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To Cloudify or Not to Cloudify

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***Abstract*—**As an emerging business model, cloud computing has been initiated to satisfy the need of organizations and to push Information Technology as a utility. The shift to the cloud has changed the way Information Technology departments are managed traditionally and has raised many concerns for both, public and private sectors.

The purpose of this study is to investigate the possibility of cloud computing services replacing services provided traditionally by IT departments. Therefore, it aims to 1) explore whether organizations in Oman are ready to move to the cloud; 2) identify the deciding factors leading to the adoption or rejection of cloud computing services in Oman; and 3) provide two case studies, one for a successful Cloud provider and another for a successful adopter.

This paper is based on multiple research methods including conducting a set of interviews with cloud service providers and current cloud users in Oman; and collecting data using questionnaires from experts in the field and potential users of cloud services.

Despite the limitation of bandwidth capacity and Internet coverage offered in Oman that create a challenge in adopting the cloud, it was found that many information technology professionals are encouraged to move to the cloud while few are resistant to change.

The recent launch of a new Omani cloud service provider and the entrance of other international cloud service providers in the Omani market make this research extremely valuable as it aims to provide real-life experience as well as two case studies on the successful provision of cloud services and the successful adoption of these services.

***Keywords*—**Cloud computing, cloud deployment models, cloud service models and deciding factors.

I. Introduction

CLOUD computing is a term used to describe a variety of computing concepts that delivers various Information Technology services over real time communication networks i.e. the internet [1]: In using cloud services, small businesses reap the benefits of not having to deploy physical infrastructure such as file and e-mail servers, storage systems or shrink-wrapped software. In addition, they enable the creation of highly-available, infinitely scalable applications and API's. Most importantly, they enhance disaster recovery and business continuity planning [2]. Many giant IT vendors such as Microsoft [3], [4], Google [5], Amazon [6], HP [7] and IBM [8] and many other new ones [9]-[13] have started providing cloud computing services.

The use of cloud computing services by organizations, including software as a service (SaaS), infrastructure as a service (IaaS), platform as a service (PaaS), security as a service (SecaaS) and Desktop as a service (DaaS), has the potential of changing the way in which the information technology departments are managed [14], [15]. It therefore makes sense to explore how the change is perceived by public and private organizations in Oman and thus judge the level of acceptance of cloud services in Oman., It is also important to evaluate the service providers by assessing the quality of their services in order to find out whether they are ready to provide good cloud services in a stable and well secured manner.

The need to push IT services as a utility creates a need for balancing the benefits against the concerns in order to decide whether or not to move to the cloud. There are many benefits of migrating to the cloud, which obviously include scalability, the reduction in running costs and time taken to bring a product to market. However, cloud computing services still raise many concerns regarding security, stability, and data ownership. They also require fast networking and Internet connectivity. The analysis of these points will help to identify the most important factors that influence the decision of moving to the cloud. It also aims to reveal the readiness of public and private organizations to adopt the cloud.

The purpose of this study is to investigate the possibility of cloud computing services to replace IT departments (personnel, roles, responsibilities and functionality). Therefore, the main research question of this research is: Can cloud services replace the services traditionally provided by traditional IT departments? Based on this, the following objectives were formulated: 1) to explore whether cloud service providers in Oman are ready to provide reliable and secure services to their customers; 2) to explore whether the private and public organizations in Oman are ready to adopt cloud services; 3) to identify the deciding factors in adopting cloud computing services in Oman i.e. both the positive factors leading to adoption (i.e. benefits, incentives or triggers) and the negative factors leading to the rejection of its adoption (perceived barriers); 4) to provide case studies of successful cloud providers; and 5) to provide case studies of the successful adoption of cloud computing services.

After the brief introduction above, the following section provides an account of the existing literature and related research. This is followed by a conceptual framework upon which the instruments are based. It is then followed by the research methodology. Next, the main findings are highlighted and discussed thoroughly. Finally, there are some concluding remarks.

II. Literature Review

A. The Concept of a Cloud Computing Service

Cloud computing represents a change in managing information technology services from 'owning and managing'

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IT systems to a service that is accessed when required, meaning that it's a decision to buy rather than 'do it yourself' resulting in a flexibility which allows accessing information from anywhere and anytime as long as a network connection is available [16]. One important characteristic of a cloud service is the provision of IT resources on demand at a minimum upfront cost [17], meaning that it is a pay-as-you-use IT service which facilitates the access of a shared pool of configurable computing resources such as applications, software development and deployment environments, and computing infrastructure [16], [18]. Also, it reduces the need to process operational tasks since the service is provided with minimal requirements of management effort or service-provider continues interaction [1], [19].

B. Categories of Cloud Computing Service Models

Cloud computing services consist of multiple service models. The main categories are: Platform as a Service (PaaS), Software as a Service (SaaS), Infrastructure as a Service (IaaS), Security as a Service (SECaaS) and Desktop as a service (DaaS):

Platform as a Service (PaaS) is a development environment service provided by cloud service providers which targets developers who build and run applications. They offer tools and handy features that create a friendly development environment for programmers to simplify the development of software and applications [20]. It is worth noting that users are able to deploy their applications on the cloud infrastructure but they are not responsible for managing the infrastructure of the cloud. Instead they have control over the deployed application [19].

Software as a Service (SaaS) consists of applications that are running in the cloud server that end users can access and simply utilize them without having to install them in their personal server. Unlike Platform as a Service (PaaS), which is utilized by developers, these applications are utilized by end users who are not involved in creating the software [20]. In other words, users use the service provider's application without having to create or manage the infrastructure [19].

Infrastructure as a Service (IaaS) consists of flexible virtual infrastructure that is facilitated by operating systems (OS) virtualization to provide storage and communication services to all users [20]. It is used to provide fundamental computing requirements and resources of cloud infrastructure in addition to provision processing, storage, and intra-cloud network connectivity services [19].

Security as a service (SECaas): This enables the delivery of standardized and comprehensive security functionality by delivering it as a service. This means that security systems are deployed, operated, and maintained by the service provider rather than the user [18].

