WHY CLOUD? - A REVIEW OF CLOUD ADOPTION DETERMINANTS IN ORGANIZATIONS

Complete Research

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Abstract

Adoption of cloud computing in organizations is increasing at a rapid pace. It is expected that the majority of the organizations in industrialized nations will be using cloud services to some extent in the near future. In this review I categorize adoption factors utilized in the literature and identify determinants playing a key role in organizations' decision to adopt cloud. I analyze both quantitative and qualitative evidence and code relationships between factors and adoption of cloud by systematically reviewing the literature. Findings show underrepresentation of the factors related to organization and external environment in cloud adoption literature. This study contributes a set of determinants of cloud adoption, which serves as a foundation for the future research and advancement of the theories in information systems field.

Keywords: Cloud computing, literature review, adoption, SaaS, TOE, diffusion of innovations

1   Introduction

Cloud computing has been gaining popularity in recent years among both IT professionals and researchers. The number of academic publications on cloud computing has been steadily increasing since the term was first coined (Figure 1). The majority of these publications are still in technical fields (e.g. computer science, engineering), however research on business aspect of cloud is on a rise. At the same time, a recent study released by IDG Enterprise indicates that for 2015 cloud projects are top priority for companies (IDG Enterprise, 2014).
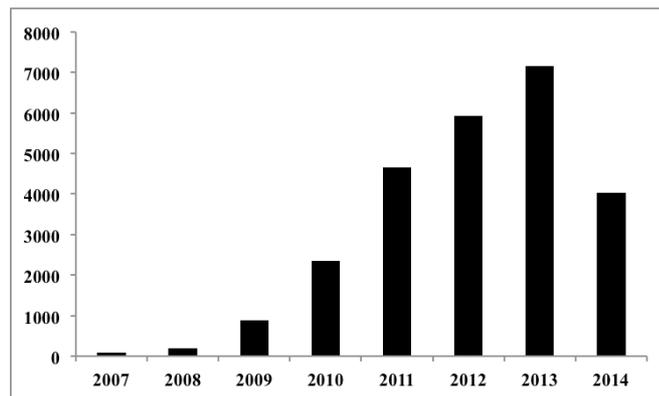

Figure 1.   Number of search results on "cloud computing" from Scopus (November 2014)

Popularity of cloud computing suggests that systematization of knowledge is required in order to observe development in the field and guide the future research to address gaps in knowledge. While there are an increasing number of articles on cloud, previous reviews observe a lack of empirical and theoretical depth (Schneider and Sunyaev, 2014; Yang and Tate, 2012). Therefore, the motivation for this review is to recognize theoretically grounded empirical work and provide deeper insights on cloud adoption in organizations. The article identifies determinants of cloud adoption in organizations. I tackle two specific research questions: *RQ1: What are the categories of cloud adoption factors? RQ2: What are the determinants of cloud adoption in organizations?*

I accomplish the objective by observing empirical evidence concerning underlying cloud adoption concepts and the use of theory in related information systems (IS) literature. I reviewed literature in two steps. First, I surveyed 31 peer-reviewed studies for cloud adoption factors and coded them into larger categories. Then I focused on 18 articles, which clearly examined relationships between the factors and adoption in order to highlight empirically supported determinants. I utilized the method by Jeyaraj et al. (2006) to systematically analyze and code relationships, resulting in a list of cloud adoption determinants. This method allowed aggregating results from both quantitative and qualitative studies into one framework.

The findings of the review provide interesting insights into empirical evidence behind determinants of cloud adoption in organizations. The review also provides a base for future research by identifying underrepresented areas of research. This review provides a unique point of view in two ways: (1) the review focuses on cloud adoption in organizational context, separating the technology from the issue of outsourcing (e.g. Schneider and Sunyaev, 2014); (2) the review concentrates on empirical work, specifically analysing evidence behind the claims in the literature, leaving out the conceptual work (e.g. Salleh and Teoh, 2012).

2 Background

2.1 Definition of cloud

For the purposes of this study I employ a definition of cloud by United States National Institute of Standards and Technology (NIST), which states: "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell and Grance, 2011). This definition offers a generic and concise explanation that encompasses essential features of cloud, making it suitable for common cloud-related studies. Mell & Grance (2011) identify key characteristics of cloud, four deployment models and three service models, Software-, Platform-, and Infrastructure-as-a-Service (SaaS, PaaS and IaaS).

2.2 Previous reviews

Cloud literature is growing fast, as adoption of the technology and media attention increase. A number of researchers have addressed the emerging need to systematize outcomes of the studies and provided reviews on accumulated knowledge. The past reviews created an overview of the business perspective of cloud and identified the need for research on specific issues organizations face while adopting cloud.

I would like to highlight some of the reviews in order to establish a context for this study. There are general reviews classifying overall themes of cloud related research (e.g. Hoberg et al., 2012; Venters and Whitley, 2012; Yang and Tate, 2012) and studies providing overview of cloud in specific contexts (e.g. Ermakova, Huenges, Erek, & Zarnekow, 2013; Tsaravas & Themistocleous, 2011). These studies provide a much-needed big picture of cloud research identifying popular themes. A general shift from technical to business perspective is observed in the literature (Hoberg et al., 2012), where adoption is one of the most popular topics (Hoberg et al., 2012; Yang and Tate, 2012). Nevertheless, the aforementioned reviews recognize a need for thorough research into concrete issues, such as adoption, security and deployment of cloud services (Ermakova et al., 2013; Hoberg et al., 2012; Yang and Tate, 2012).

A number of reviews on specific domains contribute to filling the gap, including studies concentrating on cloud adoption (El-Gazzar, 2014; Salleh et al., 2012). These studies identified benefits of the cloud (Salleh et al., 2012) as well as various legal, ethical, technical, and managerial challenges companies face during cloud adoption (El-Gazzar, 2014). Shortcoming of these studies is the lack of systematic analysis of relationships between factors and adoption. I believe this limits understanding of precise effects of the factors on cloud adoption in organizations. The reviews present a categorization of utilized factors, but do not provide analysis of empirical evidence behind relative importance of each factor.

A recently published review on cloud-sourcing decisions and their relationship to IT outsourcing (Schneider and Sunyaev, 2014) tackles aforementioned problem, by utilizing a method by Jeyaraj et al. (2006), used in this study. The authors analyse each individual relationship between independent variables and outsourcing decision. This approach allows improving depth of analysis by not only identifying and categorizing different factors, but also evaluating predictive strength of each variable, based on its previous use.

