



Cloud Migration Critical Success Factors Framework in Saudi university (CMCSFF)

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Abstract Today, Universities have become heavily dependent on Information Communication Technologies (ICT) to provide educational services for their stakeholders. Developed countries like the UK and US have harnessed the capabilities of emerging technologies, such as cloud computing (CC) as means to offer flexible and highly scalable electronic educational services. However, in developing regions such as Saudi Arabia, higher education institutions, such as Universities are uncommon and are merely start-ups. Therefore, these Universities have a restricted ICT infrastructure. CC could therefore be a viable ICT solution that could offer substantial benefits, such as agility, increased efficiency and opulent education content, all of which can renovate higher education and ICTs in Saudi Universities. Presently, there is limited research supporting Saudi universities on how to tackle existing ICT infrastructure challenges and how contextual factors affect the success of migrating to an educational cloud. This research introduces a framework to support the successful migration to an educational cloud in Saudi Universities. Here, this research identified a series of critical success factors (CSFs) through creating different elements from existing research relating to cloud migration in the higher education context. Qualitative semi-structured interviews with IT managers and academic staff who come from a prestigious Saudi University were conducted. Here, the participants' gave their views and perceptions of the potential benefits and challenges that could sway their decision to adopt or not adopt the educational cloud. These CSFs were tested against the existing CSFs identified in the existing literature. The findings suggest a high level of acceptance of the cloud in Saudi Arabia and there seems to be a positive attitude towards the potential implementation of this innovation, despite the limited coverage in Saudi Universities.

Keywords Cloud computing; Virtualization Data security Disaster management, Reliability Big data

I. INTRODUCTION

The Ministry of Higher Education (2016) found that Saudi Universities are still without the necessary online e-learning and teaching tools to support its students and staff. Recently, distance education in Saudi Arabia has matured and can be supported by the cloud. However, much improvement and development is needed, since only three major Universities have considered enhancing the online and distancing learning environment; King Abdulaziz University (Jeddah); King Faisal University. King Saud University (Riyadh) (Aljabre, 2012). For that reason, HEIs in Saudi Arabia must shift from traditional delivery methods, namely moving from tutoring and lecturing to cloud-driven education to not fall behind on the latest tools and educational services.

Odeh et al. (2014) found that Universities in Saudi Arabia remain sceptical about the educational cloud for distance learning and e-learning platforms, while Universities in Western regions are continuing to reap the benefits of the cloud to provide better quality education. Therefore, understanding the benefits and challenges or the critical success factors (CSFs) that support and impede cloud migration in Saudi HEIs is important. From a strategic point of view, the success of implementing CC for Saudi HEIs relies on top managements' ability to drive institutional change via a certified cloud migration strategy. For those reasons, this research explores and develops a framework containing the CSFs affecting the cloud migration process and to determine whether the cloud is a viable solution to the existing ICT problem in Saudi higher education.



II. LITERATURE REVIEW

The implementation of cloud computing models in the field of education is a promising venture according to its advantages and the effective evaluation and mitigation of the different disadvantages and risks to ensure that it can be used in the requisite field effectively. Alharbi (2012) found that cloud computing is offering a new computing paradigm for users in the form of a service that enables them to access large scaled data centres from any location at any time. These are commonly known as clouds. Alkhater et al. (2014) also explains that gaining an understanding of the innovative factors will help institutions to adopt a more structured approach that promotes the effective use of computing resources.

Weber (2011) suggested that the assessment of only the technical factors will not be sufficient at the institutional level and that the innovation needs to fit in the context pertaining to the institution along with the external environment. This viewpoint indicates that resistance can be anticipated from IT departments inside the institutions. The use of public cloud computing facilitates, the storage of data outside of the institution and the service provider with which the data is stored may be located in a different country or continent therefore requires careful analysis of the risks, privacy and legal aspects to achieve successful implementation of this model in HEIs (Higher Educational Institutions).

According to Khan (2012); Alabbadi (2011) and Weber (2011), the concept of cloud computing is defined as a model which ensures the enabling of ubiquitous and on-demand provisioning of access to a shared pool of resources which are configurable. The cloud also facilitates computing facilities in the form of networks, storage, services, servers and applications, which can be released to the requisite users with minimum management efforts and minimum service provider interactions.

Lastly, Alarifi et al. (2012) found that the cloud computing model comprises of five primary characteristics along with three service models and four different deployment models. The gaining of understanding pertaining to the position of the HEIs pertaining to the adoption of cloud computing is pertinent and the current research focuses on the Higher Education community across the globe as well as specifically in Saudi Arabia.