Desktop as a service (DaaS): This enables the cloud user to use virtualized desktops by allowing all data and applications to run in a centralized server in the cloud. With this service the operating system of the desktop is outsourced to a central server rather than maintaining or running it on the local storage [19].

C. Deployment Methods

There are different deployment-methods which organizations can decide to move to the cloud. These are Public Cloud, Private Cloud and Hybrid Cloud. These deployment methods share common features in resource distribution, networks accessibility and on-demand provision, but they are different in data ownership of IT resources. Depending on different factors, organizations must analyze the situation carefully and weigh the benefits and risks of every deployment method in order to select the one that suits the organization best [17].

Public cloud is cloud-owned and managed by the cloud provider, who provides various services and resources that can be accessed via the internet. These services are accessed by multiple users who utilize cloud services, meaning that organizations are using a third party, which is the cloud provider, to manage their services [21]. This cloud is not tailored for a specific industry, group or organization but serves multiple organizations. The organization is able to reduce the costs of deployment, managing and maintaining information technology resources and services. Still, by adopting this model, organizations will not own IT resources and services and communication protocols, but rather, they are owned by the provider. This model is not favourable for organizations that have critical, highly confidential data since this deployment method increases the risks of information being disclosed to other entities as the organization will have less control over data stored in the provider's server [17].

Private cloud: Unlike public cloud, private cloud is created and operated exclusively for a specific organization, meaning that the cloud is customized specifically for that organization's needs. This cloud is not used by multiple users and it is normally managed by the organization itself or a third party [21]. In this case information and IT resources are owned by the organization as if it is in-house IT infrastructure. Access to data in the organization is through an intranet, which is more reliable than the internet. However, it is optional to allow the accessing of information from outside. Although it is the most expensive deployment method since it requires substantial initial cost, it allows full control over the data, and the connection protocols used are more secure than the ones in public cloud. Therefore, it is considered to be the best for a long-term strategy [17].

Hybrid cloud: This deployment method has the characteristics of both public and private cloud, which allows it to compromise between security and cost. It is considered as having two clouds; public and private at the same time. Meaning, it allows organizations to separate critical services from non-critical services. Critical services are owned by the organization and operated internally via the intranet as a private cloud, while non-critical activities are managed by the cloud provider and accessed via the internet. This model allows an organization to retain full control of data on the resources, services and critical activities that are conducted internally, while the provider has the control over non- critical activities. In this way the organization is able to secure its valuable data while benefiting from lower costs in managing

its non-critical activities [17].

D.Deciding Factors to Move to the Cloud

In general all businesses seek to be successful in the market, but depending on the intensity of the market, being successful may not be enough. The deciding factors of moving to the cloud consist chiefly of the opportunities and benefits that can sharpen the competitiveness of the business against its competitors. Businesses must weigh the benefits provided against the risks and analyse their strengths, weaknesses, opportunities and threats in order to decide whether to "buy a new server or to move to the cloud" [22].

1. Incentives for Adopting Cloud Computing

The cloud is favoured over buying a new server or replacing an old one for the following reasons:

Availability:

It allows access to information anytime and anywhere. It enables businesses to connect to customers instantly, process their orders and arrange a delivery schedule or generate invoices wherever the staff are and whenever it is desired [23]. For example, Google doc is a cloud computing application that allows the accessing and sharing of documents easily, anywhere, anytime [23]. A survey found that 52% of small and medium-sized businesses use the cloud since it facilitates the accessing of data anytime and from anywhere [24].

Improved Business Performance:

Cloud services allow businesses to build their competitive strategies by taking care of IT operational jobs, allowing businesses to focus on their core business. "A great IT department is one that helps its business use technology strategically to advance the overall company goals" [25]. A study done by Microsoft found that every year more than 24$ billion is lost in productivity through non-technical employees being made to manage company IT solutions instead of completing their actual responsibilities [26]. A healthcare company questions itself as to whether its role is to run a software-development company or to deliver healthcare services [27]. A Canadian cloud computing survey found that improved performance was the most important benefit of the cloud [28].

Scalability:

Cloud services provide all the hardware, software, security, and maintenance required by the business on demand basis. Thus, businesses are quick and flexible in adapting to changes whenever the business grows, without having to invest in extending technical infrastructure [15], [23]. This means that businesses can expand their technology as they grow without requiring extensive investment since the cloud is able to provide more capacity and capability efficiently to users when they need it [15], [23], [29].

Security:

Although cloud services are provided to many users, they still assure a high standard of security of the data by enabling each user to access their data uniquely. Cloud security services secure business assets since they are provided by security experts [23]. Organization data are always safe even if damage occurs to their physical location since a disaster-recovery plan is offered to assure that all data are kept safe. This helps to ensure access to data no matter what happens [29].

Little or no Capital Expenditure:

The cost of investment in IT systems is always substantial and requires a high capital expenditure to be able to develop technology in the business and maintain it. In adopting the cloud no initial investment is required since all IT support needed is provided on demand. Thus the costs are spread over long periods and costs in the near future can be easily and accurately estimated [17]. Also, in some countries it is important to turn capital cost into operating expenses in order to have lower taxes and improve profit [23].

Eliminating or Reducing Non-Value-Adding Activities:

Businesses spend a lot of time just supporting and maintaining their IT infrastructure and keeping their businesses running. In fact, 161 hours of non- technical employees' productivity time are lost every year in managing IT solutions instead of working on their core responsibilities, according to a survey done by Microsoft. In a study conducted by Yang (2012) based on the 70/30 rule, Jeff Bezos of Amazon stated that 70% of employees' time is used in troubleshooting and supporting the IT infrastructure while only 30% of their time is used for innovation and improvement. By moving to the cloud employees will be free to work on value-added activities [30] .

