CLOUD COMPUTING IN HIGHER EDUCATION SECTOR FOR SUSTAINABLE DEVELOPMENT

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ABSTRACT

Cloud computing is considered a new frontier in the field of computing, as this technology comprises three major entities namely: software, hardware and network. The collective nature of all these entities is known as the Cloud. This research aims to examine the impacts of various aspects namely: cloud computing, sustainability, performance management, government and other aspects in line to develop a new sustainable cloud computing model for the higher education sector in China. Currently, there are several obstacles facing the adoption of cloud computing in China, namely: lack of standards; insufficient educational data and disregard for environmental impacts. A mixed method approach will be employed in this research comprising at least 20 interviews to elicit the attitudes of the cloud users towards the initial model, based on the interviews feedback, the model will be optimized and an online survey will be conducted with a sample size of minimum 390 to examine the perceptions and attitudes of participants towards the new model. The main target participants will be students, academic staff and personnel working in IT departments in Chinese universities.

KEYWORDS

Cloud Computing, Sustainability, Model, China

1. INTRODUCTION

The concept of cloud computing was jointly proposed by Google and IBM in 2007 (Wang and Xing, 2011). Cloud computing is a computing platform that resides in a large data centre and is able to dynamically provide servers with the ability to address a wide range of needs, from scientific research to e-commerce (Jaeger et al., 2008). The global cloud computing market is expected to grow from US$40 billion in 2011 to US$241 billion in 2020 (Ried and Kisker 2011, quoted in Cheng et al., 2016). The development of cloud computing is growing rapidly and the cloud computing industry has great market potential in China (Yu et al., 2016). This research aims to examine the current cloud computing models, with the purpose of developing and evaluating a new cloud computing model for the higher education sector in China. An in-depth analysis of cloud computing will be conducted with respect to cloud computing, sustainability, performance management, government and other aspects in order to develop appropriate solutions for China.

2. UNDERSTANDING CLOUD COMPUTING

Cloud computing generally refers to an Internet-based computing model that various PCs and servers are associated with Internet, operating systems, software and database. These resources can be shared by multiple clients based upon their demands (Chi and Gao, 2011). Similarly, Vouk (2008) claims that cloud computing aims to maximize the profit and minimize the cost of computing by migrating software, hardware, operating systems and other computing service-related devices from local data centres to cloud servers provided by cloud venders, thereby enabling cloud clients to utilize the computing resources which are available in the cloud servers via client program at any time from any location where there is access to the Internet.

2.1 Service Models

According to Metz (2011), three cloud computing service models have been defined by NIST (National Institute of Standards and Technology): Software as a Service (SaaS); Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). Software as a Service enables cloud software or applications to be operated on the cloud-based virtual server, so the clients can access the resources at anytime from anywhere once they have linked to the network (Cusumano, 2010, Armbrust et al., 2010). Google Mail and Google Calendar are good examples of SaaS. Platform as a Service is the second cloud server model. Applications and services can be built in the cloud based on clients' requirements, so the cloud users can access the online applications without having to download or install them (Qayyum et al., 2011).Google App Engine is one example of PaaS. The third cloud server model is Infrastructure as a Service. The IaaS platform provider supplies the hardware, storage space servers and other computing devices to cloud clients. The platform can be utilized immediately which saves a lot of time for clients, and routine equipment maintenance is carried out by providers (Bhardwaj et al., 2010).

2.2 Deployment Models

Just as cloud services have different models such as SaaS, PaaS and IaaS, there are different deployment models of cloud computing as well. According to Metz (2011), four different deployment models for cloud computing have been outlined by NIST: Private cloud, Public cloud, Hybrid cloud, and Community cloud. Private cloud is defined as an individual institution operating its own cloud (Metz, 2011). According to Wyld (2010), in the private cloud method, the cloud infrastructure is owned solely by a company and it may be managed by the organization or a third party and may exist on the premises or off-premises. Schubert et al. (2010) point out that private clouds are normally operated by the respective organization; the functionalities are not exposed to the customers directly and it is similar to Software as a Service from the customer‘s perspective. A public cloud service is used by the general public(Metz, 2011). The cloud infrastructure can be accessed by the public cloud users or a large scale industry group and is owned by the cloud provider (Wyld, 2010). Public cloud is based on the standard cloud computing model and the cloud service provider will make resources such as storage space or applications available to the general public cloud computing users through the Internet. The subscription models of public cloud services include a pay-per-usage model or may even be free. Hybrid cloud allows institutions to deploy an application or system using more than one type of deployment model (Metz, 2011). Finally, the term "private cloud" refers to a proprietary network or data centre managed by the organization; "public cloud" means that public cloud users can share the cloud infrastructure; the hybrid cloud is maintained by both internal and external providers. According to VMware (Chang et al., 2010), hybrid cloud is a cloud infrastructure consisting of two or more clouds; private and public cloud can be combined together under standardized technology and specific rules that enable application and data portability. "The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on premise or off premise" (CISCO 2012). Schubert et al. (2010) believe that generally cloud systems are restricted to the local infrastructure; for instance, public cloud service providers offer their own computing infrastructure to users.

