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Benefits and Challenges of Cloud Computing Adoption in Higher Education: A Systematic Literature Review

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Abstract

This paper explored the significant factors that support/hinder cloud computing (CC) adoption in Higher Education Institutions (HEIs). Through a Systematic Literature Review (SLR) of existing studies published in the top five information systems journals, our research offers a systematic exploration of the different CC adoption levels in HEIs and the benefits and challenges in the Higher Education context. Seventeen papers were analysed to draw the different views of the CC adoption process to determine its feasibility in the education domain. The findings suggest that Universities have a keen interest in using CC in their institution, and indicates a high level of successful CC adoption in HEIs owing to the flexible and collaborative capabilities of the educational cloud. In conclusion, the SLR identified a clear literature gap in this research area. That is, limited empirical studies exploring CC utilisation in HEIs and supporting frameworks that help to promote CC implementation.

Word Count: 1,970 (excluding tables and references)
1. INTRODUCTION
Cloud Computing (CC) is defined as a computing style where elastic and scalable IT-driven capabilities are made possible via internet technologies (Sultan, 2010). For the end-user, CC is a more cost-effective and flexible way of using applications. Through the delivery of many cloud-based applications to potential users, such as teachers and students, which can support their educational needs, CC can provide greater scalability, flexibility and mobility in the utilisation of resources for teaching purposes (Alharthi et al., 2015).

CC brings many potential advantages and disadvantages to the educational cloud ranging from flexibility and collaboration to security and trust issues (Mokhtar et al., 2016; Alharthi et al., 2015, Lakshminarayanan et al., 2013; Willcocks et al., 2014, Ewuzie & Usoro, 2012). CC could be used in everyday activities, including education, and for delivering various cloud-based applications and services to teachers and students to facilitate educational practices.

1.1 Motivation
This paper proposed to explore the extent of literature concerning the adoption of CC in the higher education context. Despite the plethora of literature that explicitly focus on and systematically review the benefits and challenges of CC adoption in general and industry contexts, few studies focus on the education context, particularly in higher education institutions (HEIs), such as Universities (Hussein & Omar, 2015, Ewuzie & Usoro, 2012, Fernandez et al., 2012, Ercan, 2010).

This paper aims to identify and evaluate existing literature concerning the benefits and challenges of CC adoption in the higher education context by employing a systematic review method. This systematic research will help to determine the viability of CC in HEIs, and identify the potential challenges and gaps in the existing literature and recommend areas for further research.

2. RESEARCH METHOD
Kitchenham’s and Charters’s method of conducting SLRs was adopted to support the SLR procedure (Salleh et al., 2011, Kitchenham & Charters, 2007). The search procedure involved the use of various online databases, such as Science Direct, IEEE, Springer, Scopus and ACM.

2.1 Research Question

RQ: What significant factors support the successful adoption of CC in HEIs?

2.2 Identifying Appropriate Literature
The following strategy was used to support the keyword search process (Salleh et al., 2011, Kitchenham & Charters, 2007):

- Searching for papers concerning CC in HE;
- Citing familiar keywords mentioned in primary studies;
- Determining synonyms for use, e.g. utilisation, and determining sub-topics of CC in HE e.g. e-learning management systems in education;
- Using Boolean OR to incorporate alternative spellings and synonyms;
- Using Boolean AND for linking key terms from the population, intervention, and outcome.

The following search strings were initially used to search for the appropriate literature: Cloud computing AND education or cloud computing AND higher education.

2.3 Inclusion/Exclusion criteria
The following inclusion criteria was applied:

1. Studies exploring CC adoption or utilisation in HE, and the benefits and challenges;
2. Studies highlighting a specific outcome or implemented cloud solution for HEIs;
3. English written papers.

Concerning the exclusion criteria, studies that failed to provide any empirical evidence of CC adoption, and other studies that merely provided assumptions or opinions of CC adoption without any empirical evidence were all omitted.

Table 1: SLR Studies on CC Adoption in HE

<table>
<thead>
<tr>
<th>Author/Year</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alharthi et al. (2015)</td>
<td>An overview of cloud services adoption challenges in higher education institutions</td>
</tr>
<tr>
<td>Alsuifyani et al. (2015)</td>
<td>Migration of Cloud Services and Deliveries to higher Education</td>
</tr>
<tr>
<td>Chandra and Malaya (2012)</td>
<td>Cost benefit analysis of cloud computing in education</td>
</tr>
<tr>
<td>Ewuzie and Usoro (2012)</td>
<td>Exploration of cloud computing adoption for eLearning in higher education</td>
</tr>
<tr>
<td>Hussein and Omar (2015)</td>
<td>Cloud computing and its effect on performance excellence at higher education institutions in Egypt (an analytical study)</td>
</tr>
<tr>
<td>Masud and Huang (2012)</td>
<td>A Novel Approach for Adopting Cloud-based ELearning System</td>
</tr>
<tr>
<td>Meske et al. (2014)</td>
<td>Cloud Storage Services in Higher Education–Results of a Preliminary Study in the Context of the Sync &amp; Share Project in Germany</td>
</tr>
<tr>
<td>Mokhtar et al. (2014)</td>
<td>Organizational Factors in the Adoption of Cloud Computing in E-learning</td>
</tr>
<tr>
<td>Pandian and Kasiviswanathan (2011)</td>
<td>Effective use of cloud computing concepts in engineering colleges</td>
</tr>
<tr>
<td>Smith et al. (2014)</td>
<td>Cloud computing: adoption considerations for business and education</td>
</tr>
<tr>
<td>Tantatsanawong et al. (2011)</td>
<td>Enabling future education with smart services.</td>
</tr>
<tr>
<td>Wu et al. (2013)</td>
<td>Factors hindering acceptance of using cloud services in university: a case study</td>
</tr>
</tbody>
</table>