Cost Savings:

It is an incentive for any organization, be it public or private, to be able to enhance the bottom line or operate efficiently, effectively, and within budget. With cloud a small organization can save up to 70% of its IT costs since it only pays for what it has consumed without having to worry about underutilization of the resource or having to invest fully in its IT infrastructure, platform, software and security [23]. In addition, the expenses of purchasing software and maintaining it are eliminated [31]. Accordingly, businesses become more connected, efficient and competitive. A study conducted in 2013 which surveyed more than 1000 small and medium-sized businesses found that the profits of businesses that adopted cloud services were doubled [32]. Also, according to a survey of 1,300 businesses conducted in the United States and United Kingdom, it was found that cloud computing services contributed considerably to the increase in profit of their logistics businesses [33]. Furthermore, cloud allows organizations to increase or limit the amount of resources accessed as they are needed, enabling them to control business costs [23] and make savings by paying for use only [17].

2. Concerns of Adopting Cloud Computing

Despite all the huge incentives of adopting cloud computing it has some concerns associated with it, such as:

Lack of Knowledge:

Lack of familiarity is an immense factor in hindering the fast adoption of the cloud. Not knowing what the cloud is implies an inability to judge accurately the benefits and risks of using it. According to a 2012 Global Cloud Computing survey of 88 countries around the world, it was stated that 60% of the responses reported lack of knowledge as a major barrier to moving to the cloud [34].

Legal Issues:

Cloud, as with any other new trend, has resulted in numerous new legal challenges, which present another major concern. For example, there is an absence of legal protection for users against the compromise of security, data exposure, loss and damage. All this discourages the adoption of cloud services. "Cloud providers are obliged to disclose the data of organizations and users to certain government agencies and courts". Accordingly, users will be affected, and especially if the provider discloses sensitive economic data belonging to the users without informing them[17].

Loss of Control:

Organizations are worried that they will lose control of their data after moving it to the cloud since data will be kept beyond their data centre [35]. IT managers are worried about transferring their data to other entities or keeping it elsewhere. This emphasises the need for providing fast and secure services while retaining some control for the users. Loss of control does sometimes come about with public cloud, unlike private cloud, which allows full control over the data, thus minimizing security risks [17].

Data Loss:

The need to protect business assets is crucial. Businesses require high security systems to protect their data from loss or damage. Since there is still some possibility of data loss or damage in cloud-based environments, there is a need to back up data or put other adequate measures in place to assure the protection of the data and the continuity of the business [17].

Security:

Moving an organization's data elsewhere might increase security risks. Transferring data over the internet creates various risks since some networks might be monitored and recorded by another organization. Accordingly, secure communication protocols are necessary in order to assure the security of data [17].

Job Security:

As organizations shift to the cloud many IT managers and staff become worried that they may lose their jobs since cloud services appear to be taking over their responsibilities, which drives them to resist change since organizations will start searching for cloud certification options for which they are not yet qualified [36]. In fact, a survey conducted in the United States (2012) of cloud computing trends found that moving to the cloud is difficult since it requires change, to which decision makers are resistant [37].

Internet Speed (Bandwidth):

The speed of the internet is a major issue when deciding whether or not to move to the cloud. It is important to consider the state of the internet since it is the primary channel for data transfer and for running applications [30]. Fast internet connection allows the convenient, smooth accessing and sharing of files through different devises [31]. Without an internet connection all services and activities of the organizations would stop. It is worth noting that as demand for cloud computing increases, an increase in bandwidth becomes a requisite. Otherwise it will act as an obstacle for these organizations. According to measurements collected by Ookla, a Seattle-based company, in 2011, the top runners in internet speed are as follows:

Lithuania (33.29 Mbps) and South Korea (28.63 Mbps), followed by Sweden, Latvia, Romania, the Netherlands, and Macau [30].

E. Conceptual Framework

As cloud computing services have evolved a new delivery model of IT services has been created, resulting in a change in market requirements for IT services. Although the needs and demands of cloud services are growing, so are the concerns. This makes the process of evaluating an organization's needs and concerns against the service provider's capability a valuable step in the decision making of moving to the cloud or rejecting it. In this research the authors propose the use of a conceptual framework in the evaluation process as shown in Fig. 1.

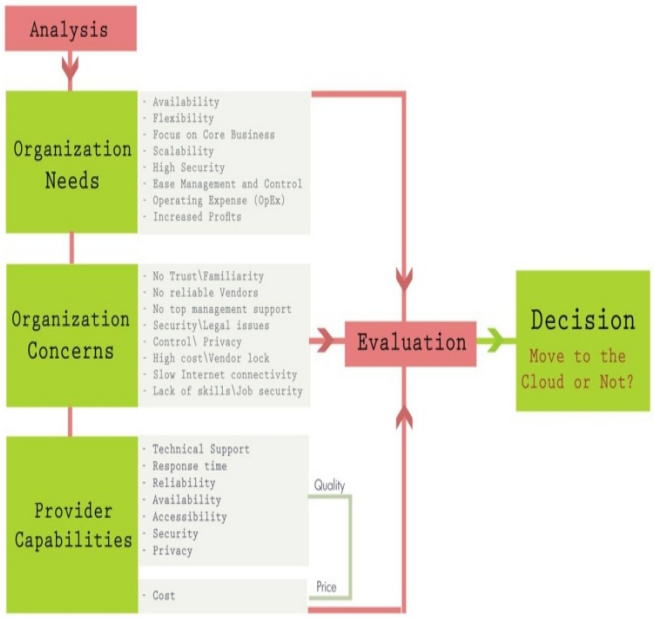

Fig. 1 Conceptual Framework: To Cloudify or not to Cloudify

This framework consists of three major components that affect the decision of migrating to the cloud or delivering IT services in the traditional way. These components are interrelated in a way that forms a simple process of deciding

whether to cloudify or not. These components are: 1) the organization's needs and expectations; 2) the organization's concerns or barriers, and 3) the service provider's capabilities.