The goal of this review is to bring similar depth to the issue of cloud adoption in organization, and thus expand the perspective gained from the previous studies. The difference between this review

compared to the work of Schneider and Sunyaev is the perspective. Schneider and Sunyaev approach cloud as a sourcing decision, where organization delegates some of its tasks to the third party, thus rooting in outsourcing literature. This study, on the other hand, analyses adoption of cloud *services,* mainly by approaching the problem through the prism of diffusion of innovation and adoption of new technologies within the organization.

3 Method

I followed vom Brocke et al. (2009) and Webster and Watson (2002) as a guide to structure the literature review, document the process of literature search, and present results of an analysis. I start by defining the scope of this review. This is followed by a description of the process of literature search. The end of this section describes the analysis of literature.

3.1 Defining a scope

Cloud computing is a cross-disciplinary topic involving both technological and organizational/business issues. There are different angles to cloud adoption, such as individual users, organizations, specific industries and services. Therefore, in order to limit a scope of this review I decided to focus on an adoption of cloud computing in organizations. I also formed 5 criteria for the articles to be reviewed in order to guide the literature search: 1) Full, peer-reviewed, articles published in journals and international venues. 2) Articles that include original empirical studies. 3) Articles that study adoption of cloud computing in organizations. 4) Articles that clearly describe methods used to conduct the study. Both quantitative and qualitative studies are included. 5) Articles that clearly identify adoption factors of cloud computing or associated service delivery models (SaaS, PaaS, IaaS).

Cloud computing is a relatively new concept in IS literature and there are not many publications in academic journals related to the topic. Therefore, I decided to include publications from selected conferences, as these venues cover wider selection of current themes, such as cloud computing.

The focus of the review are organizations, thus articles studying adoption on a level of individual consumers are excluded. The review mostly covers articles studying companies, however, studies on other organizations such as universities are also included. I consciously excluded conceptual articles without clearly reported empirical studies, in order to concentrate on the evidence related to an adoption of cloud.

3.2 Literature search

I performed a literature search in following databases: AISel, EBSCOHost, Google Scholar, Proquest, ScienceDirect, Scopus and Web of Science. Keywords used for the literature search were: "Cloud adoption", "Cloud computing adoption", "SaaS adoption", "IaaS adoption", "PaaS adoption" and "XaaS adoption".

After initial general search, I applied number of filters in order to improve the relevance of results. In case of search terms containing "cloud", I included only literature published in a period from 2007 to summer 2014, as the term "cloud" in the context of IT appeared in 2007 (Wang et al., 2010). In case of other terms I set limitation to years 2001-2014, for the same reason. I limited the search to social sciences (business, economics, organizational studies etc.) and computer science.

I based further selection of articles, on the manual examination of titles and abstracts from the search results. I applied the principles presented in the Section 3.1 to select articles for the review. I also

focused on adoption articles that included organizational component, and excluded purely engineering papers that covered only technical aspects of cloud implementation. This process yielded 76 publications, which I examined in a greater detail.

After reading 76 articles from initial search and applying the principles defined in the Section 3.1, I selected 31 articles suitable for this review. Remaining articles violated one or more of the stated principles. I examined the databases in the following order (number in parentheses indicates unique articles found in a database): Scopus (10), AISel (8), EBSCOHost (1), Proquest (3), ScienceDirect (4), Google Scholar (4), Web of Science (0). I discovered one article using backward search. Share of journals articles and conferences proceedings were roughly equal. Topically most of the venues were related to IS.

3.3 Analysis

I analysed the literature in two steps, using two methods to complement each other. I used concept matrices in the first step to generate an overview of adoption factors used in literature and create categories. I then used the identified factors and categories as an input for the second step. At this stage I utilized a method developed by Jeyaraj et al. (2006) to synthesize qualitative and quantitative evidence on relationships between the factors and cloud adoption and to identify adoption determinants .

During the first step I analysed 31 articles identified as relevant after the initial search. The goal was to form an overview of adoption factors, used in literature, and categorize them. To accomplish that I set to identify factors used to predict cloud adoption and categorize them. In order to perform an analysis, I utilized concept matrices suggested in the earlier literature (Vom Brocke et al., 2009; Webster and Watson, 2002). In this process I identified over 300 factors and recorded them. I used concept matrices and grouped similar factors together and associated them with corresponding authors and theoretical frameworks. I used inductive approach in the grouping of the factors, forming concepts grounded in the findings of the literature. After initial grouping of factors according to the similarity of the concepts I generated a list of 65 items. I used definitions of factors provided in the literature as a guide for grouping at this stage. After this, I assigned thematic codes to each factor, which resulted in five thematic categories of *drivers*, *inhibitors, organizational context, cloud providers,* and *external environment*. In order to improve this categorization, I discussed the list of factors separately with 3 researchers including a senior IS scholar, one IS and one computer science PhD candidates, working on technology adoption and digital services. I used the outcome of these discussions to review the original categorization. As a result I reduced the list to 43 items, presented in Table 1, as more conceptual connections were suggested between factors.

During the second step, I analysed relationships between cloud adoption and independent variables. The goal of this part of the analysis was to go beyond a simple categorization and create an in-depth understanding of the relationship between factors and adoption. I guided this step by the methodology for literature analysis, introduced by Jeyaraj et al. (2006) and subsequently used in literature reviews of IT, business process outsourcing and cloud sourcing decisions (Lacity et al., 2010, 2011; Schneider and Sunyaev, 2014). The biggest advantage of this method is that it allows analysing empirical results of both quantitative and qualitative studies within the same framework.

For this stage I set two requirements for studies to be included in the analysis: 1) Studies should have clear hypotheses or propositions, with clear direction, regarding relationships between factors and adoption of the cloud. 2) Studies should clearly communicate results of the empirical analysis, whether propositions and hypothesis were supported. After filtering studies based on the two requirements, I included 18 studies out of initial 31. This sample of studies included 41 of 43 variables

identified in the first stage. I examined each relationship between dependent variable (adoption of cloud) and independent variables (adoption factors), 171 in total. Following Jeyaraj et al. (2006), I coded each relationship as: +1 indicating significant positive relationship (P<0.05), -1 indicating significant negative relationship (P<0.05), or 0 in case of non-significant relationship. For qualitative studies I relied on authors' strength and unambiguity of argumentation to code the relationships. This procedure allowed us to not only answers the question of most frequently used variables to study the problem, but also to determine whether relationships between variables have been empirically validated.

4 Results

In the first step of the analysis I identified factors of cloud adoption in organizations utilized in the reviewed articles. The factors range from generic technology adoption related items, such as *change management* and *relative advantage*, to more cloud specific features, such as cloud-based *innovation opportunities* and cloud-specific *service-level agreements (SLA)*. I present altogether 43 factors resulting from the analysis grouped into five categories. The summary of findings is presented in Table 1.

