ASSIMILATION OF THE CLOUD: BENEFITS AND CHALLENGES TO ACCEPTANCE, ROUTINIZATION AND INFUSION OF CLOUD COMPUTING

Research-in-Progress

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Abstract

This study goes beyond a binary view of adoption and instead examines the more complex nature of cloud computing assimilation. It examines (i) acceptance, the extent to which an organization's members are committed to the adoption, (ii) routinization, the extent to which the use of cloud becomes a normal activity, and (iii) infusion, the extent to which more features of the cloud are used than originally planned, the extent to which use is sophisticated, and the extent to which use is emergent. Drawing on three case studies, this study will contribute to the existing cloud technologies literature that does not address the complex and multi-faceted nature of adoption. Secondly, it will provide an insight into cloud computing adoption by focusing on the benefits and challenges associated with implementation in organizations. Thirdly, we also seek to develop a set of recommended practices for overcoming such barriers to adoption.

Keywords: Cloud Computing, Assimilation, Benefits, Challenges

Introduction

The rapid emergence, prevalence and potential impact of cloud computing has sparked a huge amount of interest amongst IS and IT industry and research. For instance, in wide ranging surveys of CTOs worldwide, cloud computing first appeared on the list of "Key Technology Applications and Investments" at 17th in 2009, but jumped to 2nd when the same survey was carried out a year later (Luftman and Zadeh, 2011). Reports of the size and value of the cloud computing services market vary, but despite the rapid emergence and ubiquity of cloud computing, empirical research on adoption of cloud services is quite limited. A key step at the outset of this study is to identify a definition of 'cloud computing'. From a review of the literature it is clear that many definitions exist (e.g. Armbrust et al., 2009; Motahari-Nezhad et al., 2009, Mell and Grance, 2011). Nonetheless, the term is vague, polymorphous and multi-dimensional, and is often interpreted and applied inconsistently in the literature (Leimeister, 2010). The US National Institute of Standards and Technology (NIST) has published a working definition (Mell and Grance, 2011) that is often cited and viewed as one of the more articulate, clear yet comprehensive classifications of cloud computing, and as Motahari-Nezhad et al., (2009) state, has "captured the commonly agreed aspects of cloud computing". This definition, which will be the one adopted in this study, describes cloud computing using:

i) Five characteristics: on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service.

ii) Four deployment models: private clouds, community clouds, public clouds, and hybrid clouds.

iii) Three service models: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS).

Recent research has started to examine the benefits and challenges to cloud computing adoption. For example, studies have identified issues such as availability of service, data lock-in, data transfer bottlenecks, performance unpredictability, scalable storage, bugs in large distributed systems, and concerns regarding data confidentiality and auditability (Armbrust et al., 2009; Motahari-Nezhad et al., 2009). In terms of service provision, enough resource must be available to accommodate peaks in source consumption, it must be able to grow in accordance with growth in consumption, and the service provider must be able to predict the growth well in advance to plan and deploy any required change of infrastructure (Zhao et al, 2009). Leimeister et al (2010) also examines potential challenges surrounding the fundamental business models associated with cloud services.

Nonetheless, research around potential challenges and solutions affecting cloud computing adoption have largely been dedicated to addressing technical problems (Khajeh-Hosseini, 2010; Leimester et al., 2010), and in particular, all are examined with an assumption that there is a single point of adoption. Additionally, the perceived benefits and cloud computing lack strong empirical validation, as despite a small amount of research (e.g. Iyer and Henderson, 2012; 2010), the body of knowledge is comprised of position papers (Armbrust et al., 2009)) and relies heavily on anecdotal evidence found mainly in white papers, technical reports, and practitioner papers (see for example, Brohi and Bamiah, 2011; Forbes, 2011; Guilbert, 2008; Channel Insider, 2010; Dialogic, 2010; Goodburn and Hill, 2010). Furthermore, the adoption of any innovation is not binary, but rather a staggered, multi-faceted and often highly complex phenomenon. This study goes beyond viewing adoption in a binary manner and instead examines the more complex nature of cloud computing adoption, drawing on assimilation theory (e.g. Gallivan, 2001; Cooper and Zmud, 1990; Saga and Zmud, 1994). It examines (i) acceptance, the extent to which an organization's members are committed to the adoption, (ii) routinization, the extent to which the use of cloud becomes a normal activity, and not something 'out of the ordinary', and (iii) infusion, the extent to which more features of the cloud are used than originally planned, the extent to which it is used in a sophisticated manner to, for example, create new workflow tasks, and the extent to which it is used in an emergent manner, to perform tasks not considered in the pre-conceived scope. Thus, the objectives of this paper are to:

