costs. Either way, significant utility savings are present with a cloud computing model.

Cloud computing also brings additional opportunities such as large computing power of these cloud systems can enabling organizations to solve computational problems that were previously unsolvable with their in-house computing resources [7, 24]. Some of the driving forces behind cloud computing are economics, simpler and cheaper use of applications, no upfront costs incurred for servers and other storage devices, no need to maintain a staff to maintain day to day operations for running datacentres, application could be accessed from anywhere in the world.

In cloud computing, the service providers are responsible for operation and maintenance costs and thus very attractive to some business to prefer this type of model. Some of the benefits for cloud computing include not having to pay for software and hardware upgrades because that cost is usually rolled into the cost of the subscription fees, not having to pay for the cost of maintaining the software and hardware, the application would have greater availability because it uses the Internet, not needing a dedicated team to support the application because the application is built by the host. Services are usually very configurable and should fit most businesses. Overall the use of cloud computing can reduce the cost of operations by using these services provided by cloud computing. Regardless of the definition used, cloud computing services typically manifest themselves in one of two ways. The first is that of the utility-style infrastructure provider, such as the Amazon Elastic Compute Cloud. The second manifestation of cloud computing is that of the software as a service (SaaS) provider, like Zoho's productivity and collaboration applications. The introduction of both cloud computing services has dramatically changed the landscape of information technology and how businesses interact with it.

D. What are the downsides?

There are a few downsides of cloud computing. While placing the burden of backups and security on someone else's IT staff is cost effective but it raises the question of whether you should trust them with your sensitive data. Data that is sensitive in terms of value or confidentiality should be placed on the cloud with the knowledge that it might not be 100% secure and that the cloud should not be your only form of backup. Like any other internet resource, the cloud can also be unavailable from time to time which could be costly if it's down when you absolutely have to have a service.

Another con is the question of ownership over the data after it has been uploaded to the cloud? The question of whether the host company owns the data once it has been placed on their site has been raised. So it's a must for customers to read the Terms of Service (TOS) for a particular company before uploading data to a cloud provider.

1) Time Sharing: Although the subject of time-sharing has been popular for a number of years, it is well known that the road to effective time-sharing has been and still is arduous. Systems have been late, inefficient, and expensive. As a result there have been both opportunity and motivation to investigate the subject of time-sharing [40]. Before widespread time-sharing systems and system networks can be formed, standardization of data and file format descriptions will have to occur. Present intersystem communication experiments should provide a framework for the standardization of information interchange formats, and detailed data representation [6].

Some observers insist that time-sharing is primarily for small companies that cannot afford their own computers. Yet the biggest users of computers also appear to be the biggest users of time-sharing [30]. Despite the tremendous increase in the use of time-sharing for business applications since the introduction of the first commercial time-sharing service bureau in 1965, there remains an unanswered question "What size company can best utilize time-sharing?"

2) *Cloud Computing:* While there are many benefits to this new service, there are also potential draw backs. One of the most concerning and drawbacks is the minor outages and losses occur quite frequently with cloud computing. This issue gained a lot of attention recently when T-Mobile instantly lost thousands of their customers cell phone data due to do to a Microsoft server malfunction. This malfunction resulted in permanent loss of a lot of customer data and caused several angry customers to speak out against cloud computing. In a study, Thurman [41] identified various security concerns within cloud computing, namely: control and associated data integrity, commingling of data, and virtualization; with data integrity concerns at remote locations. This is complimented by another study by [42], who found trustworthy systems that are designed for human usability, encouraging well-trained people to take responsibility, rather than to blindly trust technology, are needed.

There are limits on which applications can be safely transferred to a cloud provider. For example, very sensitive data, such as the secret recipe of a popular wine or classified government data would need a higher level of data protection than less sensitive data, such as photographs from a company outing. As a result, an organization must carefully weigh the pros and cons of transferring various applications and data to a cloud provider. Encrypting data is another method of adding extra protection. Another barrier to converting to cloud computing involves legal restraints. For example, there are legal restrictions prohibiting moving some information, such as German health care information, out of the European Union [43]. Since cloud computing providers can be

multinational, it is imperative that such providers are aware of and abide by national regulations where they do business.

The use of cloud computing also carries with it security risks, including perils related to compliance, availability, and data integrity. Yet many companies don't think through those risks upfront. For example, having proper failover technology in place is a component of securing the cloud that is often overlooked. In some cases, the risk is too great to rely on the cloud. Today, you never know where your data is stored in the cloud. But this indeterminate location is beginning to change. For example, Google lets customers specify where their Google Apps data is stored, thanks to its acquisition of Postini, an e-mail security company.

The Swiss Bank for example, wanted its customer data files stored in Switzerland, which Google can now participate in [44]. Gartner has identified what it believes are today's top five [45] most critical inhibitors such as 1) Risk-testing, 2) Data location, 3) Data and Code portability, 4) Data Loss, and 5) Data Security. For example, it is just not easy to envision Coke and Pepsi running data analysis and report generation on the same servers side by side. The emergence of cloud computing has set off a debate over data ownership. Once data is uploaded to the cloud, who owns it? Does that data belong to the person who created it, or did that person give up ownership by uploading it?