3. REVIEW OF THE LITERATURE

From the synthesis of evidence, 17 studies for inclusion explicitly explored the benefits and challenges of CC adoption in education. Generally, these studies have demonstrated a growing interest from Universities and their students to migrate to the cloud.

Table 2: Key issues deduced from SLR

<table>
<thead>
<tr>
<th>Issue</th>
<th>Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anytime, anywhere access (mobility and flexibility)</td>
<td>Tantatsanawong et al. (2011), Masud and Huang (2012), Akin and Matthew (2014), Mircea and Andreescu (2011a), Marston et al. (2011), Armbrust et al. (2010), Alkhater et al. (2014)</td>
</tr>
<tr>
<td>Awareness of CC</td>
<td>Surya and Surendro (2014), Behrend et al. (2011), Wu et al. (2013)</td>
</tr>
</tbody>
</table>
3.1 Benefits & Challenges of Cloud Adoption in Higher Education

In Tantatsanawong et al. (2011), factors such as availability, accessibility, affordability were vital towards successful CC adoption in HEIs. This was apparent through the various learning services that were previewed, e.g. cyber learning systems, which enabled teachers to share contents anytime, anywhere with easy access and use, and creation and reuse capabilities. These collaborative traits of the cloud were also found in other studies (Masud and Huang, 2012; Sultan, 2010; Geng et al., 2009). These authors were in agreement with Tantatsanawong in that the cloud does provide collaborative capabilities for HEIs. Masud and Huang (2012) proposed an “education cloud” model to convince HEIs to adopt CC. The authors argued that the model could promote sharing of computing resources, and is expected to deliver various functionalities, such as collaboration, digital library, easy access, interoperability, online storage, provisioning and security/privacy. This supports Tantatsanawong’s findings as learning cloud services have various integrated applications ranging from interactive applications, and picture and video sharing capabilities to collaborative tools e.g. email, messaging, blog, Skype and video conferencing system, and access to e-journal libraries. This indicates a growing interest in cloud technology.

However, Sultan (2010) is more critical about the collaborative aspects of the cloud. His study on the benefits and challenges of migrating to the cloud in HEIs provided a strong case study based on a UK University situated in Westminster. It revealed that the institution’s interest to adopt was down to their current email system being out of date, thus a CC Gmail system was proposed (Geng et al., 2009). However, what hindered the university’s intention to adopt the technology centred on the security and privacy issues surrounding the transfer from the traditional email system to the CC SaaS Gmail system. Sultan concluded that despite the Gmail system encouraging collaborative learning and the ability to share resources efficiently, the university did not go ahead with the adoption process.

| Collaboration | Tantatsanawong et al. (2011), Masud and Huang (2012), Sultan (2010), Geng et al. (2009) |
| Enhanced academic teaching and learning | Kihara and Gichoya (2014) |
| Improved centralised data management | Chandra and Malaya (2012) |
| Improved content/resources sharing | Tantatsanawong et al. (2011), Sultan (2010), Geng et al. (2009), Chandra and Malaya (2012) |
| Return on investment (ROI) | Mokhtar et al. (2014) |
| Security, privacy and trust issues | Masud and Huang (2012), Geng et al. (2009), Sultan (2010), Alkhatier et al. (2014), Chandra and Malaya (2012) |
| Technological readiness | Mokhtar et al. (2014), Behrend et al. (2011), Wu et al. (2013) |
| Upgrading existing/obtained technologies | Sultan (2010), Geng et al. (2009) |
This owed to the legal implications of transferring all of their data to a new system they were unfamiliar with and trusting a third party (Voas & Zhang, 2009). Here, Sultan is arguing that trust issues could hamper HEIs intention to adopt a collaborative cloud owing to a lack of awareness of CC benefits among their stakeholders.

Behrend et al. (2011) studied the ways in which CC benefits particular stakeholders in educational settings. It aimed to influence community colleges to adopt and use CC, and provide a series of recommendations for successful utilisation. The Technology Acceptance Model (TAM) by Davis (1989) was used to assess community colleges’ influence to adopt and use CC by raising awareness of the technology, where students’ adoptive behaviours within their respected institution were assessed (Venkatesh & Bala, 2008). The TAM components, such as perceived usefulness, perceived ease of use, attitude towards adoption, behaviour intention to adopt and actual utilisation were all assessed. Ease of use perception was found to mostly influence CC adoption more than the usefulness perception, thus indicating that the students of these community colleges may be familiar with using CC technologies, but maybe demotivated to use it due to its user unfriendliness (Behrend et al., 2011).