Factors	Articles
Drivers of cloud adoption	
Cost advantage	Alshamaila et al. (2013); Benlian and Hess (2011); Borgman et al. (2013); Feuerlicht and Margaris (2012); Gupta et al. (2013); Hsu et al. (2014); Johansson and Ruivo (2013); Khajeh-Hosseini (2012); Koehler et al. (2010); Lee et al. (2013); Lewandowski et al. (2013); Lian et al. (2014); Lin and Chen (2012); Low et al. (2011); McGeough and Donnellan (2013); Morgan and Conboy (2013); Nkhoma and Dang (2013); Oliveira et al. (2014); Repschlaeger et al. (2012, 2013); Saedi and Iahad (2013); Sarkar and Young (2011); Suh and Chang (2013); Wu et al. (2012)
Relative advantage	Alshamaila et al. (2013); Benlian and Hess (2011); Borgman et al. (2013); Gupta et al. (2013); Johansson and Ruivo (2013); Khajeh-Hosseini (2012); Lewandowski et al. (2013); Lian et al. (2014); Lin and Chen (2012); Low et al. (2011); McGeough and Donnellan (2013); Morgan and Conboy (2013); Repschlaeger et al. (2012, 2013); Saedi and Iahad (2013); Sarkar and Young (2011); Seethamraju (2013); Wu et al. (2012)
Accessibility	Benlian and Hess (2011); Hsu et al. (2014); Johansson and Ruivo (2013); Lee et al. (2013); Lian et al. (2014); Repschlaeger et al. (2013); Saedi and Iahad (2013); Suh and Chang (2013)
Strategic flexibility & adaptability	Benlian and Hess (2011); Feuerlicht and Margaris (2012); Johansson and Ruivo (2013); Nkhoma and Dang (2013); Repschlaeger et al. (2012); Suh and Chang (2013)
Implementation times	Feuerlicht and Margaris (2012); Hsu et al. (2014); Johansson and Ruivo (2013); Lee et al. (2013); Repschlaeger et al. (2013); Seethamraju (2013)
Online collaboration	Gupta et al. (2013); Morgan and Conboy (2013); Sarkar and Young (2011)
Scalability	Feuerlicht and Margaris (2012); Lee et al. (2013); Nkhoma and Dang (2013); Repschlaeger et al. (2013)
Focus on core competences	Benlian and Hess (2011); Seethamraju (2013); Suh and Chang (2013)
Trialability	Alshamaila et al. (2013); Lin and Chen (2012); Morgan and Conboy (2013)
Opportunities for innovation	Alshamaila et al. (2013); Lian et al. (2014); Seethamraju (2013)
Information processing capabilities	Cegielski et al. (2012); Hsu et al. (2014); Johansson and Ruivo (2013)
Inhibitors of cloud adoption	
Security & privacy	Benlian and Hess (2011); Feuerlicht and Margaris (2012); Gupta et al. (2013); Heart (2010); Hsu et al. (2014); Johansson and Ruivo (2013); Lee et al. (2013); Lewandowski et al. (2013); Lian et al. (2014); McGeough and Donnellan (2013); Morgan and Conboy (2013); Oliveira et al. (2014); Repschlaeger et al. (2012, 2013); Saedi and Iahad (2013); Sarkar and Young (2011); Suh and Chang (2013); Trigueros-Preciado et al. (2013)
Cost unpredictability	Benlian and Hess (2011); Feuerlicht and Margaris (2012); Khajeh-Hosseini (2012); Koehler et al. (2010); Lewandowski et al. (2013); Lian et al. (2014); Repschlaeger et al. (2012, 2013); Saedi and Iahad (2013); Sarkar and Young (2011); Seethamraju (2013);

	Suh and Chang (2013); Trigueros-Preciado et al. (2013)
Complexity	Borgman et al. (2013); Lian et al. (2014); Lin and Chen (2012); Low et al. (2011); Morgan and Conboy (2013); Nkhoma and Dang (2013); Oliveira et al. (2014)
Lack of standards in Service-Level Agreements (SLA)	Hsu et al. (2014;) Lee et al. (2013); Nkhoma and Dang (2013); Repschlaeger et al. (2012, 2013); Saedi and Iahad (2013)
Technological limitation compared to existing systems	Dutta et al. (2013); Feuerlicht and Margaris (2012); Lee et al. (2013); Lewandowski et al. (2013); Lin and Chen (2012)
Performance risk	Benlian and Hess (2011); Dutta et al. (2013); Hsu et al. (2014); Lewandowski et al. (2013); Suh and Chang (2013)
Lack of control over resources	Feuerlicht and Margaris (2012); Lee et al. (2013); Lewandowski et al. (2013); Trigueros-Preciado et al. (2013)
Required expertise	Borgman et al. (2013); Koehler et al. (2010); Lee et al. (2013); Suh and Chang (2013)
IT governance issues/change management	Borgman et al. (2013); Feuerlicht and Margaris (2012); Koehler et al. (2010); Seethamraju (2013)
Managerial risk	Benlian and Hess (2011); Dutta et al. (2013); Suh and Chang (2013)
Loss of internal competences	Benlian and Hess (2011); Sarkar and Young (2011); Suh and Chang (2013)
Vendor lock-in	Sarkar and Young (2011); Seethamraju (2013); Trigueros-Preciado et al. (2013)
Low level of standardization	Lee et al. (2013); Nkhoma and Dang (2013)
Data accessibility	Feuerlicht and Margaris (2012); Lee et al. (2013)
Organizational context	
Compatibility & technological readiness	Alshamaila et al. (2013); Borgman et al. (2013); Hsu et al. (2014); Johansson and Ruivo (2013); Khajeh-Hosseini (2012); Lewandowski et al. (2013); Lian et al. (2014); Lin and Chen (2012); Low et al. (2011); McGeough and Donnellan (2013); Morgan and Conboy (2013); Nkhoma and Dang (2013); Oliveira et al. (2014); Seethamraju (2013); Wu et al. (2012)
Management support	Alshamaila et al. (2013); Borgman et al. (2013); Lewandowski et al. (2013); Lian et al. (2014); Low et al. (2011); Morgan and Conboy (2013); Saedi and Iahad (2013); Wu (2011a, 2011b)
Organization size	Alshamaila et al. (2013); Borgman et al. (2013); Low et al. (2011); McGeough and Donnellan (2013); Oliveira et al. (2014); Saedi and Iahad (2013)
Transaction costs *(e.g. uncertainty, asset specificity)*	Alshamaila et al. (20130; Cegielski et al. (2012); Feuerlicht and Margaris (2012); Lin and Chen (2012); Repschlaeger et al. (2013)
Previous experience with cloud	Alshamaila et al. (2013); Lee et al. (2013); Suh and Chang (2013)
Attitudes towards technology	Benlian et al. (2009); Hsu et al. (2014); Lee et al. (2013); Lin and Chen (2012)
Perceived technical expertise	Lian et al. (2014)
Cloud providers	
Provider trustworthiness & reputation	Feuerlicht and Margaris (2012); Gupta et al. (2013); Heart (2010); Koehler et al. (2010); Lee et al. (2013); Lewandowski et al. (2013); Nkhoma and Dang (2013); Repschlaeger et al. (2012, 2013); Seethamraju (2013)
Provider competences	Heart (2010); McGeough and Donnellan (2013); Saedi and Iahad (2013); Trigueros-Preciado et al. (2013)
Customer support	Alshamaila et al. (2013); Feuerlicht and Margaris (2012); Koehler et al. (2010); Lewandowski et al. (2013)
Economies of scale	Lee et al. (2013); McGeough and Donnellan (2013)
Location of data	Feuerlicht and Margaris (2012); Lee et al. (2013)
External Environment	
Legal issues	Borgman et al. (2013); Dutta et al. (2013); Feuerlicht and Margaris (2012); Hsu et al. (2014); Lee et al. (2013); Lewandowski et al. (2013); McGeough and Donnellan (2013); Morgan and Conboy (2013); Nkhoma and Dang (2013); Seethamraju (2013); Trigueros-Preciado et al. (2013)
Competitive pressure	Alshamaila et al. (2013); Borgman et al. (2013); Hsu et al. (2014); Lian et al. (2014); Low et al. (2011); Oliveira et al. (2014); Saedi and Iahad (2013)
Social influence & peer pressure	Benlian et al. (2009); Saedi and Iahad (2013)
Shared best practices	Johansson and Ruivo (2013); Nkhoma and Dang (2013)
Partner pressure	Hsu et al. (2014); Khajeh-Hosseini (2012); Low et al. (2011)
Regulatory support	Hsu et al. (2014); Lian et al. (2014); Oliveira et al. (2014)