The different literary findings clearly indicate that there are numerous technological benefits associated with the adoption of CC by HEIs in Saudi Arabia in the form of better provisioning of disaster recovery along with better interoperability. Also better and flexible network bandwidth coupled with improved reliability and security can be procured by HEIs for their data, which do not have requisite means to ensure better privacy and security by their service providers from CC.

Different organisational benefits are also evident in the form of SLAs that be customised as per the needs of the specific HEIs and CC providing better control. The current Saudi policies for CC adoption are prospective and positive as per the different findings. However, technological challenges in the form of IT maturity, migration non-adaptability, and security and privacy issues have been identified as major factors whereas organisational challenges in the form of compliance issues and cultural resistance are two main hindrances pertaining to CC adoption, which require effective handling. Here, there is a literature gap in the form of determining how migrating to an alternative emerging technology like cloud computing can transform Saudi Universities' existing ICTs. Therefore, this research has formulated the following question to be answered by conducting empirical research in order to address the literature gap:

How can migrating to an alternative emerging technology, such as cloud computing transform Saudi Universities' existing ICTs?

Lastly, Table 2.1 summarises the main themes covered in this literature review, as well as deduces the CSFs of the cloud in higher education and factors to include in the framework. The following table acts as a road map during the empirical research process.



Table 2.1: Summary of Key Literature Themes

Themes Literature Review	Critical Success Factors identified
Cloud Computing in Higher Education	Technological and organizational benefits and Challenges
Cloud Computing Adoption in Saudi HEIs	Technological and organizational benefits and Challenges
Benefits of Cloud Migration in Saudi HEIs	<p>Technological :</p> <ul style="list-style-type: none"> Disaster recovery Interoperability Network Bandwidth Reliability Security and Privacy <p>Organizational :</p> <ul style="list-style-type: none"> Custom SLA requirements Degree of Control Ministry of Education Policies Top Management Support Users' awareness
Challenges of Cloud Migration in Saudi HEIs	<p>Technological :</p> <ul style="list-style-type: none"> IT Maturity Migration issues Security <p>Organizational:</p> <ul style="list-style-type: none"> Compliance Cultural resistance

III. RESEARCH METHODS

As the current research is qualitative in nature, the different available methods suited for the course of this research are already narrowed down to interviews, ethnography action research along with grounded theory.

However, the use of interviews is the most suited out of the available methods for qualitative strategy as IT managers and academic staff have been selected as the test subjects, both totalling to 10 respondents. Interviews will enable pragmatic and reflective responses from the respondents based on their actual experience which when evaluated via the use of different analytical methods lead to new insights pertaining to how a successful framework of cloud migration for Saudi Universities can be prepared effectively.

The set of interview questions will require reflective outlook as its focus is on acquiring in-depth responses from the IT managers and the academic staff interviewed at Imam Abdurrahman Bin fausal University based in Saudi Arabia. The academic staff from Imam Abdurrahman Bin fausal University will ensure that the research is able to successfully map the benefits and challenges associated with the adaptation of cloud by the Saudi Universities. In addition, how a framework to implement cloud migration can become successful and both IT managers and University staff will have reflective pragmatic insights, which are analysed manually. This will help to collate a set of generalisations that can lead to more meaningful results regarding how migrating to an alternative



emerging technology, such as cloud computing will transform Saudi Universities' existing ICTs in a positive manner.

IV. RESULTS AND DISCUSSION

Reflecting on the interview results, all of the participants were in favour of technological factors with IT managers in particular demonstrating a strong agreement with network bandwidth and disaster recovery related issues being of high importance. Delving deeper into the interview outcomes, there was a unanimous support from the participants for reliability, security and privacy concerning dimensions, such as up time, multi-vendor migration and governmental compliance. These findings are consistent with a study by Alshwaier (2012) who agrees that security in particular supports the significance of security and privacy by considering dimensions ranging from identification and authentication to confidentiality and availability in the educational cloud that supports research and learning practices.

Likewise, Sultan (2010) has reported the significance of privacy and security issues, including reliability factors. However, Sultan reports that reliability presents a challenge within the educational cloud owing to the University having to commit to SLA requirements on reliability processes set out by the cloud vendor. Furthermore, the IT managers were in favour of interoperability and disaster recovery issues, whereas other staff were not. This makes sense as not many of the non-IT staff members were not technically minded with the exception of a few admins. Moreover, the positive aspects relating to reliability as reported by the participants concur with studies by Weber (2011) and Yamin (2015) who found that a clear SLA ensures that Universities have 24/7 access and availability to the cloud, all of which can sway the University's decision to adopt the cloud.