A key driver for business success is the one satisfying customers by meeting their needs, such as the need for access to scalable, flexible and secure IT services on demand. Therefore, service providers are expected to identify these needs and satisfy them. However, the decision to adopt the cloud should not be made by focusing on customers' needs alone. This is because customers might have concerns such as security, trust, and the speed of the internet connection, for example that are hindering their fast adoption of cloud services. One factor pertaining to the decision is a proper evaluation of both needs and concerns through identifying the needs and the risks of adopting the cloud. The other part of the evaluation must include the assessment of the service provider's capabilities in terms of quality and price, so as to assure that it is able to deliver the required service. In this way the potential user's organization can evaluate itself and the service provider to decide whether or not to move to the cloud. This enables it to avoid a decision which might be risky or non-value adding for it.

This study explains the relationship between the need for adopting cloud computing services and the concerns effecting organizations in their decision as to whether or not to cloudify.

III. Research Methodology

To achieve the stated objectives four different groups of people participated in this research:

- *Cloud services providers in Oman:* A set of interviews were conducted amongst cloud services providers (national and multinational companies) to probe into their experience in providing services to Omani clients.
- *Current users of the cloud computing services:* A set of interviews were conducted amongst current users of cloud services to explore their experience in using cloud services.
- *Experts in the field:* A questionnaire was distributed among experts in the field of cloud computing, these including academicians and practitioners. The aim of this study was to include their insight into the process of migrating to the cloud.
- *Potential users of the cloud computing services and the top management*: A questionnaire was distributed amongst the potential users, including the IT managers and some top management in different public and private organizations in Oman.

All these research instruments are available from the authors upon request.

IV. Findings

A. Experts in the Field

A questionnaire was created to gather information from experts in the field. The results are as follows:

When the experts were asked about their opinion of what IT professionals think about moving to the cloud, one expert said, "If the question is about adopting public cloud services, I'd say that public clouds are not yet trustworthy when it comes to moving government information systems to it". However, he indicated that many government sectors have or are in the process of employing private clouds, which are found to be more secure since data will not be shared among multiple users.

In the second question the experts were asked whether benefits gained from cloud services outweighed its concerns. One expert commented, "The answer is yes". He believes that the major concern of adopting the cloud is security. However, the huge reduction in cost that the cloud provides, in addition to many other benefits including scalability and availability, certainly outweigh any security concerns. He also stressed that the security aspect has improved a lot and will continue to improve further. Another expert stated that adopting cloud computing is domain-specific. He supported his point with the example of the security sector, which cannot adopt the public cloud anyway. Also, he believed that the public cloud is a good option for SMEs for many reasons such as cutting the cost of hardware, maintenance and human resources, shortening the path towards running the business. However, he stressed the importance of agreeing on a clear Service Level Agreement (SLA) with the cloud provider. Nevertheless, he thought that, to ensure that the benefits of the cloud outweighed the concerns for the government organizations, a private cloud should be considered with care.

The third question in the questionnaire was concerned with whether organizations (large, medium or small) could move everything to the cloud. One expert stated that it would not be possible at the moment. He thought that organizations should be selective in which data to move to the cloud. Confidential data are better kept in the company's premises (although backup is needed). However, he thought that if confidential data were to be moved they should be encrypted before moving them. He stressed that this data would not be usable unless it is decrypted again which can incur additional computation cost. Another expert stated that a company of any size could benefit from the cloud, but the right cloud topology must be selected. For example, a large corporate company that has security or data sensitivity concerns might choose a private cloud, while other data might be better served by a public cloud in order to reduce the costs.

Also, the experts were asked whether they foresee that cloud services replacing the services provided by traditional IT departments. One expert responded that if most organizations used cloud computing, surely this would affect the way IT departments run businesses or employ people, and that the restructuring of the IT operations would be needed. He pointed out that IT people would probably have the chance to focus on more serious issues. He believed, however, that it is not clear now whether or not the cloud would totally replace services provided by traditional IT, but it would certainly affect them. He explained this by indicating that developing applications and engineering them would still be a task for the organization's IT department while the load on the technical staff would probably be reduced or staff would actually

receive a higher level of responsibility such as monitoring cloud providers' performance and outputs.

The experts were asked about the most influential factors in deciding whether or not to move to the cloud**.** One of the experts stated that the major factor is the cost-savings. Another expert supported this point. He added another factor which is improved productivity, enabling the leverage and enrichment of data by creating, sharing, accessing and co-editing it anywhere and with any device. Apart from cost-savings and productivity, another expert thought that other important factors include 1) technical considerations related to specific technology challenges that may arise; 2) external business considerations related to dealing with third party cloud providers; and 3) internal business considerations related to potential non-technological impacts upon the business caused by the move to the cloud. Another expert believed that scalability is also a major factor. Further, another expert focused on the opportunities gained from cloud adoption in terms of systems development. He claimed that most organizations' development projects are slowed down because of hardware and software acquisition and security policies. Therefore, utilization of the cloud for development could eliminate these, thus accelerating development efforts.

Furthermore, concerning the fate of IT staff after adopting cloud, one expert said "If it is a private cloud then many of the staff will be part of it, but if it is a public cloud people working in the technical support department will be affected. Another expert stated "actually the fact that the cloud will result in the loss of jobs is absolutely not true. As is true of any technology wave, the cloud will only sharpen the skills set in the market and will definitely create new specialized jobs in the area of virtualization, storage (Big Data), IaaS, PaaS, and SaaS. Another expert supported this view by indicating that as IT departments will have different functionalities, IT staff will need to be trained for the new jobs or transferred to other departments in the organization. This expert stressed that if both options failed then it would be hard to work out what the next step should be, especially for a government agency where the hiring and firing policies are very strict and rigid. Another expert thought that cloud computing would take some roles and responsibilities from them, so that the talented staff would stay while some others would not. He noted, however, that there would still be a need for some of them to manage the relationship with cloud vendors, monitoring, evaluating, and testing the various solutions.

Finally, regarding the policies/regulations/laws that regulate the relationship between users and providers, the expert declared that the SLA is the one that contained the detailed contractual clauses between the consumer and the providers. It contained everything related to the life cycle of the data. If the provider failed to obey the agreement there would be a way to deal with this in the law. In the SLA, availability of services, location of the data, the retention period, quitting the services, the cloud provider bankruptcy situation, etc. should all be discussed.