1. Identify the benefits of cloud computing adoption amongst organizations;
2. Identify barriers to cloud computing acceptance amongst organizations;
3. Identify barriers to cloud computing routinization amongst organizations;

4. Identify barriers to cloud computing infusion (i.e. extensive, integrated and emergent use) amongst organizations.

The next sections of the paper summarize the pertinent literature to this research, outline the research objective, and describe the theoretical framework to guide it. The research approach adopted in this study is outlined, and although the study is still a research in progress, preliminary results from one case study are presented and discussed. The paper concludes with a discussion of the implications of the study and possible avenues for future research.

Theory of Innovation Assimilation

The theory of innovation, and in particular information systems innovation, suggests that adoption or assimilation of an innovation is often far from simple. Meyer and Goes (1988) define assimilation as "an organizational process set in motion when individual organization members first hear of an innovation's development". Assimilation is rarely binary however, and when one examines the introduction or non-introduction of a technology for example, there are often many different points in time where that assimilation may intensify or deteriorate (Gallivan, 2001; Zmud, 1990; Saga and Zmud, 1994). Very often the cause for this success or failure may be very subtle. An assimilation stage describes how deeply an adopted innovation penetrates the adopting unit (company, group or individuals) (Gallivan, 2001). Many frameworks to understand the various stages of innovation assimilation have been proposed, along with many others to study the factors and events that influence them (e.g. Zmud, 1990; Saga and Zmud, 1994). Amongst the most commonly cited is that of Gallivan (2001) who proposes a six-staged model (Table 1), based on the work of Cooper and Zmud (1990) and Saga and Zmud (1994).

Table 1: Stages of Innovation Assimilation (Gallivan, 2001)

Stage	**Description**
Initiation	A match is identified between an innovation and its intended application environment.
Adoption	The decision is made to adopt the innovation.
Adaptation	The innovation is developed, installed and maintained, and organizational members are trained to use the innovation.
Acceptance	Members are committed to using the innovation.
Routinization	Usage of the innovation is encouraged as a normal activity in the organization; the innovation is no longer defined as something out of the ordinary.
Infusion	The innovation is used in a comprehensive and sophisticated manner. Infusion is measured in three different ways: *Extensive use*: using more features of the innovation; *Integrative use*: using the innovation to create new workflow linkages among tasks; *Emergent use*: using the innovation to perform tasks not in the pre-conceived scope.

When studying assimilation stages, one must consider the extent to which we may assume that an organization, group or individual's progression through the assimilation stages is sequential. For example, Cooper and Zmud (1990) imply an "unfreeze-refreeze" sequential model of stages by associating initiation with Lewin's (1952) 'unfreezing' stage, adoption and adaptation with the 'change' stage, and acceptance, routinization and infusion with the 'refreezing' stage. However, models such as Lewin (1952), which assume sequential assimilation, have been criticized. Firstly, they have been criticized for failing to account for feedback, or for the situated nature of actions (Orlikowski and Hofman, 1997; Palmer and Dunford, 1997). Secondly, empirical research has demonstrated a non-linear progession through stages (Gallivan, 2001; Rosch, 2002). Additionally, Cooper and Zmud (1990) claim the sequential model may be more appropriate for technologies that are borrowed or adapted rather than custom made.