Table 1.   Categorization of cloud adoption factors

In the second step, in order to improve understanding of the research done on adoption of cloud, I have analysed evidence behind claims in the literature. By applying literature analysis method utilized by Jeyaraj et al. (2006) I analysed 18 studies, which clearly identified and tested, or persuasively argued in case of qualitative studies, relationships between independent variables and adoption of cloud. I used the five categories created on the first step of the analysis to draw a framework for summarizing findings (Figure 2). These findings present determinants of cloud adoption, which proved as relatively reliable predictors, backed up by empirical evidence.
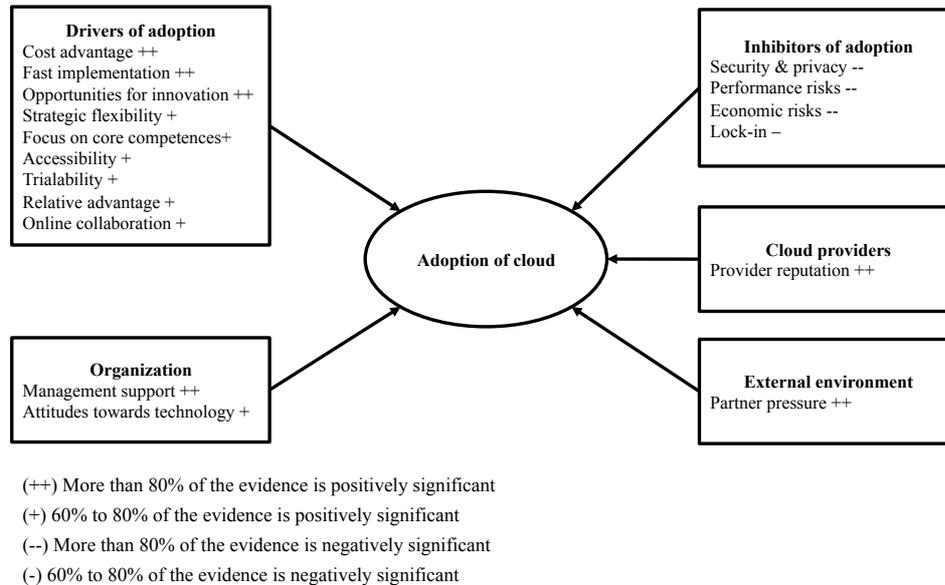

Drivers of adoption
Cost advantage ++
Fast implementation ++
Opportunities for innovation ++
Strategic flexibility +
Focus on core competences+
Accessibility +
Trialability +
Relative advantage +
Online collaboration +

Inhibitors of adoption
Security & privacy --
Performance risks --
Economic risks --
Lock-in –

Adoption of cloud

Cloud providers
Provider reputation ++

Organization
Management support ++
Attitudes towards technology +

External environment
Partner pressure ++

(++) More than 80% of the evidence is positively significant
(+) 60% to 80% of the evidence is positively significant
(--) More than 80% of the evidence is negatively significant
(-) 60% to 80% of the evidence is negatively significant

Figure 2. Cloud adoption determinants based on cloud adoption literature.

After coding relationships according to a direction and significance, I followed Jeyaraj et al. (2006), and Lacity et al. (2010, 2011) and marked significant relationships across multiple articles accordingly. Relationships marked with ++, were positively significant in more than 80% of studies, which analysed them. Positively significant relationships with support between 60% and 80% were marked as +. Similarly, negative significant relationships were marked -- and -, for more than 80% and 60% to 80% correspondingly. As the sample of the analysed articles was relatively smaller, compared to the study by Jeyaraj et al. (2006), the findings also include relationships that were studied in less than five instances. However, I excluded the factors that were studied only in one instance.

This analysis of empirical evidence allowed us to look deeper into the adoption factors of cloud. While on the initial sample of 31 papers covered a large variety of factors, which produced a table of 43 items, analysis of empirical evidence showed that only 17 factors had any substantial evidence supporting them (Figure 2). Technology-Organization-Environment (TOE) and diffusion of innovation (DOI) were most-utilized frameworks in the reviewed studies. Therefore, independent variables used in these frameworks are notably present. Next I present the results of the analysis from the both steps described above.