The devil is in the details, so we need to explore security risks from all angles. Data security needs to be measured and then add operational and legal issues to the mix. We need to find out what happens when a cloud user wants to switch services or if a cloud company goes out of business. What happens to a user's data if they can't pay the bill that month? Is it destroyed? While many argue that with Amazon, Dell, HP, or Google hosting the cloud servers, clients have nothing to fear. "Hey, up until a few months ago, we thought Lehman Brothers was secure too," is not it? The risk of moving sensitive data and applications to an emerging infrastructure might exceed your tolerance [46]. As with any new technology, it creates new risks and new opportunities. In some cases moving to the cloud provides an opportunity to re-architect older applications and infrastructure to meet or exceed modern security requirements..

E. Where is it going?

Adoption of a new technology occurs in stages. As is the case with cloud computing, there is a staggered time frame for adoption, with some early adopters embracing the technology before the mainstream users begin using it. The Technology Acceptance Model (TAM) was developed by Davis in 1986 to model patterns of user adoption of information systems [as cited in 47]. The TAM is used to evaluate the perceived usefulness, the perceived ease of use, and the attitude toward using a technology. Ross [7] research concluded the decision on whether or not to adopt cloud computing technology appears to depend on whether the technology is cost effective and satisfies organizational needs.

1) *Time Sharing:* Time-sharing has been used in a variety of applications, ranging from education to law enforcement. It is possible that the market for time-sharing systems may be effected by recent developments of small, faster and inexpensive computers. The user of the sma1l computer must in essence be a programmer, coder, and a computer operator. This is usually more complex and more time consuming than working with a remote terminal in a time-sharing system. Small computers usually have relatively small memories. The lack of a spacious memory will limit the size and complexity of jobs that may be run. The small computer is considerably less flexible than the time-shared computer and has limited processing capabilities.

As per DataPro [34]basis of trends and projects, it seems likely that the time-sharing industry of the future will shape up in the following way: 1) there will be several large nationwide suppliers of time-sharing services, 2) the s all time-sharing companies that service will generally do so by offering highly specialized services to specific types of business firms in a restricted geographical area so as to reduce the costs of the required communications equipment, 3) many current users of commercial time-sharing services will install their own in-house computer systems, and 4) finally, time-sharing users will have an ever-growing variety of "packaged: application programs to choose from. Campbell-Kelly and Garcia-Swartz [48] found time-sharing industry constituted a major sector of the computer services industry until the early 1980s, when time-sharing was made obsolescent by the personal computer.

2) Cloud Computing: The difficult part of cloud computing to predict what exactly that space is, where it is, how it is used and who else is using that same space. Carr [49] suggested that cloud computing will become a utility, in that computing will be supplied by an array of computer utilities much like electricity today and that users will pay fees based on usage. Does this mean that standards will be in place to protect users from outside threats? What about the multiple users, could one of them be a hacker out to get our data or software? Many of the same questions are asked of internal servers, internal computing and internal data security.

IV. CONCLUSION

As the technology matures, and if more market incentives appear, additional firms are expected to embrace cloud computing. Cloud computing also shows promise for online gaming, a growing market with a large user base [7, 50]. Utilizing IT within an organization is a undeniable and is now emerging as a priority in strategic management facing all levels of management. Cloud computing has become an essential element of strategy, whether a business is trying to move, process, access or manipulate information. It will become essential to every business in order to succeed in this IT revolution.

It is impossible to treat a subject as broad and dynamic as cloud computing in one paper with any degree of precision. If this paper develops even a small increase in our understanding of cloud computing as a technical innovation, it will have achieved its purpose. Regardless of the approach, companies are able to alleviate the burden of support as well as dramatically reduce their start-up costs by making these significant application conversions. Furthermore, it provides needed information to anyone involved with the organization via a browser. Although by not using a terminal per se, this sure looks like the time-sharing model of the 1960s and 1970s, but with Amazon's EC2, Google's AppEngine and recently Microsoft's Azur, cloud computing looks like an evolution.

Ultimately, IT organization need to work with business units to formulate a strategy for questions, such as deciding

which workloads should be exported to the cloud. These new technologies also bring some new challenges such as there are different vendor management skills. Staff experienced in managing outsourcing projects will find parallel to managing work in the cloud. Cloud computing has the potential for removing business friction to make more services possible and to do so much more easily with less risk and capital outlay [51]. According to Carr [49], cloud computing may be the answer for organizations looking to boost their server and storage utilization rates without increasing the workforce supporting those systems. The cloud will enable companies to lower their capital equipment costs and reinvest IT money in other areas, such as new product development.

Cloud Computing will not suit every corporate and line-of-business computing need at least not yet! Therefore corporations will need to understand strategic trends and get the fundamentals right first. There is plenty of corporate homework to be done, but these are standard building blocks of technological adoption with minimal resistance for a change. Over time, enterprises perception may change and other risks will become greater inhibitors to adoption. In conclusion, cloud computing is utilized by most computer users in one fashion or another. Almost 40 years later, we are back full circle to cloud computing from time-sharing like an evolution rather than revolution.

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