Research Method

Our research method involves three case studies representing service providers (SourceDogg, Colt and Almir) and their customers in a network (see Table 2). The decision to use the perspectives of these two different groups was based on the belief that services provides could provide a better understanding of benefits and challenges of adopting cloud computing based on their own interaction with, and feedback from clients, while those customers that had adopted cloud computing solutions could provide us with information regarding benefits and potential challenges to routinization and infusion. Interviewees were senior decision-makers with experience of assessing cloud-computing adoption. While we are still in the process of collecting and analyzing data, it is clear that the organizations studied are different in many ways, varying according to size, sector, structure, and geographical location. Their cloud initiatives also differ in terms of amount, type and use of cloud technology adopted. Any and perhaps all of these variables may have affected the degree of cloud technology assimilation by each organization. From a methodological point of view, however, these are not of significant concern, as this study does not seek to establish a causal link in terms of assimilation. Rather the objective is simply to examine assimilation and the barriers to assimilation, and so a diverse range of cases was considered ideal to serve this purpose.

SourceDogg, a sourcing software provider, was founded in 2009 and presently has 21 employees (although they have recently announced 80 new jobs due to customer numbers expanding rapidly). They offer a cloud-based e-sourcing service (also called SourceDogg.com), provided on a subscription basis that allows users to find and evaluate new suppliers with an easy-to-use approach to quotations, tenders and other aspects of the procurement process. The company has an extensive list of clients from both the public and private sectors based in five different countries, who use SourceDogg to deliver cost and time savings and transparent sourcing in their procurement processes. Both IBTB and APM are public sector clients of SourceDogg and have adopted their e-sourcing system in their respective procurement departments.

AD Networks, founded in 1992, provides major organizations, midsize businesses and wholesale customers with resources that combine network and IT infrastructure and possess expertise in IT managed services, networking and communication solutions. AD Networks has 5,500 employees and operates a 21-country, 35,000km network that includes metropolitan area networks in 39 major European cities with direct fibre connections into 18,000 building and 19 AD Networks data centres. Their cloud infrastructure service provides businesses with a modular IT infrastructure provided on a subscription basis, covering networking, storage, a systems and software catalogue, backup service and self-service portal. Information Mosaic, one of AD Networks customers, is a global leader in providing modern, high volume software applications for middle office, back office and corporate actions automation within the global financial markets industry. They leverage Colt's infrastructure service in their development environment.

Almir is a management consultancy of 12 experienced professionals that work extensively in a consulting capacity with companies in the area of business improvement and techniques including implementation of proven international best practice management standards such as Quality, Environmental, Health and Safety and Information Security management systems. Their complimentary software as a service offering includes a suite of management system on-line tools around continuous improvement, training, asset management and documentation. NDC is a customer of Almir and specialize in the delivery of customized and integrated GPS vehicle tracking systems and fleet management solutions for leading businesses in over thirty countries worldwide. This company use Almir's continuous improvement tools to manage their ISO systems.

Data Collection and Analysis

Data collection took place between October 2011 and April 2012 and was primarily personal face-to-face interviews, a technique well suited to exploratory research such as this because it allows expansive discussions to illuminate factors of importance (Oppenheim, 1992; Yin, 2003). To improve the reliability and repeatability of the research, a traceable, 'audit trail' of the research process, from data collection through to the drawing of conclusions, was sought. Kirsch's (2004) model was followed; this model defines a set of procedures to (i) identify and selecting project cases, (ii) determine who to interview and

(iii) how the interviews were to be conducted. Interviewees were senior decision-makers with experience of assessing cloud-computing adoption.

Table 2: Data Sources for the Study

Firm	Industry	Interviewees
Case Study I - SourceDogg (SaaS)		
SourceDogg	Procurement software	Chief Executive Officer (1 interview) Executive Director (2 interviews)
IBTB[1]	Public Sector Body (Health)	Purchasing Manager (1 interview)
APM*	Public Sector Body (Food and Drink)	Procurement Officer (1 interview)
Case Study II - Colt (IaaS)		
AD networks*	IT and Networking Solutions	Chief Technology Officer (1 interview)
Information Mosaic	Global Securities Processing	Product Management (2 interviews) IT Manager (1 interview)
Case Study III - Almir (SaaS)		
Almir	Consultancy	Managing Director (2 interviews)
NDC*	Electronics	IT Manager (1 interview)

