Does Cloud Computing Deliver the Promised Benefits for IT Industry?

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ABSTRACT

Cloud computing has captured the attention of both the researchers and practitioners alike. Companies and other cloud users are expecting to receive significant benefits from the new cloud based technologies. To what extent these benefits materialize for enterprise IT is not clearly understood. In this paper, we examine the perceived benefits of cloud computing from the cloud users' perspectives. Cloud users include users of SaaS/PaaS/IaaS, ranging from end-users, to service developers and system administrators. Using content analysis techniques, we examine one of the major discussion forums of cloud computing. Rather than offering a yes/no answer to the question posed, we offer five empirically drawn insights on the perceived benefits of cloud computing. It is proposed that the empirical insights gained are valuable to both researchers and practitioners. The value lies in a more holistic view on the promised benefits' landscape.

Categories and Subject Descriptors

C.2.4 [**Computer-Communication Networks**]: Distributed Systems - Cloud Computing

General Terms

Management, Performance, Reliability, Security

Keywords

Cloud computing, Perceived benefits, Content analysis, IaaS, PaaS, SaaS

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1. INTRODUCTION

Cloud computing is here to stay for foreseeable future. It has brought benefits of utility computing to a global scale [1]. For an enterprise, cloud offers IT infrastructure and maintenance services on demand. For a software service provider, it provides a ready-to-use development and deployment environment to host a software solution. For an end user, cloud delivers seamless access to data and applications from multiple devices. Moreover, for a cloud service provider, cloud offers profit maximization through the economies of scale.

Cloud computing has gained a tremendous amount of interest and criticisms in this recent years [5,6,7,9], as an IT community has started to utilize cloud-based services or is seriously considering to adopt this new paradigm. Researchers and practitioners seek to understand the situations in which they could make most of the benefits out of the cloud while eliminating the causes of potential risks. To achieve this, it is important to clearly understand the impacts of cloud computing, both the positive and negative sides, from all related perspectives. Moreover, the influencing factors that contribute to successful adoption of cloud need to be identified.

Literature claimed that cloud-based services offer benefits in many aspects. From a technical view, cloud promises scalability of resources to address volatile computing workload without an upfront investment on cost and effort to set up an IT infrastructure [1,8, 9, 10]. This results in cost reduction at an enterprise level and allows for better financial risk management [2,3]. Cloud users gain advantages from a provider's experiences and professional know-how to assure quality of service with regard to a service level agreement [26]. For IT personnel, a shift of routine administrative IT-related work to a provider opens room for more strategic work [1, 4]. However, there is still a lack of empirical evidence confirming the extent to which such claimed benefits are manifested.

The aim of this paper is to explore the realization of cloud computing benefits in practitioner communities. The research question, thereby, is formulated as follows. *How do cloud users perceive the promised benefits of cloud computing for IT and software development*? For this purpose, we conducted a content analysis of a major cloud computing discussion forum. The themes emerged from the discussion threads analyzed lead to several empirical insights on how the claimed benefits are materialized in five areas including availability, security, scalability, comprehensive computing platform, and cost reduction.

The remainder of the paper is organized as follows. In the next section, the related literature is portrayed from the viewpoints of the terminology and claimed benefits. This is followed by a presentation of the study plan, after which the results of the content analyses are shown. The paper is concluded with the identification of the limitations and the outline of the future work.

2. RELATED LITERATURE

2.1 Definition of Key Terms

There are several definitions of cloud computing and related stakeholders [12], while the most respected definition of this term is given by NIST [11]. Based on the literature, we convey the simple meaning of cloud terms. Cloud is a stack of hardware or software residing in a data center. It has at least four flavors - public cloud (available to general consumer mass with a free or pay-per-use model), private cloud (restricted to a specific organization for its use), community cloud (shared and maintained by a group of organizations, generally for a common cause), or hybrid cloud (a combination of public, private and community clouds). Cloud computing refers to delivering a stack of hardware or software residing in a data centre as a utility-like service over the network.