4.1 Drivers

In this category I have grouped all factors associated directly with those benefits of cloud that drive adoption. The most common drivers of adoption, in terms of number of appearances in the literature, are *cost advantage* and *relative advantage*. This result is realistic given that potential cost savings and

performance improvements are the most visible features of the technology. In the reviewed articles, *cost advantage* is sometimes included into *relative advantage* (e.g. Low et al. 2011), however I have divided two concepts, as former is also widely cited as a separate entity. Therefore, in this paper I use relative advantage to refer to technological or operational advantages that cloud brings, such as improved usability, quality of a service, or new applications.

Features frequently associated with cloud, such as *accessibility, scalability, implementation times,* and *online collaboration* were also utilized across studies. However, consistency of their use was lower compared to top drivers of adoption. Some of the articles chose to use one feature, while ignoring others.

Drivers of adoption are the most tested determinants in the research. *Cost advantage* was widely utilized (6 times) and proved to be a good predictor of adoption in all studies except one. Contrary to the overall perception, Gupta et al. (2013) find that cost factor was not on the top of the list of adoption determinants. However, the cost was very strongly associated with willingness of companies to move to cloud. *Fast implementation time* and *opportunities for innovation* were also found to be good predictors, however their use was relatively low (2 and 3 times respectively). Some cloud-centric factors, such as *online collaboration, strategic flexibility* and *accessibility* also show predictive power in most of the studies in which they were utilized.

4.2 Inhibitors

In this category I included all inhibitors and risks associated with cloud that discourage adoption. In combination with cost advantage as most utilized driver of cloud adoption, presence of cost unpredictability in the top of inhibitors is interesting. A discussion on cost benefits could lose credibility somewhat, where estimation of the cost of cloud is problematic. This may indicate disagreement on whether cloud is proven itself as a reliable cost reducer.

Rest of the category is composed of various risks associated with *performance, management,* and *SLAs*. Surprisingly, the issue of *vendor lock-in*, discussed in practice-oriented literature (Armbrust et al., 2010; Brynjolfsson et al., 2010), was addressed in only three relatively recent studies (Sarkar and Young, 2011; Seethamraju, 2013; Trigueros-Preciado et al., 2013).

Inhibitors of adoption include a number of factors hampering adoption of cloud in organizations. There were 4 variables with strong empirical support in the literature in this group. *Security and privacy* issues are the most studied risk factor of cloud (11 times), demonstrating a negative relationship to adoption in 82% of studies. Studies found that cloud security was one of the top barriers for companies to adopt the technology (Benlian and Hess, 2011; Gupta et al., 2013; Trigueros-Preciado et al., 2013). Nevertheless, Gupta et al. (2013) highlight that overall companies were enthusiastic about cloud, and deemed services secure enough for use, in spite of ranking cloud *security and privacy* as one of their biggest concerns. Other factors, while showing high ratio of significance across the literature, were present only in few studies.

4.3 Organizational context

In the organizational context category I included factors describing organizational characteristics that affect the decision to adopt cloud. In this category, the most utilized factors are *compatibility & technological readiness of organization* and *management support* of cloud initiative. As technological limitations in terms of customization and integration present a risk in cloud computing, compatibility of existing IT with a cloud is highly important. *Previous experience with technology* and *perceived*

technological expertize in an organization are less explored. This can be attributed to an overall perception of cloud as being easier compared to developing and maintaining own infrastructure.

From organizational factors only *management support* and *attitudes towards the technology* have significant support in reviewed studies. *Management support* was empirically supported in all 4 occasions in was tested. There was a general agreement throughout the articles that analysed role of *management support*, that the factor significantly contributes to a decision, whether to adopt cloud (Borgman et al., 2013; Low et al., 2011; Oliveira et al., 2014). On the other hand *compatibility*, the other key attribute of DOI, proved to be significant in merely 2 studies out of 8.

4.4 Cloud providers

I created a separate category for factors related to cloud providers. *Provider trustworthiness & reputation* stands out among factors analysed in literature, by number of times it has been utilized. This can be explained how involvement of cloud providers with implementation and delivery of IT services is much greater compared to traditional IT vendors. Organizations have to trust provider on issues such as consistent performance of the system, sensitive data, and timely implementation of new features.

Provider reputation was the most cited determinant of cloud adoption, concerning cloud providers**,** in all studies**.** However, it has been tested only in two studies (Heart, 2010; Seethamraju, 2013). Both of the studies found support for the impact of provider reputation on adoption, although more research is needed on the issue. Other attributes, were widely discussed in many of the reviewed articles, but did not have strong empirical support.

4.5 External environment

In this category I included all factors that affect cloud adoption but are beyond cloud properties, organizational context or providers. In external environment *legal issues* and *competitive pressure* are most researched. Cloud providers deal with sensitive data of client organizations, but sometimes operate in different legislations from clients. Such environment intensifies the importance of legal compliance. As there are no established practices at the moment, issues such as ownership of data, and privacy. *Competitive pressure* is understandably present as more and more companies are discussing adoption of the technology. Two studies address potential influence of *shared best practices* and success stories as an environmental factor for adoption (Benlian, 2009; Saedi and Iahad, 2013). Success of others could be an influential factor, however at this stage of cloud maturity, convincing examples may be scarce, thus undermining an effect of the factor.

Surprisingly, among external environment factors only *partner pressure* was empirically supported, even though the attribute was tested only in two studies. While *legal issues* and *competitive pressure,* were the most utilized variables, the results are either controversial or insignificant. In case of *legal issues* the reason could be a complexity of the topic, importance of the research setting and vague interpretation of the factor. For example, while some authors see legislation as a supportive factor (e.g. Oliveira et al. 2014) others view it as a hindrance to technology adoption (e.g. Borgman et al. 2013; McGeough 2013).

5 Discussion

In the beginning of this study I set to answer two research questions addressing current state of research cloud adoption in organizations. More robust analysis of empirical results in literature allowed us to gain an in-depth understanding of cloud adoption research beyond a simple overview of

literature and identify future trends as well as shortcomings in the research. In the first step of the analysis presented I have answered the first research question by generating 5 thematic categories of cloud adoption factors.

Based on the identified factors and their categorization I applied a literature analysis method presented in Jeyaraj et al. (2006) and synthesized empirical results from the articles to identify cloud adoption determinants. Resulting summary (see Figure 2) answers to the second research question regarding adoption determinants. Next I discuss some significant findings from the review and point out implications for researchers and practitioners.