2.3 Current Status of Cloud Computing Development in China

According to the research report from BAS Global Cloud Computing Scorecard, China has shown enthusiasm for ICT development and improvement compared with other countries, and China was ranked in 19th among 24 countries that account for 80% of the global ICT market in 2013. Moreover, China has made critical progress regarding broadband coverage, and in June 2012 carried out a magnificent national broadband arrangement to meet the anticipated 800 million web clients in China in 2015 (2013). As for the education area, believe that there is an immense shortfall in educational information among different districts, between urban and rural areas and among various schools (Wang and Xing, 2011, Wang, 2002, Mundial, 2013). Because of the dense population and vast territory of China, some areas of public education, assets allocation and utilization are not adequately supervised.

2.4 Research Gap

Governance involves the strategic task of establishing an organisation's goals, direction, limitations and accountability frameworks. It is necessary to set up the governance strategy up front if universities or institutions consider adopting the cloud computing technology. Once cloud computing has been adopted, performance management is required to ensure that the system operates as planned. Moreover, sustainable green IT attracts more attention nowadays. Environmental sustainability has been defined as "development that meets the needs and aspirations of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). Thus, governance, sustainability and performance management should be considered together when developing a cloud computing model. To the best of my knowledge, none of the articles which have been reviewed so far has covered these three aspects together, so this study aims to create a cloud computing model that includes cloud computing governance, sustainability and performance management.

3. RESEARCH METHOD AND QUESTION

The mixed methods approach has been chosen for this research. Mixed methods research is a methodology for conducting research that involves collecting, analysing, and integrating quantitative and qualitative research in a single study or a longitudinal program of inquiry. The advantage of this form of research is that both qualitative and quantitative research, in combination, provides a better understanding of a research problem or issue than either research approach alone. This research contains online survey and semi-structured interviews. In this research, all the data will serve to resolve the research questions, and the online survey will contain both close-ended and open-ended questions. Thirty universities from top 500 universities in China have been selected as the target participants of this research, and data of interviews and questionnaires will be mainly gathered from these 30 universities. This research aims to develop and evaluate a new cloud computing model for the higher education sector (universities) in China, and would answer the following question: What are the perceptions and attitudes of students, academic staff and IT department personnel towards the new sustainable cloud computing model in Chinese universities? Certainly target participants would have different expectations as their needs are different, various information would be received from participants, thus software like Nvivo will be utilised with the purpose of analysing and combining the useful information to develop a sustainable cloud computing model for Chinese universities.

4. RESEARCH OUTCOME

This research will provide a detailed description and new perspective on the cloud computing in Chinese universities. Based on the literature review, an initial model was developed and it consists of three components namely: governance, sustainability and performance management. The proposed model aims to provide a broader view of the cloud technology by combining all these three elements together. Internal stakeholders such as students' staff and IT personnel will be the users of the new model, and external stakeholders' service provider, researchers, software developers, government, research partners, etc. could also be effected by this model. This research will review the current cloud computing models. A series of solutions and standards regarding cloud computing will be generated in this research. The outcome of this research is a new cloud computing model which can be applied to universities in China in the future. It is anticipated that this model will encourage Chinese universities to adopt the cloud computing technology in line to become more sustainable. For those universities who already using the cloud technology, this model will provide some valuable information to improve their cloud strategy. Furthermore, with certain modifications, this cloud model could be adapted for other universities in other countries. The new model will be evaluated by using mixed methods approach. The new cloud computing model will be developed to support a great number of potential cloud users who need to clearly understand the principles for cloud-related governance; enterprise architects, business analysts and software developers who are willing to adopt newer approaches to develop and deploy cloud services and infrastructures based on a new cloud computing model; cloud computing field researchers who would like to further increase their understanding of the governance, sustainability and performance management aspects of cloud computing; and students and lecturers who are interested in further enhancing their cloud-related knowledge.

5. CONCLUSION

In conclusion, this research provides an initial description regarding the cloud computing model for the Chinese universities. The proposed model aims to improve the environmental sustainability and efficiency of the use of resources in China, especially in the higher education sector. Also, this research will review the current cloud computing models. A series of solutions and standards regarding cloud computing will be generated. The research outcome will benefit potential cloud computing users and institutions in China and globally simultaneously. As time limited, only a few aspects and components from cloud computing have been examined to form this new model in this paper, however, further discussion will be carried out in the future to discuss the assessment, examination and feedback from stakeholders.

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