A service model determines the type of computing resources offered to consumers. They come in at least four flavors including infrastructure (IaaS), platform (PaaS), software (SaaS) and data (DaaS).

2.2 Promised Benefits of Cloud Computing

An adoption of cloud computing services, i.e. provisions of data center, hosted development platform, or on-demand software, introduces different degrees of impacts to an organization. In this subsection, several claimed benefits are identified from the relevant literature.

Often, cloud computing benefits are related to the like of an IT outsourcing paradigm. For example, Khajeh-Hosseini et al. have identified over 50 academic papers and industrial reports discussing risks and benefits of public IaaS clouds [10]. Lessons learned from an IT outsourcing paradigm are combined to the analysis as the authors consider IaaS clouds as a solution for infrastructure outsourcing. Even if a self-service model of cloud offers a higher degree of control than IT outsourcing, both paradigms share common risks such as the ones applicable to an IT department.

In addition, Clarke presents a collective downside of cloud computing through a user centric risk model [13]. In line with the work of Khajeh-Hosseini et al., the author views cloud as a form of outsourcing as the responsibility of resource management is shifted to a provider. The author categorizes risks as operational, contingent, security, and business. Technical issues at different likelihoods and with different impacts are described through the first three categories, while financial and legal issues are classified as a business case.

Cloud benefits also depend greatly on service models. For example, SaaS introduces a number of positive impacts to an enterprise. They include (a) increased user and stakeholder collaborations due to a capability of anytime/anywhere/any device access to applications and data; (b) minimized software maintenance activities due to a shift of work such as installation, upgrade, backup, and license control to the cloud provider; (c) centralized quality assurance as the responsibility on quality control such as availability, security and performance is transferred to the provider.

When the advantages of cloud data center offered by IaaS are considered, a number of constructive influences for an enterprise could be drawn. They include (d) ability to shorten a cycle from ideas to profitable products; (e) ability to address volatile workload without service interruptions or slowing down system performance; (f) decreased run time for backend job such as batch processing and analysis by using temporary resource acquisition; (g) increased system security due to the provider's experiences and advancements; (h) efficient solution for disaster recovery.

PaaS offers a couple of additional advantages to IaaS in exchange with flexibility over the choice of operating systems and middleware for the platform. It provides (i) simplified processes of establishing environments for application development and deployment; (j) integrated security framework which eliminates vulnerabilities existing in the gap between cloud infrastructure and a client's virtual systems.

3. STUDY DESIGN

The main objective of our study is to examine the perceived benefits of cloud computing for IT and software development. We conduct a content analysis of a major cloud computing discussion forum to examine the perceived benefits. Discussion forums are commonly used as data sources for analyzing the opinions and perceptions of people on a given trend or topic (such as [21, 22, 24]). Even though content analysis is defined as a research technique for the objective, systematic, and quantitative description of the manifest content of communication [20], there are different types of content analysis ranging from simple to complex, and from syntactical, referential, propositional to thematic (see [25] for a detailed description of these). This study adopts the thematic type of data analysis. We are interested in the emergent themes from the data in terms of the perceived benefits of cloud computing for IT and software development.

The chosen discussion forum, Cloud Computing Google Group (https://groups.google.com/forum/?fromgroups#!forum/cloud-computing), is one of the biggest and fastest growing discussion forums regarding cloud computing. It is an active discussion forum for practitioners who are practicing or interested in different aspects of cloud computing. The data source of the study, the posts in the Cloud Computing Google discussion group, is seen as appropriate for the research question investigated, which is to understand the perceptions of people on the promised benefits of cloud computing for IT and software development. The first post was posted in April 2008. In total the forum contained 1445 discussion topics on the 5th April 2012. The total number of posts was about 7,470. Generally the discussants have experiences of cloud computing, as users, developers, consultants, entrepreneurs or researchers.

In order to sift and identify the discussed topics that are most relevant to our research question, we went through the following steps. These steps form our overall study design as presented in Figure 1.