5.1   Underrepresented categories among adoption determinants

The key finding is a notable underrepresentation of environmental and organizational adoption determinants in the results. Similar to the findings on cloud-sourcing decision determinants (Schneider and Sunyaev, 2014), I found a strong focus on technology characteristics directly related to cloud. Drivers and inhibitors of adoption, which are fully focused on technology aspect of cloud, dominate the literature. The majority of empirical studies used theoretical foundations from the established research on technology adoption, such as TOE and DOI frameworks. At the same time other factors related to organization, and external stakeholders, that are integral parts of these frameworks, were underrepresented.

It is troubling to see the research results skewed towards issues like *cost advantage* and *security,* which are part of mainstream media discourse on cloud at the moment, while seeing established technology adoption factors, such as *complexity* and *compatibility* underrepresented. Even though cloud is a new breed of organizational technology, I believe it would be wrong to assume that variety of other factors affecting technology adoption do not play a role in cloud adoption decision. For example *complexity,* one of the key attributes of DOI was tested in 8 different occasions, however it turned out to be one of the worst predictors, showing significant relationship to adoption just in 2 occasions. Studies attribute inconsistency concerning *complexity*'s predictive power to technological immaturity of cloud, poor understanding of cloud by companies and need for better empirical data (Borgman et al., 2013; Low et al., 2011).

Combined with underrepresented organizational and environmental factors, these results point out to a narrow view of cloud adoption from both researchers and managers. One other explanation for these results is majority of the reviewed studies taking a top-down view of the cloud adoption. 15 out of 18 studies had collected data exclusively from either IT professionals (2 studies) or top management of the company (13 studies). While these actors have high influence on the technology adoption process, other members of organization usually play a role in the process. I argue that the bias towards top decision-maker informants could be responsible for the prominence of determinants such as *top management support* or *partner pressure* and simultaneous absence of more routine organizational and environmental factors.

Nevertheless, as both organizations' view on cloud and academic research mature there is some hope going forward. According to the latest industrial reports, cloud is entering a mature stage, where managers have increasing understanding of the technology and adoption decisions are becoming more sophisticated (Burton and Willis, 2014; Verizon Enterprise Solutions, 2014). Some examples of the latest research show some promise that hyped determinants such as *security*, while still important, might actually have lesser role in the decision than previously thought. Also established adoption factors such as *complexity*, *compatibility,* and *technological readiness*, whose significance is not supported by earlier studies, seem to play increasingly important role in more recent studies (e.g. Alshamaila et al. 2013; Morgan and Conboy 2013; Oliveira et al. 2014).

5.2 Implications for future research

First, I propose to concentrate future research on environmental and organizational adoption factors. One remedy to the problem would be a wider use established frameworks on technology adoption in organizations. From the original sample of 31 articles less than half used frameworks such as TOE or DOI, which consider environmental and organizational factors. Another way to address the problem would be to modify the approach to data collection. Collecting data from a wider variety of stakeholders participating in adoption decision may address this problem. In addition to that more thorough qualitative and mixed-method studies could help future researchers to understand the role of organizational and environmental factors better.

Second, I find that more studies need to take into consideration different contexts of cloud adoption, such as industry and the size of the company. Majority of the articles in this review either concentrate on one narrow context (e.g. technology SMEs) or have not explicitly specified a context or compared different groups. Schneider and Sunyaev (2014) in their review of cloud-sourcing decisions discovered that specific contexts yield mixed results across different studies utilizing the same framework (e.g. transaction cost economics). I believe this also applies to the cloud adoption studies. A recent paper by Oliveira et al. (2014) provides a good example of a study across multiple contexts. The authors analyse adoption across manufacturing and service industries, as well as various sizes of companies, presenting more robust and interesting results. I argue that this approach has a great potential to advance the knowledge on cloud adoption and generate truly generalizable findings that can withstand time.

The third area to explore is the role of factors associated with cloud providers. Initial overview of the articles revealed that researchers attempted to utilize factors such as *provider competences* (e.g. Heart 2010; Trigueros-Preciado et al. 2013) and *location of data* (e.g. Feuerlicht and Margaris 2012; Lee et al. 2013) to analyse adoption decision. However, in the analysis of adoption determinants only *provider reputation* showed empirical support. I argue that further research needs to be done on cloud providers and their impact on adoption decision. I base the argument on the differences in between cloud provider and client organization relationship, and traditional software vendor-client relationship. The differences are rooted in issues related to higher dependence of client organization on the provider as all or most of the software and data is stored and managed by provider. Thus, provider characteristics, such as location of provider's infrastructure, legislation of provider's home country, and ability of provider to ensure uninterrupted, secure service, would play an increasingly big role in adoption decision.

5.3 Insights for practitioners

Findings from this review also provide some insights for practitioners. Takeaway for providers of cloud services is the presented list of adoption determinants considered by current and potential users. The results suggest that providers need to offer users a clear structure to estimate exact costs related to the implementation and use of cloud services, and benchmark them to the current IT arrangements. Providers also need to keep in mind that as understanding of cloud computing evolves in organizations, managers' decision-making is becoming more sophisticated, thus basic benefits such as cost-cutting or rapid scalability will not be enough to satisfy customer needs.

Security and privacy are the most cited inhibitors of cloud adoption. While security trade-offs are not always obvious in some contexts, it is apparent that providers need to consider their practices in order to maintain high standards on this front. Considering that a recent study has reported "unrealistic optimism" regarding IT security risks among cloud providers (Loske et al., 2013), these issues need to be addressed timely in order to ensure long-term success of cloud on a corporate level.

Another interesting finding for cloud providers, is the prevalence of subjective factors in making an adoption decision. Factors like managerial support, peer and competitive pressure, previous experiences, and best practices suggest that currently adoption decisions are based on the perceptions of potential customers, and their overall attitude towards cloud. Considering a prevalent emphasis on provider trustworthiness and reputation I recommend providers to highlight their strong track record with previous customers and demonstrate benefits of cloud that correspond to the perceptions of managers.

For organizations considering adoption of the cloud this paper offers an extensive overview of the factors that cloud adopters need to consider. The findings also suggest that organizations need to look beyond perceived benefits of the cloud, advertised by industry, and simple cost cutting. A more strategic look at the adoption of cloud services in the organization, and their integration with organization's operations, may lead to the better outcomes in a long run.

5.4 Limitations

As any research this review has limitations. First, the selection process of the articles for this review could be debated. I made number of decisions to limit the search of literature to fields of business and computer science. I also limited the review to articles explicitly talking about cloud computing and X-as-a-Service (XaaS), excluding studies in related areas such as Application Service Providers (ASPs). When identifying adoption determinants I excluded exploratory studies and articles that did not establish clear relationships between factors and adoption, which also narrowed the sample for this review. These choices were made in order to improve comparability of findings, however I realize that I may have missed some articles that could have been relevant for this review.