A further investigation of the CSFs found that there was strong agreement with privacy, disaster recovery, compatibility and extensibility factors being influential toward cloud adoption. The same can be said for factors, such as interoperability, bandwidth and Arabic language support. El-Seoud et al. (2013) found that interoperability enables users to successfully adopt the innovation and its services in a manner that facilitates seamless exchanges between multiple information clouds in a unified way. In contrast, Al-Qahtani and Higgins (2013) highlighted the challenges of insufficient internet bandwidth and disaster recovery capabilities for data loss and theft. These factors indicate the participants' reason not to adopt the cloud, which is mostly down to the security and integrity of their personal data.

Moreover, the final analysis indicated that the organisational factors were of great importance among non-IT staff, which is no surprise considering the institutional level issues as opposed to technical issues that were raised regarding cloud migration. Specific organisations CSFs that were considered the most are policies and top management support. In addition, most of the participants were in agreement with degree of control and SLA requirements having an impact on their decision to consider the educational cloud. The only CSF to have a negative perception was training and user awareness, which indicated an uncertainty to adopt the cloud. Reminiscent of technological factors, the organisational factors were also tested, assessed and verified. The factors that received the greatest concurrence were the provision of knowledge-base, staff training and technical support. Likewise, service knowledge and data access control under the umbrella of the degree of control CSF also indicated a strong concurrence, as well as other CSFs, such as strategy planning, management support and compliance. Knowledge-base and management support CSFs to support the acceptance of the educational cloud is consistent with the findings of Alwasel et al. (2016) and Alassafi et al. (2016). Both studies agree that gaining an understanding of the cloud will influence the overall University's efficiency and willingness to adopt the technology, as well as make the necessary changes to plan its execution. Interestingly, there were no studies that support the multi-lingual or in this context Arabic language support for the cloud. Therefore, the findings have revealed a new discovery based on multi-lingual support influencing higher levels of cloud acceptance in the higher education context.



Reflecting on both technological and organisational CSFs, there is a clear indication that the University would adhere to the majority of the CSFs tested in this research with the exception of certain security and reliability aspects. These aspects include physical location of data placing an element of distrust among the participants, and thus would outright reject the cloud on that basis alone. In addition, the location aspect holds very little significance among the participants' as long as the data is domestically hosted. The participants' experiences also indicated supplementary CSFs, both organisational and technological. These ranged from Arabic language support and compliance with Saudi regulations to strategic planning and extensibility.

The findings also indicated that addressing privacy and security issues in potential cloud adoptions in Saudi Universities is possible through adhering to governmental rules and regulations regarding the cloud migration process. Such rules and regulations prohibit government data being outsourced beyond the national borders. It appears that reliability is possible by obeying the quality of service rules in cloud migrations with interoperability playing a key role during this process. Interoperability can help to circumvent cross-vendor migration problems that may incur additional costs. Opting for a domestic cloud hosting service would require Saudi Universities to concentrate on aspects like native backup and recovery, which may incur huge costs.