B. Cloud Service Providers

From the interviews conducted with several IT professionals from several cloud providers including the Oman Data Park (ODP) and Microsoft, it was found that all cloud service models are provided, including SaaS, PaaS, IaaS, DaaS and SECaaS. Examples of some cloud services provided in Oman are virtual private servers, cloud servers, and cloud backup. Both service providers offer various types of deployment method for cloud services, whether they are private, public, or hybrid clouds. However, it was noted that most of their users, and especially large organizations, preferred private cloud as a deployment method, while small and medium organizations chose public cloud.

Moreover, the service providers offer flexibility on the selection of data to be kept on the cloud without forcing users to keep their data in one location. As the Microsoft representative said, "If users want to keep part of their infrastructure on the premises and another part on the cloud, they can do so easily because of the flexibility offered to them".

When considering the issues, concerns and deciding factors in moving to the cloud many points were discussed, including the regulations which govern the relationship between users and providers, the assurance given to users for good service delivery, and the issue of internet connectivity in terms of its speed and cost.

Service providers indicated that the relationship between them and their customers is governed by an SLA which assures the protection of the rights of both parties. As the ODP representative stated "we provide good services to our clients by committing ourselves to a strict SLA and contracts". He mentioned that customized SLAs and reporting for customers are offered to customers according to their unique requirements to assure the satisfaction of special customer requests and the comprehensiveness of the agreement between them. This helps to guarantee a well-managed service and clear boundaries for both parties and the protection of their rights. They also mentioned that other agreements such as a Nondisclosure Agreement (NDA) can be signed to assure the confidentiality of the data. Regarding the assurances given to the customers for good services, providers indicated that an SLA, for example, specifies the percentage of availability expected during the year. The providers assure their reliability by providing 24/7 security and support through a guaranteed response in a minimum time.

Regarding security there are many measurements that are taken to make sure that data are kept safe, including physical security, firewalls, vulnerability management, and attack prevention through regular penetration testing. Providers are also committed to comply with international regulations. For example Microsoft and ODP are committed to ISO 27001 for security standards. Also, they assure the ability of customers to scale up or down but only pay for what they use. In addition to this providers have their Disaster Recovery site which is frequently tested to assure that the data of customers are kept safe. Furthermore, the procedure of removing customers' data from a providers' data centre was explicitly described as being

a simple process. Technically the customers have full control over their data and they are able to delete it easily while, from a contractual perspective, customers are securely protected from data misuse by the SLA.

When the internet connectivity issue was discussed it was found that it is considered to be a big challenge, and especially in Oman compared to other countries. The bandwidth provided by the telecommunication service is too slow for the requirement of cloud services. In addition to that, the cost of network connectivity is too expensive. Another Microsoft rep that was interviewed, the virtualization architecture noted that "the cloud is dependent on telecommunications. It actually serves as a backbone for the cloud, which therefore affects the feasibility of adopting it". Therefore, it was unanimously agreed that Oman has to put more effort into improving its telecommunications by offering affordable internet connection rates in order to encourage the cloud concept in Oman.

The future expectations of cloud services in Oman were discussed thoroughly. It was found that people *are* being encouraged to move to the cloud. Providers stated that as technology grows most organizations, by default, are up for adopting the change. As a move has already started towards virtualization, the cloud is surely the next step for IT to take into the future. The ODP rep supported this statement by saying, "That the banks have started moving to the cloud indicates that organizations are becoming familiar with the benefits gained from cloud services in terms of security, flexibility, etc."

The motives that have most encouraged organizations to move to the cloud were highlighted in the discussion. According to the discussion with providers the main drivers of moving to the cloud were:

1. The ability to have access to a whole infrastructure with which to start the business, and being able to run it without making huge investments (OpEx), paying for use only.
2. That less time is required for the procurement, development and launch of an entire IT infrastructure, software, platform and security for the business than is the case in the classical way of doing it.
3. That operational IT tasks and, therefore, the requirement for skilled IT personnel, are reduced, which results in an increased focus on the core business.
4. That there is a single point of contact, rather than having to interact with a multiplicity of IT vendors.

Regarding providers' expectations as to whether cloud services are going to replace services provided by traditional IT department, they indicated that there would be a move to the cloud but it would not be a 100% transition; there would very likely still be some services related to critical activities that would be operated in the traditional way.

Providers in Oman were confident that they would be able to accommodate the increased demand for cloud services in the future. The Microsoft rep said that Microsoft now offers 1 terabyte of cloud storage per user in OneDrive for Business, and it is ready to accommodate any increased demand confidently. Also, another Microsoft rep claimed that they have designed for a scalable environment that will be able to absorb nearly 1000 customers without having to make huge changes or large investments.

Thus the providers claimed that they are ready to provide the cloud services needed in Oman. They thought that they are capable of providing services according to customers' requirements since they possessed all the expertise and skills required performing the job. Neither did they think that ramping up would be a problem for them.

C. Current Cloud Users

Two main cloud service users were selected and interviewed (abbreviated as BN and BZ). Although there are many users in Oman who are already using various cloud services, these two were taken as typical examples of private cloud adopters. Examples of services adopted by the users are; office automation, data centre, collocation, Virtual machine and security as a service. Both users are using Multiprotocol Label Switching (MPLS) to get connected to their cloud. Other connectivity methods are also utilized such as point to point for the Disaster Recovery (DR) site, the lease line for online mobile banking and the ADSL for payment solutions and exchange.

It was found that one of the most influential factors in deciding to move to the cloud was the considerably shorter time it took to launch the company. They strongly agreed that other important factors that made them move to the cloud were fewer IT staff requirements, security, scalability and increased profits. They agreed, however, that availability, flexibility, improved organizational performance, better management and control and no CapEX were also factors to be taken into consideration.