A common interview protocol was prepared based on the assimilation framework (see Table 1), and specifically it's three underlying constructs (acceptance, routinization and infusion). Each interview was structured around three issues, with the interviewers asking probing questions based on responses. These three issues were: (i) the level of adoption, (ii) perceptions of benefits of cloud computing, and (iii) perceptions of challenges to adoption. The interviews lasted between 50 and 120min. The questions were largely open-ended, allowing respondents freedom to convey their experiences and views, and expression of the socially complex contexts that underpin cloud technology assimilation (Oppenheim, 1992; Yin, 2003). The interviews were conducted in a responsive (Wengraf, 2001; Rubin and Rubin, 2005), or reflexive (Trauth and O'Connor, 1991) manner, allowing the researcher to follow up on insights uncovered mid-interview, and adjust the content and schedule of the interview accordingly. The protocol also included questions regarding the sub-constructs of infusion, also listed in Table 1, namely extensive, integrated and emergent use. These provided a list of 'intellectual bins' (Miles and Huberman, 1999) to structure the data collection and the open coding stage of data analysis. In order to aid analysis of the data after the interviews, all were recorded with each interviewee's consent, and were subsequently transcribed, proof-read and annotated by the researcher, and then coded using nVivo. Also, venting was used, whereby results and interpretations are discussed with professional colleagues to avoid the problem of what Kaplan and Duchon (1988) call multiple realities. Findings were continuously presented and discussed with colleagues and practitioners informally. In any cases of ambiguity, clarification was sought from the corresponding interviewee, either via telephone or e-mail. Supplementary documentation relating to the cloud technologies and their use were also collected. These included a comprehensive review of publicly available documents including websites of firms, company brochures, white papers etc.

Data analysis used Strauss and Corbin's (1998) open coding and axial coding techniques. Open coding is 'the process of breaking down, examining, comparing, conceptualizing, and categorizing data' (Strauss and Corbin, 1998). Glaser (1992) argues that codes and categories should emerge from the data, while with Strauss and Corbin's approach (1998) these are selected prior to analysis. The approach adopted in this study is more akin to the latter, where, as discussed above, the interview questions and subsequent analysis was based on the assimilation framework and its components (Table 1). The second phase of analysis, to identify the barriers to assimilation, used axial coding. Axial coding is defined by Strauss and Corbin (1998) as a set of procedures whereby data are put back together in new ways after open coding;

[1] IBTP, APM, AD Networks and NDC are pseudonyms used to protect anonymity

whereas open coding fractures the data into categories, axial coding puts the data back together by making connections between the categories and sub-categories. As the data were coded, theoretical questions, propositions and code summaries arose regarding potential barriers across various stages of cloud technology assimilation. These were documented in analytic memos (Miles and Huberman, 1999) to aid understanding of the concepts being studied and to refine further data collection. Miles and Huberman (1999, pp. 72-74) offer advice on effective analytic memos, and these practices were followed where possible. As categories emerged follow-up interviews were arranged with all of the original interviewees to elicit further, richer, more focused information. This was done to confirm, extend, and sharpen the evolving list of categories.

Preliminary Results from Case Study I

The analysis from case study I revealed that the adoption of the SourceDogg e-sourcing system by both IBTB and APM has reached the acceptance and routinization stage. The procurement staff in both organizations uses the system on a daily basis as part of their tendering process. Prior to adopting the system, feasibility studies were carried out and IT personnel were involved in investigating how the system would work and how it would be secured on the cloud. The Purchasing Manager at IBTB explained that, "there are issues for cloud computing in the public sector. Who owns the information? Where is it stored? These types of things". Thus, regular meetings took place initially with advisors from SourceDogg to ensure it was a risk free environment. As the Executive Director at SourceDogg pointed out "transparency and integrity are very important with public and private sector bodies…for the public sector we need to demonstrate that we are doing things properly".

Benefits of Cloud Computing

Preliminary results suggest that the benefits of cloud computing are highly perceived in the organizations. While the SourceDogg system was found to be very user-friendly, the turnaround time in terms of implementing the system was viewed as extremely effective. Both managers at SourceDogg explained that companies are up and running on the system in 24 hours, which is beneficial when one considers that traditional IT systems implementation can often take up to 6-months. Thus, there was no migration issues to worry about in implementing the system as "it's all cloud-based, so all you need to do is send them logins" (CEO, SourceDogg).