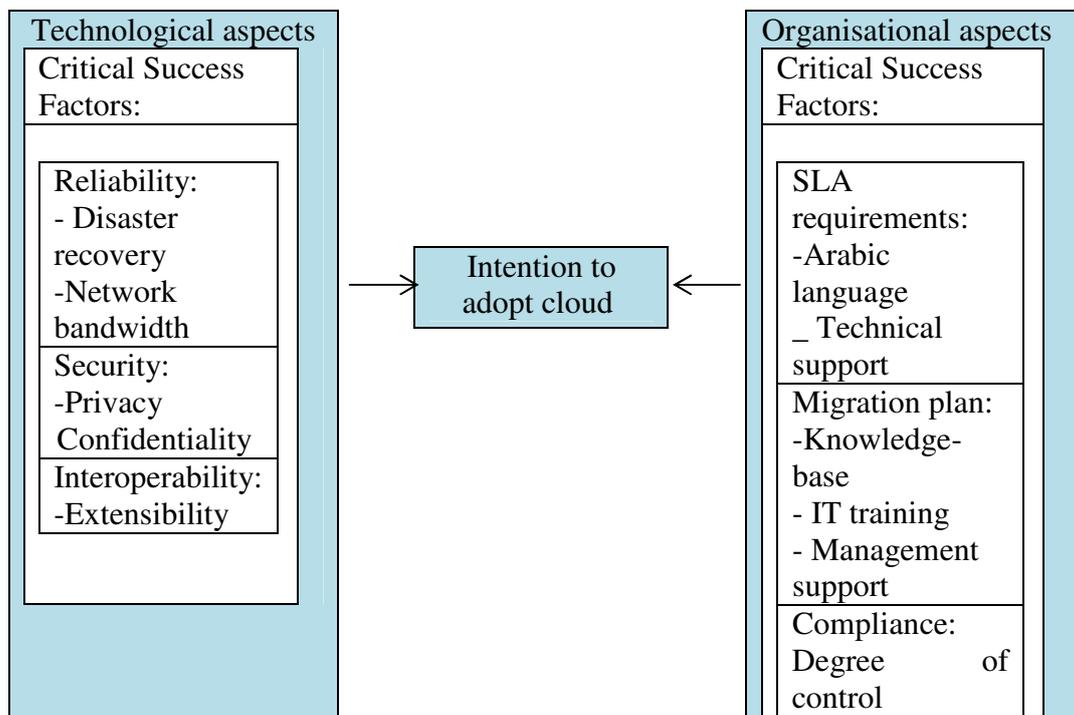


Figure: Framework to support successful cloud migration in the Saudi higher education context

V. CONCLUSION

There is a high level of acceptance of the cloud in Saudi Arabia and there seems to be a positive attitude towards the potential implementation of this innovation, despite the limited coverage in Saudi Universities. According to the participants, ease of use is vital in order for them to accept the cloud in their University. Participant feedback calls for better network bandwidth, flexible and customisable SLA requirements that meet user demands and expectations of the cloud and that all sensitive information would be stored in-house for better control over data.

These findings are consistent with Alkhatir et al. (2014) who stated that there are numerous factors, such as trust, privacy and cost that influence stakeholders' acceptance of an educational cloud.



Similarly, Tashkandi (2015) found that privacy and trust issues relating to intellectual property assets and student records impede their acceptance of the cloud.

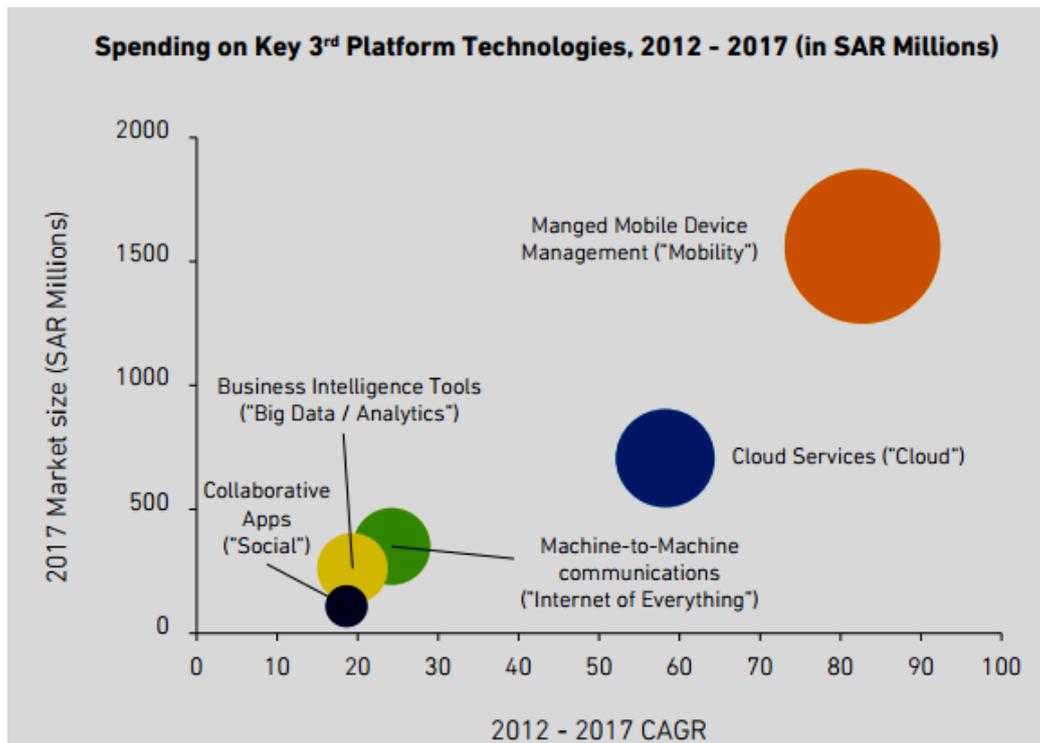


Figure: Growth expectancy of Cloud Computing in Saudi Arabia (Alwasel et al., 2016)

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