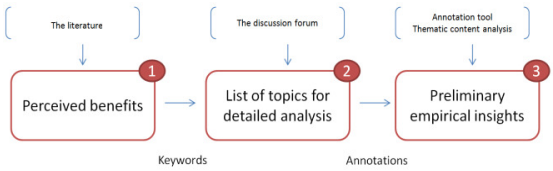

Figure 1. The study design.

Step 1: Based on the literature survey, we first identified ten perceived benefits of cloud computing to IT and software development. We also developed a set of keywords to encode each perceived benefit (presented in Table 1). Due to the inconsistency of terms used in the practitioner community, we tried to include the variations of keywords to capture most of the related posts.

Step 2: Using the keywords from Step 1, we identified a list of topics from the discussion forum for detailed analysis. This step included three activities. Firstly, we used the "Advanced" search function embedded in the web interfaces of Google groups (http://groups.google.com/advanced_search) and searched for the posts containing the relevant keywords. We limited the search to the messages posted between January 2011 and March 2012, as they reflected the most recent perceptions of the community.

Secondly, for each group of keywords, we grouped the search results into topics. A discussion topic was considered a unit of data analysis. It preserves the complete context of a discussion, including the contributing members of the topic, the chronicle order, and the logical structure of the posts.

Finally, to identify the topics to be included in the detailed analysis, we examined the topics that were ranked above 50 percent of the most discussed topics for each of the keyword groups (identified by the number of respondents). We then randomly selected 10 percent of the most discussed topics from each group. The assumption behind the choice of popular topics was that they reflected where the interests of the cloud computing community lie.

As a result, we identified 21 topics that are considered relevant for in-depth analysis. They are shown in Table 2.

Table 1. Benefits of Cloud For Software Development

Id.	Benefits	Keyword
1	Capability to scale up or down the computing resources to response to volatile resource requirements	scale OR scalability , capacity OR workload
2	Decreased run time for backend job	performance OR speed
3	Increased system security due to provider's experiences and advancements	security OR secure
4	Efficient solution for disaster recovery	backup OR recovery
5	Simplified processes of establishing environments for application development and deployment	develop OR deploy
6	Integrated security framework which eliminates vulnerabilities existed in a gap between cloud infrastructure and client's virtual systems	security OR secure
7	Cloud-based testing can make testing faster and enhance the delivery of testing services	Test
8	Minimized software maintenance activities due to a shift of work to the cloud provider	Maintenance
9	Ability to shorten a cycle from idea to profitable products	"time to market"
10	Increased user and stakeholder collaborations due to a capability of anytime/anywhere/any device access to applications and data	Collaboration

Table 2. The List of Topics Included in the Analysis

Id.	Topic	Start Date (m/d/y)	End Date (m/d/y)	No. of Posts	No. of Respondents
1	The illusion of cloud Computing adoption in data centers	01/04/2011	01/10/2011	24	17
2	Risk of 3rd party hosting, AWS, & Wikileaks	01/09/2011	01/24/2011	18	14
3	Your thoughts on SeaMicro's server architecture - a fit for cloud computing?	01/10/2011	01/27/2011	22	12
4	What is IT's role shifting confronted with cloud computing?	01/18/2011	01/24/2011	10	6
5	Research on something "new" related to cloud computing	02/15/2011	02/26/2011	15	13
6	Very anti-cloud/IaaS article	03/02/2012	03/08/2012	34	22
7	Recommend Cloud aware Database	03/03/2011	04/11/2011	35	16