Both users found that cloud computing was a good way to facilitate the launch of their business in a very short period of time. As the BZ rep said, "We only had 5 months to launch the business, so private cloud was the best solution in order to gain time, and especially because we are a green field bank". In addition to that, both users emphasized that private cloud was easy and manageable, as they themselves didn't have any infrastructure in place. This smoothed the progress of their decision to adopt the cloud and made it the most favourable solution. Through their feasibility analysis they found that adopting cloud services would be cheaper than investing in and building their own infrastructure. However, one of the users was worried that it may end up having high costs because of the high internet connection charge in Oman.

Neither user indicated that legal issues had arisen between them and their service providers. They said that there had been no problems apart from very minor ones that were addressed immediately. However, one user pointed out that the concerns which they still had were the stability of the internet connection, and its cost, both of which could have serious consequences for their businesses. Regarding the bandwidth limitation, some optimization solutions are already utilized such as the 'Cashe storage', which creates a copy of the data in the local server so that one does not have to go to the central server to retrieve data. This makes it faster, thus

reducing the need for bandwidth.

In the long term, one user thought that, for large organizations, the cloud may not be the ideal solution for its businesses once the costs were taken into consideration. It argued that cloud services are more suitable and beneficial in the short run only. It felt that it was paying too much in purchasing and owning its own equipment, but that this option might turn out to be less expensive in the long run when compared with the cloud. However, it still think that if telecommunication costs were brought down then perhaps the cloud would be cheaper in the long run.

Furthermore, another user pointed out that it was governed by the 'Central Bank' which was restricted in terms of disclosing customers' data, making it difficult to migrate fully to the cloud because if they did it would make them look as though they had less control of their data. For this reason the BZ rep stressed that creating a comprehensive SLA was very important in addition to implementing monitoring tools that enabled the user to see what was happening on the other side. It was highlighted that one of the minor concerns was losing control over the data, but they believed that they were protected from this by the SLA, and they considered the ease of management to be compensation for this concern. It was believed, however, that having automation and cloud support would not be sufficient, and that they would still require their own knowledgeable professionals of automation in order to process the daily operations of the core business smoothly.

Lastly, an assessment was performed to measure the level of satisfaction of these users with the service provided. One user was satisfied with the technical support provided and the response time, reliability, availability/accessibility, cost, security of the services and the privacy given to it. Similarly, the other user was 'satisfied' with all services except for the cost, which he rated as neutral.

D.Potential Cloud Service Users:

A questionnaire was distributed amongst IT professionals from different organizations. The results were as follows:

When IT professionals were asked to give their opinions about moving to the cloud and whether they are ready to adopt the change, the majority commented that they are ready to move to the cloud, some were not sure, while others rejected it, but in general most of the participants thought it is a good idea and are already discussing the move.

Below the different opinions about readiness to adopt the cloud are highlighted:

Ready:

One respondent described the cloud as 'the hottest topic of the day', which was responsible for a huge IT transition globally and was monopolizing the attention of all organizations, who were putting enormous effort into the optimization of this latest technology in order to drive their businesses forward. This respondent believed that the technology is enabling customers to avoid having to install the software they required physically on their own hardware and servers.

Hence, in simple words, cloud computing is simply an intelligent strategy to share the computing resources over the internet rather than having local servers or physical devices to handle applications. Instead all data storage, processing and bandwidth are centralized efficiently according to each organization's individual requirement.

Another respondent claimed that the cloud presented a good opportunity to reduce the capital investment (CapEX) requirements by using the cloud as a revolutionary way of managing IT through pushing it as a utility rather than having to invest in infrastructure. The third respondent stated that the cloud is a way to improve the business by reducing the costs, since users only pay for what they used. The fourth participant added to this by pointing out that the cloud reduced the human resources needed and hence reduced the cost of support, while others highlighted that it helped to focus on business goals. Another participant supported this point by expressing that it is the perfect way to get rid of a headache of operational tasks of IT and managing tasks that added no value.

Not Sure/Maybe:

On the other hand, some participants noted that there are considerations to be kept in mind prior to adopting the cloud including security, privacy and management. Another respondent commented on the need to know the capacity of the cloud and the price of the services. Another individual stated that it depends on the type of data to be processed. Critical data that may impact on the business must be hosted internally while non-critical data can be hosted outside the organization. One respondent indicated that it is the time to implement the cloud, but that the IT department would still be needed to solve the complicated problems. Yet another indicated that they might only move to the cloud if a local service provider assures them that their data would be kept in Oman. Another commented that they would be ready to move to the cloud if the following issues were met: a) that a strong and reliable cloud service is provided in-country (as there is a grey area that exists in laws and regulations for government-owned companies as to whether critical data can be stored outside the country); b) that there would be reasonable telecommunication costs (Leased Lines or MPLS). At present the high speed\response required for the main applications is very costly; and c) that additional services such as backup\archiving etc. are provided.

Not Ready:

A group of potential users said, "It will take some time before we feel secure and trust the providers". Another commented that the IT infrastructure is not ready, so they did not think they are ready either. Another participant stated, "We are sceptical about cloud security and the ability of other parties to access the information available on the cloud". Another added to this by saying "The move is difficult, since we will be dependent on the cloud providers". Another supported this by indicating that the mobile operator did not provide a high quality internet connection. Another one said that they aren't sure how the cloud will add value.

In a second question, respondents were expected to evaluate all barriers/concerns and to indicate whether or not they are factors that are hindering the fast adoption of the cloud. Over half the respondents (59%) were from the public sector and the rest from the private sector. The results are shown in Table I.

TABLE I
FACTORS HINDERING FAST ADOPTION OF CLOUD

No	`Factor	Agreement	Neutral	Disagreement
1	Lack of trust	70	14	16
2	Lack of familiarity	63	16	21
3	Unreliable IT vendor	51	33	17
4	Legal issues	56	26	18
5	Lack of top management support	58	28	14
6	Control and privacy	77	16	7
7	Data loss	40	19	41
8	Security concerns	81	7	12
9	Job security	49	28	23
10	Vendors lock	56	34	10
11	Expensive internet connection	59	34	7
12	Slow internet connection	77	14	9
13	High monthly cost	58	33	9
14	Lack of skills	56	23	21

Table I, above, clearly shows the major concerns as being: security concern (81%); slow internet connection (77%); control and privacy (77%); lack of trust (70%); lack of familiarity (63%); followed by expensive internet connection (59%); high monthly cost (58%); lack of top management support; legal issues. Lack of skills and vendors lock is rated equally at 56%. Other factors such as unreliable IT vendor, job security and data loss were considered less important in terms of being obstacles/barriers for the adoption of the cloud.