Second, I realize that categorization and coding process is not perfect. Even though I discussed in-depth, the categorization of factors generated as a result initial review with 3 different scholars with understanding of adoption issues, I realize that these are still subjective.

6 Conclusion

In this paper I have conducted systematic literature review on cloud adoption in organizations. The contribution of this work is thus twofold. First, I identified and categorized determinants of cloud adoption in organizations. The contribution to the field is directions for the future research on cloud adoption, supporting overall development of theory in IS field. IS scholars can use findings regarding determinants of adoption in order to construct their studies and advance the knowledge on adoption decisions. Second, I provide practitioners with recommendations regarding development and adoption of cloud services. This review offers valuable insights for both cloud service providers and organizations considering adopting the technology.

References

Alshamaila, Y., Papagiannidis, S. and Li, F. (2013). "Cloud computing adoption by SMEs in the north east of England: A multi-perspective framework." *Journal of Enterprise Information Management*, 26 (3), 250–275.

Armbrust, B., Griffith, R., Joseph, A.D., Katz, R., Konwinski, A., Lee, G., Patterson, D., et al. (2010). "A View of Cloud Computing." *Communications of the ACM*, 53 (4), 50–58.

Benlian, A. (2009). "A transaction cost theoretical analysis of software-as-a-service (SAAS)-based sourcing in SMBs and enterprises." In: *Proceedings of the 17th European Conference on Information Systems (ECIS) 2009*. Verona: Italy, pp. 25-36.

Benlian, A. and Hess, T. (2011). "Opportunities and risks of software-as-a-service: Findings from a survey of IT executives." *Decision Support Systems*, 52 (1), 232–246.

Benlian, A., Hess, T. and Buxmann, P. (2009). "Drivers of SaaS-Adoption – An Empirical Study of Different Application Types." *Business & Information Systems Engineering*, 1(5), 357–369.

Borgman, H.P., Bahli, B., Heier, H. and Schewski, F. (2013). "Cloudrise: Exploring Cloud Computing Adoption and Governance with the TOE Framework." In: *Proceedings of the 46th Hawaii International Conference on System Sciences*, IEEE. Maui, Hawaii: USA, pp. 4425–4435.

Vom Brocke, J., Simons, A., Niehaves, B. and Reimer, K. (2009). "Reconstructing the Giant: On the Importance of Rigour in Documenting the Literature Search Process." In: *Proceedings of the 17th European Conference on Information Systems (ECIS) 2009*. Verona: Italy, pp. 2206-2217.

Brynjolfsson, E., Hofmann, P. and Jordan, J. (2010). "Cloud computing and electricity." *Communications of the ACM*, 53 (5), 32-34.

Burton, B. and Willis, D.A. (2014). *Gartner's Hype Cycle Special Report for 2014*, 1–19.

Cegielski, C.G., Jones-Farmer, L.A., Wu, Y. and Hazen, B.T. (2012). "Adoption of cloud computing technologies in supply chains: An organizational information processing theory approach." *The International Journal of Logistics Management*, 23 (2), 184–211.

Dutta, A., Peng, G.C.A. and Choudray, A. (2013). "Risks in Enterprise Cloud Computing: The Perspective of IT Experts." *Journal of Computer Information Systems*, 53 (4), 39–48.

El-Gazzar, R. (2014). *A Literature Review on Cloud Computing Adoption Issues in Enterprises*, *Creating Value for All Through IT*, Springer Berlin Heidelberg, 214–242.

Ermakova, T., Huenges, J., Erek, K. and Zarnekow, R. (2013). "Cloud Computing in Healthcare–a Literature Review on Current State of Research." In: *Proceedings of the 19th Americas Conference on Information Systems (AMCIS) 2013*. Chicago: USA.

Feuerlicht, G. and Margaris, N. (2012). "Cloud Computing Adoption: A comparative study." In: *Proceedings of 1st WSEAS International Conference, Recent Advances in Computer Engineering Series*. Vienna: Austria, pp. 441–448.

Gupta, P., Seetharaman, A. and Raj, J.R. (2013). "The usage and adoption of cloud computing by small and medium businesses." *International Journal of Information Management*, 33 (5), 861–874.

Heart, T. (2010). "Who is Out There ? Exploring the Effects of Trust and Perceived Risk on SaaS Adoption Intentions." *ACM SIGMIS Database*, 41 (3), 49–68.

Hoberg, P., Wollersheim, J. and Krcmar, H. (2012). "The Business Perspective on Cloud Computing - A Literature Review of Research on Cloud Computing." In: *Proceedings of 18th Americas Conference on Information Systems (AMCIS) 2012*. Seattle: USA.

Hsu, P.-F., Ray, S. and Li-Hsieh, Y.-Y. (2014). "Examining Cloud Computing Adoption Intention, Pricing Mechanism, and Deployment Model." *International Journal of Information Management*, 34 (4), 474–488.

IDG Enterprise. (2014). *Computerworld Forecast Study 2015*, URL: http://www.idgenterprise.com/report/computerworld-forecast-study-2015 (visited on 03/15/2015).

Jeyaraj, A., Rottman, J.W. and Lacity, M.C. (2006). "A review of the predictors, linkages, and biases in IT innovation adoption research." *Journal of Information Technology*, 21 (1), 1–23.

Johansson, B. and Ruivo, P. (2013). "Exploring Factors for Adopting ERP as SaaS." In: *Proceedings of the CENTERIS 2013 Conference on ENTERprise Information Systems*, Elsevier B.V., pp. 94–99.

Khajeh-Hosseini, A. (2012). "The cloud adoption toolkit: supporting cloud adoption decisions in the enterprise." *Software: Practice and Experience*, 42 (4), 447–465.

Koehler, P., Anandasivam, A. and Dan, M. (2010). "Cloud Services from a Consumer Perspective." In: *Proceedings of the 16th Americas Conference on Information Systems (AMCIS) 2010*. Lima: Peru.

Lacity, M.C., Khan, S., Yan, A. and Willcocks, L.P. (2010). "A review of the IT outsourcing empirical literature and future research directions." *Journal of Information Technology*, 25 (4), 395–433.

Lacity, M.C., Solomon, S., Yan, A. and Willcocks, L.P. (2011). "Business process outsourcing studies: a critical review and research directions." *Journal of Information Technology*, 26 (4), 221–258.

Lee, S.-G., Chae, S.H. and Cho, K.M. (2013). "Drivers and inhibitors of SaaS adoption in Korea." *International Journal of Information Management*, 33 (3), 429–440.