8	Idle Capacity on Cloud in Financial Statement	03/06/2012	03/17/2012	15	9
9	Impact of "Cloud" becoming a buzz word	03/11/2011	03/31/2011	20	13
10	does the location of datacenters affect Data Migration to the cloud??	03/18/2011	03/21/2011	5	4
11	Say What, Amazon?	03/31/2011	04/04/2011	25	14
12	Rapid reporting of Amazon EC2 cloud status	04/22/2011	05/02/2011	27	19
13	Significant milestone for cloud computing	05/20/2011	06/08/2011	82	20
14	78 services at Federal agencies migrating to the cloud, link for archived webcast	05/29/2011	06/03/2011	7	5
15	Malware: the dark side of the public cloud	06/06/2011	06/09/2011	8	5
16	How much time and money can businesses save by using cloud infrastructure?	06/17/2011	06/21/2011	17	9
17	Using and combining existing data centers to create a public Cloud offering.	06/20/2011	09/21/2011	5	4
18	What do you believe is the biggest barrier to entry for cloud computing?	08/24/2011	10/31/2011	48	33
19	When selecting a cloud provider, how important is their network performance?	10/18/2011	11/01/2012	11	10
20	Requirements for Applications to be "Cloud-Ready"	12/16/2011	03/02/2012	48	23
21	How fast is the transition of On-Premise ISVs to offering SaaS products?	12/30/2011	03/12/2012	32	18

Step 3: Based on the keywords from Step 1 and the list of topics from Step 2, we started the detailed thematic analysis to develop preliminary empirical insights. We used Diigo (http://www.diigo.com), an online annotation tool, to analyze the 21 topics. Diigo allowed us to preserve the original thread structure of each topic, and to analyze the posts in their original context, in terms of the time they were posted, who were the authors of these posts, etc.

As mentioned previously, our analysis has relied on the discussions extracted from one of the biggest discussion forums in cloud computing. The use of secondary data (which was either collected by individuals other than the researchers that conduct the study, or collected for other purposes than the one currently being considered), however, poses several limitations. One is a lack of control of data quality and accuracy. Another limitation lies in the characteristics of discussion forums. Generally speaking discussion forums have low participation rates despite the large number of members [23], which means that discussions are generally led by a small group of "elite" members. To improve the generalizability, this study can be replicated using another cloud computing discussion forum, to see if the empirical insights reported in this study will be found in a different data source.

In the next section, we report the themes emerged through the analysis of these topics.

4. RESULTS

In this section the empirical results of the study are presented. The section is organized around the themes emerged from the discussion threads being analyzed. Each subsection is concluded by a preliminary empirical insight.

4.1 Availability

Literature claims that the users of cloud services see the continuous availability of resources and services as beneficial. Indeed, one of the principal promised benefits of cloud computing is that it provides anytime/anywhere access to data and/or services located in the "cloud". For this reason, as an example, one of the quality measures of a cloud-based service is its up-time with respect to the quality level specified in the SLA [14]. Cloud service providers gfoften state in their service offerings high to extremely high availability figures such as 99.5%.

18.3% of the data concerned itself with the notion of the availability, fault tolerance, and reliability of a cloud service. The content analyses show that the practitioners actively raised up the issue of availability in the followed discussion forum. The discussion generally followed a repeating pattern, which was initiated by stating a specific (and typically a negative) incident and asking for peers' views on it. In the following extract from the discussion forum a typical incident is provided:

> *"There are problems in the public cloud, specifically [ServiceProvider1]. There are outages of a number of sites built on the [ServiceProvider1] Web Services infrastructure […]" (Practictioner1)*

This particular incident was also made public by [ServiceProvider1].

The lack of availability may lead to other issues as well. This specific instance for example leads to a data loss, which is presented in the next subsection dealing with the security viewpoint.

Other perceived impacts from the lack of availability were periodic service outages, unexpected shut down of virtual machine instances and the perception that the service provider

does not respect the notion and idea of a public cloud. The latter indicates that each service provider has right to refuse service to anyone not confirming to their specific agreements. Thinking of a cloud service as a public utility similar to electricity this would not be the case, i.e., in an electric company.

While the lack of availability does cause problems, it can be mitigated by a service provider if they give an early enough "heads-up" notice as well as enough information for its users as the following two extracts demonstrate:

> *"[…][ServiceProvider1] behaved professionally and talked it through with us. There were no unexpected shut downs but rather organized emails with full details, questions, and a chance to respond." (Practictioner2)*

> *"I was pleased to see an explanation with enough detail that I felt some confidence they actually root-cause diagnosed the problem, and had a fairly clear path to avoiding it in the future." (Practictioner3)*

The content analyses reveal that the cloud users were offering each other some mitigation strategies in the unexpected event of a service outage. These mitigation strategies included the approaches for dealing with hot migration in an autonomous way, deployment of multi-location & multi-vendor cloud services, automation tools for the IaaS migration and finally, tools that provide automation for multi-cloud migration.