In response to any other barriers that respondents thought might hinder the fast adoption of the cloud, most of those surveyed mentioned the issue of data mining, budgeting, and the fear of trying something new.

Other respondents mentioned that regulations might exist which do not allow data to be hosted outside the country's borders. Another supported this point by highlighting the inability to visualize the data centre. An IT professional also supported this point by indicating that "With the cloud we can't see our servers and we don't know what happens on the other side". One respondent stressed that the culture favours informal relationships away from technology. "Go with phone calls rather than emails" might hinder the adoption.

In response to the question "When is your organization likely to move to the cloud?", 26% of the organizations said that they are planning to adopt the cloud within 6 month. Similarly, 26% of the respondent selected 6 months to 2 years while 33% of all indicated that they still have no plans to move to the cloud.

Regarding the preferred deployment method of adopting the cloud, it was found that the majority (60%) of the organizations are ready to adopt a private cloud while 16% of the organizations are planning to adopt the public cloud. A few of the organizations (9%) are planning to develop a hybrid cloud.

Concerning the type of service models that organizations in Oman are willing to adopt, 24% and 25% of the total respondents indicated that they are planning to adopt SaaS and PaaS respectively. 15% of the respondents are interested in adopting SECaaS, and 14% are planning to adopt DaaS. A small number of organizations (7%) are not willing to adopt any of the service models.

V. DISCUSSION

From the research findings it can be seen that the providers in Oman are ready to provide reliable and secure services and are already providing a variety of services with strict, customized Service Level Agreements (SLA) that enhance their credibility and their ability to meet customers' unique requirements. Specifying clear percentages of the provided service level and taking the full responsibility for meeting them is a guarantee that they are able to deliver their promises. One expert supported this by saying that there are legal clauses that could be used if providers failed to comply with the signed SLA. In addition, the service providers are ready to provide their services to the customers and are already offering various types of deployment method for cloud services that provided more flexibility for the users without forcing them to keep their data in one location.

Regarding security, it is thought that the security provided by cloud providers is better and more reliable than any that the organization could provide for itself. This is attributed to the ability of the service providers to apply certain security measurements, since they have more capabilities and are specialized in doing so. As mentioned in the literature review [23], security services keep businesses secure because they employ security experts. Actually, current users declared that they are satisfied with the technical support provided and the response time, the reliability, availability/accessibility, security and the privacy offered by the cloud service providers. They supported their opinion by assuring us that there had been no serious issues apart from minor problems which were addressed immediately.

Furthermore, providers are confident that they are able to accommodate a future increase in demand for cloud services. They claim that they have designed for a scalable environment that will be able to absorb any increased demand without having to make huge changes or large investments. It is believed that the providers are capable of providing services according to customers' needs since they have all the required expertise and skills to serve the users.

Regarding whether or not organizations in Oman (both public and private) are ready to move to the cloud, it is clear from the findings that service providers' expectations are positive. Furthermore, they find that organizations in Oman are feeling encouraged by the idea of moving to the cloud. They explain this by referring to the growing demand for cloud services in Oman. The experts' opinions match providers' expectations as they indicated that there *is* a move, but a careful one, especially when it comes to public cloud services which are not fully trusted. However, they admitted

that many government sectors have or are in the process of employing private clouds. It is worth noting that they all claimed that the preferred deployment method for large organizations is private Cloud while small and medium organizations prefer public cloud. In fact, from the potential users' questionnaire it was found that the majority (60%) of organizations are in favour of adopting a private cloud while 16% of the organizations are planning to adopt the public cloud. Fewer than 9% of the organizations are planning to develop a hybrid cloud. These preferences can be explained through the findings of previous studies [17] and [21] which demonstrate the benefits and the risks of each deployment method. In terms of costs, for example, it will be much economical for the small/medium businesses to choose a public cloud rather than a private cloud. These findings indicate that there is an acceptance towards moving to the cloud despite some cases which require special conditions. Many potential users agree with these expectations, stating that they are ready to move and mentioning several benefits to be gained from shifting to the cloud. This indicates that there is an awareness of cloud benefits that can be gained it terms of reducing capital investment (CapEX) requirements, costs, number of IT staff, and helping to focus on the core of the business. Even the IT professionals who were not sure whether they are ready still indicated that they had certain plans for the future such as the introduction of affordable telecommunication costs and availability of reliable in-country service providers. They are mainly concerned about the type of data to be stored in the cloud and the trustworthiness of the service providers. On the other hand, users who are not ready to move to the cloud declare that a certain amount of time will be required before they trust the providers and feel secure. They are just worried about the idea of being totally dependent on them. Additionally, they think that the quality of the internet connection provided in Oman is not sufficient.

Surprisingly, in response to the question “When is your organization likely to move to the cloud?”, only 26% of the organizations were planning to adopt the cloud within six months. Similarly, 26% of the respondents are planning to move within 6 months to 2 years, while 33% indicated that they still have no plans to move to the cloud as yet. This finding contradicts some of the other responses which seemed to show more excitement for moving to the cloud. This could be attributed to the lack of awareness of the cloud or lack of top management support. It is also widely believed that the internet cost might be an important factor in putting companies and organizations off moving to the cloud. However, it is clear that there will be a future shift to the cloud. After all, these simple concerns will not last forever and organizations will have to cope with the change.