Lewandowski, J., Salako, A.O. and Garcia-Perez, A. (2013). "SaaS Enterprise Resource Planning Systems: Challenges of Their Adoption in SMEs." In: *Proceedings of the IEEE 10th International Conference on e-Business Engineering*, IEEE. Coventry: United Kingdom, pp. 56–61.

Lian, J.-W., Yen, D.C. and Wang, Y.-T. (2014). "An exploratory study to understand the critical factors affecting the decision to adopt cloud computing in Taiwan hospital." *International Journal of Information Management*, 34 (1), 28–36.

Lin, A. and Chen, N. (2012). "Cloud computing as an innovation: Perception, attitude, and adoption." *International Journal of Information Management*, 32 (6), 533–540.

Loske, A., Widjaja, T. and Buxmann, P. (2013). "Cloud Computing Providers' Unrealistic Optimism Regarding IT Security Risks: A Threat to Users?" In: *Proceedings of the International Conference on Information Systems (ICIS) 2013*. Milan: Italy.

Low, C., Chen, Y. and Wu, M. (2011). "Understanding the determinants of cloud computing adoption." *Industrial Management & Data Systems*, 111 (7), 1006–1023.

McGeough, B.T. and Donnellan, B. (2013). "Factors that Affect the Adoption of Cloud Computing for an Enterprise: A Case Study of Cloud Adoption Within Intel Corporation." In: *Proceedings of the 21st European Conference on Information Systems (ECIS) 2013*. Utrecht: Netherlands.

Mell, P. and Grance, T. (2011). "The NIST Definition of Cloud Computing, Recommendations of the National Institute of Standards and Technology." *National Institute of Standards and Technology*.

Morgan, L. and Conboy, K. (2013). "Factors Affecting The Adoption Of Cloud Computing: An Exploratory Study." In: *Proceedings of the 21st European Conference on Information Systems (ECIS) 2013*. Utrecht: Netherlands.

Nkhoma, M. and Dang, D. (2013). "Contributing Factors of Cloud Computing Adoption: a Technology-Organisation-Environment Framework Approach Mathews." *International Journal of Information Systems and Engineering*, 1 (1), 38–49.

Oliveira, T., Thomas, M. and Espadanal, M. (2014). "Assessing the determinants of cloud computing adoption: An analysis of the manufacturing and services sectors." *Information & Management*, 55 (5), 497–510.

Repschlaeger, J., Erek, K. and Zarnekow, R. (2013). "Cloud computing adoption : an empirical study of customer preferences among start-up companies." *Electronic Markets*, 23 (2), 115–148.

Repschlaeger, J., Zarnekow, R., Wind, S. and Klaus, T. (2012). "Cloud Requirement Framework: Requirements and Evaluation Criteria to adopt Cloud Solutions." In: *Proceedings of the 20th European Conference on Information Systems (ECIS) 2012*. Barcelona: Spain.

Saedi, A. and Iahad, N. (2013). "An Integrated Theoretical Framework For Cloud Computing Adoption By Small and Medium-Sized Enterprises." In: *Proceedings of the* In: *Proceedings of the 17th Pacific Asia Conference on Information Systems (PACIS) 2013*. Jeju Island: Korea

Salleh, S. and Teoh, S. (2012). "Cloud Enterprise Systems A Review of Literature and its Adoption." In: *Proceedings of the 16th Pacific Asia Conference on Information Systems (PACIS) 2012*. Ho Chi Minh city: Vietnam.

Salleh, S., Teoh, S. and Chan, C. (2012). "Cloud enterprise systems: a review of literature and its adoption." In: *Proceedings of the 16th Pacific Asia Conference on Information Systems (PACIS) 2012*. Ho Chi Minh city: Vietnam.

Sarkar, P. and Young, L. (2011). "Sailing the Cloud: A Case Study of Perceptions and Changing Roles in an Australian University." In: *Proceedings of the 19th European Conference on Information Systems (ECIS) 2011*. Helsinki: Finland.

Schneider, S. and Sunyaev, A. (2014). "Determinant factors of cloud-sourcing decisions: reflecting on the IT outsourcing literature in the era of cloud computing." *Journal of Information Technology*.

Seethamraju, R. (2013). "Determinants of SaaS ERP Systems Adoption." In: *Proceedings of the 17th Pacific Asia Conference on Information Systems (PACIS) 2013*. Jeju Island: Korea.

Suh, J. and Chang, S. (2013). "An Empirical Study on the Enterprise Cloud Service Adoption." In: *Proceedings of the 17th Pacific Asia Conference on Information Systems (PACIS) 2013*. Jeju Island: Korea.

Trigueros-Preciado, S., Pérez-González, D. and Solana-González, P. (2013). "Cloud computing in industrial SMEs: identification of the barriers to its adoption and effects of its application." *Electronic Markets*, 23 (2), 105–114.

Tsaravas, C. and Themistocleous, M. (2011). "Cloud Computing and eGovernment: A Literature Review." In: *Proceedings of the 8th European, Mediterranean & Middle Eastern Conference on Information Systems (EMCIS) 2011*, pp. 154–164. Athens: Greece.

Venters, W. and Whitley, E. (2012). "A Critical Review of Cloud Computing: Researching Desires and Realities." *Journal of Information Technology*, 27 (3), 179–197.

Verizon Enterprise Solutions. (2014). *Enterprise Cloud 2014*, pp. 1–12.

Wang, L., Laszewski, G., Younge, A., He, X., Kunze, M., Tao, J. and Fu, C. (2010). "Cloud Computing: a Perspective Study." *New Generation Computing*, 28 (2), 137–146.

Webster, J. and Watson, T. (2002). "Analyzing the Past to Prepare for the Future: Writing a Literature Review." *MIS Quarterly*, 26 (2), xiii-xxiii.

Wu, W.-W. (2011a). "Mining significant factors affecting the adoption of SaaS using the rough set approach." *Journal of Systems and Software*, 84 (3), 435–441.

Wu, W.-W. (2011b). "Developing an explorative model for SaaS adoption." *Expert Systems with Applications*, 38 (12), 15057–15064.

Wu, Y., Cegielsk, C. and Hall, D. (2012). "An Information Processing Paradigm of IT Innovation Adoption." In: *Proceedings of the 18th Annual Conference of the Southern Association for Information Systems* (*SAIS) 2012*. Hilton Head Island, South Carolina: USA

Yang, H. and Tate, M. (2012). "A descriptive literature review and classification of cloud computing research." *Communications of the Association for Information Systems*, 31 (2), 35–60.