The primary empirical insight regarding the realization of availability from the cloud user perspective is the following.

E1. The users in the cloud seem to expect close to 100% availability of the promised resources or services made available. Yet, it appears that the failure of delivering the promised availability is tolerated as so far as information about the service failure is offered early enough with sufficient information. Moreover, there seems to be a tendency indicating that the developers are keenly searching for solutions mitigating the problems caused by the outages. Multi-cloud deployment appears to dominate the solution space.

4.2 Security

General perceptions towards cloud security involve not only a technical angle such as the vulnerabilities of underlying infrastructure and web service security, but also refer to an emotional angle in which trust and a sense of privacy are of primary concerns [15]. Traditional data centers rely on firewalls and physical access controls to protect sensitive data. As a public cloud offers data center and development platform on-demand, the responsibility over security control and resource management is shifted to the service provider. For SaaS, the notion of security refers to data security on multi-tenant environments [17]. Cloud Security Alliance provides guidance on reducing security risks when adopting different cloud services [27]. Literature claims that the users of cloud services could benefit from experiences and professional "know-how" of the service provider to protect their critical data and systems [10].

Approximately 20.57% of the extracted data concerns itself with security. The practitioners strongly perceived the security concern as a barrier resulting in the hesitance of public cloud adoption in an enterprise, especially in a critical sector such as health care and e-commerce. A private cloud became a preferable choice for this reason. The community calls for security improvements in many areas, such as physical access control and compliance guarantee. The following extracts express:

> *"Cloud technology does not have security level access controls of a traditional data center. It is the people and process issues that are driving concerns for Enterprises." (Practictioner4)*

> *"Developing attack resistance, improving trust metrics, enhancing reliability and increasing the risk transparency remain crucial to widespread enterprise use of cloud computing" (Practictioner5)*

The terms and conditions regarding the right of a service provider to access user data, even though for a constructive purpose or law enforcement, appeared to raised users´ concerns. Withdrawal from taking security liability appears to damage trust of a certain group of users.

> *"The standard agreement starts from practically zero liability, giving [ServiceProvider1] a lead at the start of the negotiation process. Everything that agree to give in addition to the standard agreement is priced extra or requires a very high volume of business guaranteed […] It is like the wealthy avoiding to pay taxes" (Practictioner6)*

However, a large group of users tolerate this condition. This might be due to their lack of understanding, unawareness and a lack of other options. On the other hand, it means that users are comfortable with the risk. In the case that a provider allows for negotiation, several respondents reported difficulties involved in the process.

Other perceived security issues include risk of data exposure, misuse of cloud services by notorious users, insufficient identity verification during the registration process and increased incentive of attackers on multi-tenant infrastructure.

It appeared that a security issue, such as data loss, was an impact from another incident. The following extract demonstrates that, in this specific instance, a "small" amount of data was actually lost in the recovery process.

> *"[ServiceProvider1] reports the EC2 recovery process at the Northern Virginia data center is complete. Access to the Relational Database Service has been restored for all availability zones. However, a small percentage of EBS volumes were not recoverable." (Practictioner1)*

Apart from the discussions on security threads, the analyses reveal the respondents' ideas on prevention mechanisms. Encryption is perceived as mandatory in public cloud. They concerned as well about its impact on performance. Other mechanisms suggested included image protection, application virtualization, hybrid implementation, and payment verification.

The primary empirical conclusion regarding the realization of security from the cloud user perspective is the following.

E2. Cloud users have to rely largely on third party or a cloud provider's security provisions. The cloud user, still, appears to perceive the security issues as the main concern prohibiting the adoption of the public clouds. It seems that the main concerns are related to transparency over the processes, agreements and privacy terms. Abovementioned issues may motivate the practitioners and users to consider private cloud based solutions.