When focusing on the deciding factors in the adoption of cloud computing services in Oman (there are both positive factors leading to their adoption (i.e. benefits, incentives and triggers) and negative factors leading to their rejection (perceived barriers), as discussed above. According to the providers’ experience the most influential factors in deciding to move to the cloud are the possibility of having access to a whole set infrastructure, software, etc. without having to make huge investments, and the reduction in IT support costs through ‘pay only for what you use’. Many experts agree with this statement, stating that the main reason for moving to the cloud is the cost savings. Also, current users have realized, through careful analysis, that adopting the cloud is cheaper than investing in and building their own infrastructure. These findings support previous research mentioned in the literature [23] and [17] which indicate that savings can be made by paying for use only. These studies collectively show that the cloud may play an important role in reducing costs, doubling profits and managing an organization’s budget efficiently and effectively. However, one of the users thinks that the cloud may not be the ideal solution for their business when considering the costs. This can be explained by the requirement of a high internet speed, which is too expensive in Oman. According to [30], internet speed is an important factor that requires careful consideration since the internet is the channel for data transfer and running applications. In addition to this the providers claim that another major factor that affects the decision of whether or not to move to the cloud is the short time required to launch an entire IT system for the business compared to the classical way of doing so. Current users agreed that this was the driver of their decision to move to the cloud.

What is more, providers, current users, potential users and experts agree that reduced operational IT tasks and requirement for skilled IT personnel were also major attractions in moving to the cloud. The experts supported this statement by declaring that the cloud allows organizations to focus on development and their core business rather than wasting their efforts in managing IT-related issues. These findings are also consistent with [30] study, which indicates that fewer employees will be required for IT solutions and therefore, it is believed, there will be less time wasted and more time to invest in innovation and improvement. Furthermore, a single point of contact rather than interacting with multiple IT vendors is another important factor that reduces the headache of managing IT. Current users support this statement by indicating that cloud facilitates management and control. Scalability is another major factor, as all four groups agreed.

Regarding the concerns, current users pointed out that the quality and stability of the internet connection are serious concerns that affect the decision of moving to the cloud. Potential users state that a slow internet connection is a major factor slowing cloud adoption in Oman (77%). The providers and the experts support this point and indicated that the network connection is a challenging in Oman. Although some optimization solutions are utilized such as the Cashe, the cost of having high internet speed is still very expensive. In fact, from the potential users’ survey, it was found that the majority of the professionals (40%) strongly agree that the expense of having a high speed internet connection is a major barrier to the fast adoption of the cloud which is a large percentage! In addition, 49% of potential users think that lack of trust also plays an obstructive role in its fast adoption. Also, 40% of the

respondents agreed that lack of familiarity is also a factor. This finding supports previous global surveys which classified lack of knowledge as a major barrier to moving to the cloud.

These findings can explain the result regarding data loss, where respondents do not have strong opinions about whether this is an obstacle or not. It is thought that since they are not familiar with the cloud and they do not trust it, they are not sure how secure their data is. However, in contrast to the previous research which reported that there is a possibility of data loss, it is believed that data are not likely to get lost since they are actually replicated to multiple locations. However, the majority of the participants (44%) agreed that concerns about security are a major barrier. This is also supported by experts and providers. Security is a very challenging issue that needs to be taken seriously. As the current users believe that having a comprehensive SLA may not be enough; there is a need to implement monitoring tools to keep an eye on what is happening on the other side. Also, the literature [17] states that security is a major concern and it advises that secure communication protocols should be used to ensure the security of data. This explains the use of MPLS by current users. Likewise, 40% of IT professionals strongly agree that control and privacy is a considerable barrier. This can be explained by the previous research which indicated that IT managers are concerned to transfer or keep their data beyond their data center.

Another considerably important factor is the lack of top management support. One participant commented about this statement by indicating that it is a question of changing the way jobs are performed. For example, managers are more likely to make phone calls than type emails, so that it is not clear whether moving to the cloud is going to add value or not. This is a new point which indicates that migrating to the cloud is not only a technical issue, but a social issue too.

Regarding concerns about job security, 28% of the IT professionals were neutral about it, while 14% of the respondents strongly disagreed with this statement which says that moving to the cloud might result in job losses of IT staff. This can be attributed to the job security offered in Oman and the strict employment policies that forbid organizations to fire workers easily, especially in the public sector. Some experts supported this point by stating that the view that the cloud will result in job losses is absolutely without foundation as there will still be a need to manage relations with cloud vendors, monitoring, evaluating, and testing various solutions. It is believed that it may even create new specialized jobs.

Some of the experts highlighted that the decision of migrating to the cloud as being domain-specific, and there are certainly many considerations that need to be kept in mind regarding the criticality of the data and the danger of them being exposed to a third party.

VI. Conclusions

Based on the research findings it can be stated that cloud providers in Oman are ready to provide reliable and secure services to their users. It was observed that they had a dedication to the creation of a strong base for proficiency that was built with careful consideration for scalability and security. The providers are aware of users' needs and concerns, which thus enhance their ability to meet those needs and absorb those concerns to better satisfy their customers.

Using the proposed framework enables the process of analysing the organization's requirements and service providers' capability through a clear analysis, allowing good decision-making. It may also help to explain customers' attitudes towards the cloud and whether they accept it or reject it.

Also, it can be stated that organizations in Oman - whether they are public or private - are somehow ready to move to the cloud, indicating that there are just a few special requirements that need to be met in order to gain their trust. It is important to note that since there is an acceptance of the idea by the organizations then the shift to the cloud is just a matter of time. Concerning the deciding factors to move to the cloud, it is obvious that there are many that are encouraging customers to move to the cloud such as time-saving, OpEX expenditure and ease of management, while the most notable concerns were the access to a good internet connection, security and privacy, control and top management support. There are many other factors that also need to be considered.

Overall, although some IT operations will be restructured after the cloud is widely adopted, it is not expected that cloud services are going to completely replace services provided by traditional IT departments. Some services which are related to critical activities will still be operated in the traditional way. As the experts said "it won't be a 100% transition" but there will be a shift to the cloud. Organizations should be selective concerning the type of data to be moved to the cloud and the suitable deployment method. Yet, it must be kept in mind that advanced security measures are going to be expensive too.

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