Both managers in IBTB and APM explained how the adoption of the online e-procurement system from SourceDogg saved them time, money, improved their processes and promoted more communication between team members. The Purchasing Manager at IBTB described how they were getting inundated with the amount of procurement they had to manage centrally and the main reason for adopting a cloud based procurement system was to save time. The organization was able to cut down on their administrative time by 65% as they now have supplier online questionnaires for national and European tenders, which they can update or change as required. As Purchasing Manager at IBTB further added, "it addresses the administrative elements which are resource hungry on organizations. I am talking about transparency, audit..what we are looking at is how we can use it for getting quotes". The SourceDogg system was also seen as providing full traceability from an audit point of view. Moreover, the company have 'locked-down processes' on data confidentiality and information repositories are outsourced to secure datacentres. Interestingly, the Executive Director at SourceDogg pointed out that the biggest risk to security is staff in an organization "people dealing with a favourite supplier all the time, telling their friends about them and not bothering to go beyond 3 quotes".

Challenges to Cloud Computing Adoption

Nonetheless, the adoption has not yet reached the infusion stage in both IBTB and APM, as the system is not extensively used by non-procurement staff. The Procurements Officer at APM explained that for somebody working in procurement, it's very straightforward but for the non-procurement people, it can be challenging. He suggested that "some training and handholding" is necessary at the start and "give it six months or a year, it definitely is going to show true value in what it's costing us and what it will deliver". It was found that the biggest barrier to cloud computing infusion is people themselves – staff

who do not want to use the system. Therefore, it is important to "build a system that is intuitive to people's needs". (CEO, SourceDogg). Presently APM have 9 procurement staff using the system but eventually want to increase usage to 30 employees in the Dublin offices and also staff based in their overseas offices. Similarly, there are 7 people in IBTB using the system, but again they are investigating how best to roll it out across the organization. The study revealed that because there is huge risk averseness in the public sector, this presents many challenges in the adoption of cloud. For example, the Purchasing Manager at IBTB explained that, "if we go out on a limb to try something innovative and it doesn't work, what will happen is you end up in the newspapers. And nobody wants this corporate image of inefficiency". In adopting the e-procurement system, both managers in IBTB and APM added that there were a lot of hurdles to jump through in terms of getting approval and support from senior management. Additionally, it was found that it is necessary to create an environment or structure whereby public sector bodies could engage in pilot projects around cloud in a risk free environment. There would still have to be audit trails and essentially a case of value for money. Overall, the analysis revealed that there are no real issues around cloud computing once it is implemented within a controlled environment. In terms of public sector community cloud-based systems, the challenges are much more substantial. As one manager noted "it's the fear of loss of control and the risk of it…do you want to be first one to do it? (Purchasing Manager, IBTB). Nevertheless, both managers believed that a community cloud-based model would enable public sector bodies to collaborate on different things and drive down costs. However, risks have to be measured, the impact likelihood and how to mitigate against these risks, should they arise. Once people are educated on how best to govern and manage the process, both managers revealed that public sector cloud computing would be more rapidly adopted.

Next Steps

This paper constitutes part of research in progress aimed at exploring benefits and challenges to adoption of cloud computing. While only preliminary results from case study I are presented in this actual paper, we can report that findings from case study II reveal that cloud services have been accepted and routinized while findings from case study III portray both acceptance and infusion. Additionally, the challenges identified in the analysis are more of a psychological nature than a technical one and warrant further research. For example, perceptions of the term 'cloud' was viewed as one potential barrier to acceptance of cloud computing, while persuading employees in organizations to use cloud systems was viewed as a barrier to further infusion. When completed, this research will make a number of contributions to the field. Firstly, it will make a contribution to the existing literature on adoption of innovations, in that the framework will provide a lens for analyzing cloud-computing adoption. Secondly, it will provide an insight into cloud computing adoption by focusing on the benefits and challenges associated with implementation in organizations. Additionally, we also seek to develop a set of recommended practices for overcoming such barriers to adoption.

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