4.3 Scalability

The pertaining notion of scalability refers to having reliable performance by means of endless computing resources which are managed by so-called on-demand resourcing services [11]. In practice this means that from one day to another, one can have a predictable response time regardless of the number of requests received by the service. Elasticity refers to an ability to scale with minimum overheads in terms of time and operation supports [18, 19]. It reflects that scalability must be done in an automated manner. Scalability often deals with the notions of performance, latency time, elasticity and application frameworks.

The cloud practitioners raised scalability as an issue in the discussion forum, 21.14% of the cases selected for the empirical analysis. Similar to the availability ambition, the practitioners perceived scalability as a highly desirable quality. The discussion predominantly searched for solutions in achieving the scalability of the respective service. Based on the data available, it appears to be difficult to achieve.

Developing highly scalable services is perceived to require knowledge of distributed database, database transaction, application architecture and a decision on scaling approaches. The following extracts demonstrate:

> *"My experience is that the real issues come from your plans for scaling up. The key question is: will you in future need to 'scale up' or 'scale out' […] The effective 'scale up' limit for NoSQL is usually at 10s of GB. After that you have to get involved in sharding your data […] or in splitting your data blobs into smaller chunks […]" (Practictioner2)*

> *"While IaaS can PaaS can wrap applications and increase cloud characteristics [...], a team's ability to realize benefits are limited by application architecture […] For example, applications conforming to eventual consistency, embarrassingly parallel operations, actor model interactions, and REST" (Practictioner7)*

Other relevant components that contribute to effective scaling included a proper configuration of virtual machine image, load balancing strategy, caching system, and middleware. A variety of middleware which are integrated to deployment environment encapsulate the qualities such as scalability and fault tolerance, thus transparently automate those desired qualities on behalf of the services it hosts.

On the other hand, unreliability over the large-scale network is perceived to contribute negatively to the time behaviour of a service, an ultimate goal in this context.

The practitioners further discussed approaches to achieve scalability in an automatic manner. It requires an effective resource tuning algorithm which is very specific to the nature of an application, the request pattern and the goal which can be either high throughput or fast response.

> *"self-tuning instance pool size, tuning for response time goal is very different from maximizing throughput. […] I think it is extremely difficult to do that precisely and fast - just because auto-tuning heuristics must have a very small number of guesses to test." (Practictioner8)*

The primary empirical insight regarding the realization of scalability from the cloud user perspective is the following.

E3. Dynamic resource scaling (up or down) may not be the real issue for software in the cloud. Rather, practitioners seem to focus more efforts in understanding how to utilize the resources available. Thus, the practitioners seem to aim at developing software that properly balances the load in accessing and provisioning the cloud resources. Practitioners also appear to place focus on data management and service architecture issues.

4.4 Computing platform

PaaS provides users with configurable development and deployment environments to host their services based on APIs and programming frameworks supported by the providers. Literature claims that developers gain benefits due to a shift of work on environment preparation and maintenance. Compared to IaaS, a hosted platform enhances security by integrating security framework and monitoring at the operating system level [16].

The cloud practitioners raised the discussion on hosted platforms, 5.7 % of the cases selected for the empirical analysis. Thus, it is less than the cases of the other claimed benefits. Still, the analysis shows that developers appreciated the emergence of tools (e.g., a plugin in Eclipse) that enhanced the functionalities of the platform, and thus helped them to increase their productivity.

Several concerns were raised regarding supported operating systems and the integration of each component in a platform. Modern and complex operating systems are perceived to be a source of overhead. The lack of integration between virtualization, an operating system, and a middleware results in complex integration and the loss of audit trails. The following extract provides an example:

> *"Once you modify the runtime environment of a VM image using the OS level tools you have lost the audit trail from the perspective of the lifecycle management tools." (Practictioner9)*

In addition, the practitioners found it important to have sufficient control over the infrastructure such as the ability to adjust resource configurations, operating system, and storages.