Similarly, Wu et al. (2013) argues that a lack of awareness can severely hinder CC adoption/acceptance and utilisation in universities. Using the same TAM model, the author’s findings appear to be consistent with the findings of Behrend et al. as it was found that perceived ease of use is the most important facet to drive CC adoption, while better productivity and usefulness or perceived usefulness were seen as a necessity towards successful CC utilisation within universities. Behrend et al. (2011) and Wu et al. (2013) came to a similar conclusion that perceived ease of use and perceived usefulness determines whether a university will adopt CC, more so hinders rather than improves their intentions to use the technology, since many universities are unaware of the benefits of incorporating a CC solution (Wu et al., 2013). Lastly, Behrend et al. noted that without students feeling that CC can actually support them in their educational setting, and being a reliable tool and easy alternative, they would more than likely reject it, and thus the HEI will not be benefitted.

However, studies by Kihara and Gichoya (2014), and Surya and Surendro (2014) go beyond the findings of Behrend et al. and Wu et al. (2013), and proposed an eReadiness framework that aimed to measure the degree of IT readiness level before adopting CC. Kihara and Gichoya (2014) placed much emphasis on the enhanced academic teaching and learning capabilities of the cloud. This helped to evaluate the implementation level of CC in HEIs to raise awareness of the cloud benefits and the issues surrounding CC adoption in HEIs. HEIs currently using CC were found to have supported their existing e-learning services, which enabled their students to perform better academically, and thus have the appropriate knowledge and skills expected from the market. The most significant aspects identified for adopting CC in HEIs were having a degree of awareness of CC, the ways it must be developed and assessed, and analysing how CC can potentially influence HEIs’ organisational strategy (Surya & Surendro, 2014). Here, University stakeholders’ requirements were essential to the readiness of CC given their unfamiliarity with the technology. Therefore, gaining stakeholder insights of new technologies prior to making that adoptive decision is vital to increase acceptance of these technologies. Here, HEIs need to assess whether stakeholders actually demand these technologies or at least the characteristics that embody the cloud e.g. better collaboration, increased learning capabilities and enhanced security.
In Chandra and Malaya (2012), a case was made for improved centralised data management in the cloud. A case study of an Israeli university was conducted, which had recently adopted a new “Storage on Demand” model to support their CC services. The results indicated a 65% to 83% reduction in storage management requirements within the university, and encouraging efficient utilisation of CC. The authors concluded that the adoption, utilisation and the subsequent application of resources via CC would support the fulfilment of the huge demand for high-speed data processing, thus allowing to achieve the educational development of radical changes in the CC trend. Moreover, factors such as enhancing educational resource utilisation, reduce costs, centralised data management, ease of use and enhancing information security were among the most significant towards improving CC utilisation in HEIs.

In Alkhater et al. (2014), the factors that affect CC adoption, non-adoption and utilisation in an organisational and educational context were explored. The study aimed to determine organisations’ adoptive decisions of CC by examining those factors that affect such decisions using the Technology-Organisation-Environment model (TOE). The model was used to examine the adoptive factors of CC, and identify new and existing factors, to subsequently improve the TOE model. Security, privacy and trust issues, availability, compatibility and cost savings were among the most significant factors of successful cloud adoption. Similar findings were found several other studies (Akin & Matthew, 2014, Mircea & Andreescu, 2011a, Marston et al., 2011, Armbrust et al., 2010). These studies advocated that trust played a major role in rejecting CC owing to stakeholders’ anxiety towards using the technology that resulted from security and privacy issues. These studies came to similar conclusions that there are many benefits that influence a firm’s decision to adopt CC, like cost reduction, flexibility, and green IT, though shifting from an existing system to the cloud still impacts a firm’s or institution’s decision and remains one of the greatest influences of non-adoption (Alkhater et al., 2014).

4. IMPLICATIONS FOR RESEARCH
The SLR revealed limited studies to support CC implementation and utilisation in the HE context. Most papers focused on adoption of CC services. Some studies mentioned the benefits and challenges that affect CC in HE (Alharthi et al., 2015, Mokhtar et al., 2014, Wu et al., 2013, Chandra & Borah, 2012, Sultan, 2010). However, the SLR did reveal many interesting issues concerning CC adoption in HE, ranging from cost efficiency and collaboration to security issues in the educational cloud (see Table 2).

In conclusion, the findings suggest that Universities are beginning to show a keen interest in utilising CC, though few studies support CC utilisation and supporting frameworks that help to promote CC implementation in HE. This opens to potential future studies that consider CC utilisation in HE by developing a cloud implementation/utilisation framework to enhance university practices.

5. REFERENCES


organisation's intention to adopt cloud computing in Saudi Arabia’.


*Computer Supported Cooperative Work in Design (CSCWD)* IEEE, pp. 552-557.