The primary empirical insight regarding the suitability of hosted platform from the cloud user perspective is the following.

E4. While not directly articulated, it appears that cloud platforms are delivering their promises as perceived by the practitioners. The deployment environments seem to be sufficiently functioning and they seem to be having an adequate level of maturity for a widespread use. However, the perceived notion is that the tooling supporting the software development on a platform remains still quite limited. There are also some indications that an OS that would be more reliable and less complex could be expected to emerge.

4.5 Costs & IT-department

Impacts of cloud computing at an organizational level involve financial impacts and changes to an IT department. Literature suggests that the consumption-based pricing model opens room for an enterprise-level cost reduction. This is due to the removal of upfront IT investment and over-provision of resources, reduced maintenance cost, and reduced IT personnel. From the software development perspective, a shift of IT-related work to a provider

shortens the product time-to-market, which in turn increases enterprise revenue.

Approximately 21.7 % of the extracted data concerns itself with cost and impacts on enterprise IT. The practitioners claimed to receive benefits mainly from the hardware side. But from the software side the benefits were not so clearly present. In fact, the practitioners expressed their concerns with regard to pricing structures and licensing models. In practice, there are two types of licensing models: per-seat subscription and domain subscription plan. However, per-seat subscriptions, which are generally offered by SaaS providers, appear to introduce the pricing overhead as the paid capacity is not in use all the time. The following extract demonstrates the case:

> *"I know first hand from my clients how much they hate variable per-seat subscriptions, using credit cards and promo codes to sign up, and paying for accounts that are not being used." (Practictioner10)*

Licensing interoperability is one of the desired services. It appears that there is a lack of standard that allows for license mobility so that organizations are not charged for the software they are already licensed for.

Apart from that, they also sought a cost comparison model to compare related cost for public and private clouds, and to compare the cost among cloud providers

Perceived benefits of cloud computing in an IT department include a shift of routine administrative work to the provider, which in turn creates room for more strategic work.

> *"many fear that a shift to cloud services will make IT a less relevant role in an organization due to outsourcing. […] many are happy to treat this as a great opportunity for IT to shift their role as managing less internal infrastructure and focusing more on strategy." (Practictioner11)*

Resistance to the change of role and responsibility was found in many cases, as some IT people perceive it as a loss of control.

The primary empirical insight regarding the costs and IT-department from the cloud user perspective is the following.

E5. Practitioners perceive to receive the promised benefits in terms of cost savings coming from the hardware. From software side there still appears to remain many issues hindering the adoption related to licensing and pricing structure. IT departments may face resistance to change due to the feeling of having lost the control over the service offering. However, practitioners indicate a need to develop more creative strategies for the IT of tomorrow. Reduction of routine tasks appears to be a welcomed impact.

5. CONCLUSIONS

In this study, we examined the perceived benefits of cloud computing from a large community discussion forum. Discussion forums are commonly used as data sources for analyzing opinions and perceptions of people on a given trend and topic. We used the thematic content analysis to prepare and analyze the data. Five preliminary empirical insights across availability, scalability, security, computing platform and cost reduction are proposed as a result. The findings serve as a basis to define structured questionnaires and interview protocols to investigate how the promised benefits of cloud computing are manifested and to identify the factors that contribute to successful cloud adoptions.

The insights gained from the content analysis also show that a discussion forum is a valuable source of information to acquire more understanding on the state of the practice and challenges faced by practitioners of a given technology.

Further studies should extend the scope of the present study in three ways. First of all, to address the inherent issues with secondary data, one avenue for future work will be collecting primary data to investigate the perceptions of cloud users on the promised benefits. Survey, interview, and case study are useful research methods to collect primary data. Secondly, to improve the generalizability, this study can be replicated using another cloud computing discussion forum, to see if the empirical insights reported in this study will be found in a different data source. And finally, compared to the large range of discussions and the large number of posts, the number of topics analyzed in this study is relatively small. Further studies should increase the sample size to enhance the validity of the findings.

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