Cloud Computing Adoption, Cost-benefit Relationship and Strategies for Selecting Providers: A Systematic Review

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Abstract: Context: Cloud computing has been one of the most promising computing paradigms in industry to provide a customizable and resourceful platform to deploy software. There are a number of competing providers and available services that allows organizations to access computing services without owning the corresponding infrastructure. Goal: Identify the main characteristics of opportunities to migrate to the cloud, the respective challenges and difficulties as well as factors that affect the cost-benefit relationship of such adoption. Method: This paper presents a systematic literature review to compare reported strategies of organizations to migrate and adopt cloud computing and their perception of the cost-benefit of this adoption. Results: The overall data collected from these studies depicts that a significant part of the companies perceived inclination towards for the innovation adoption process influenced by technological, organizational and environmental contexts. Conclusion: Due to the variety of strategies, approaches and tools reported in the primary studies, it is expected that the results in this systematic literature review would help in establishing knowledge on how the companies should adopt and migrate to the cloud, how the cost-benefit relationship can be evaluated as well as providers can be selected. These findings can be a useful reference to develop guidelines for an effective use of cloud computing.

1 INTRODUCTION

Cloud computing (CC) is a paradigm shift in computing that has changed the way users deal and perceive computing (Weiss, 2007). This scenario has created opportunities for enterprises that have manifested perceived inclination toward cloud computing and the benefits reaped by them (Buyya et al., 2009). However, the identification of opportunities for migration, the reasoning of an attractive cost-benefit relationship and the selection of service providers that best fit their needs are not trivial tasks (Li et al., 2012a) (Li et al., 2012b). The selection of commercial cloud providers is a challenging task and depends on several variables and indicators. Among other reasons, cloud providers may continually upgrade their hardware and software infrastructures, and new commercial Cloud services, technologies and strategies may gradually enter the market (Li et al., 2013). Studies have shown that successful migration to the cloud are usually driven by a set of criteria to select providers that best fit their needs (Li et al., 2012b)(Li et al., 2010)(Garg et al., 2013).

The motivation for a Systematic Literature Review (SLR) is the need to identify, classify, and compare existing evidence on the strategies used by companies to identify scenarios of migration opportunities to the cloud computing. To justify the adoption, a set of factors should be considered for the assessment of the cost-benefit relationship. Moreover, companies should be able to select a provider according to their needs and profile. The evidences collected and discussed in this SLR is intended to gain and share insight from the literature so that companies can decide towards cloud computing. This paper has three major contributions: i) the identification of strategies and issues that companies have considered to migrate to the cloud; ii) factors that should be considered in the cost-benefits relationship while adopting and migrating to the cloud; iii) and finally aspects related to the selection of cloud computing service providers.

The rest of this paper is organized as follows: Section 2 provides background related to the research area and emphasizes the differences between this systematic review and previous systematic reviews in the domain. The subsequent sections outlines the

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research methodology (Section 3); presents and discusses the results of the SLR and its corresponding analysis (Section 4). The concluding remarks as well as limitations and scope for future research have been discussed in Section 5.

2 PROBLEM STATEMENT AND SCOPE

In this section, we present the concepts related to cloud computing to justify why we position our contribution of this SLR. Based on a systematic search, we also link to existing secondary studies that discuss aspects related to the migration to the cloud and correlated factors.

Many enterprises have adopted the paradigm of cloud computing where producers and consumers (of information) do not necessarily reside within the same physical proximity (Gupta et al., 2013) (Li et al., 2011)(Mahesh et al., 2013). Studies have revealed that cloud computing adoption by enterprises is primarily based on their perceptions about *cost reduction*, *ease of use* and *convenience*, *reliability*, *sharing* and *collaboration* and lastly but not the least, *security* and *privacy* (Gupta et al., 2013).

Cloud computing comprises basically three services. Probably the most popular is the *Software-as-a-Service* (SaaS). It relies on the principle that instead of installing software on the clients machine and updating it with regular patches, the applications are available (hosted) over the web for the consumption of the end-user. This scenario enables the achievement of economy of scale (Gupta et al., 2013). The companies that provide SaaS most of the time hire the *Platform-as-a-Service* (PaaS). The main idea of PaaS is that instead of buying the software licenses for platforms like operating systems, databases and middleware, these platforms along with software development kits (SDKs) and the programming languages (such as Java, .NET) are made available over the web (Gupta et al., 2013). The last is the *Infrastructure-as-a-Service* (IaaS). It refers to the tangible physical devices (raw computing) like virtual computers, servers, storage devices, network transfer, which are physically located in one central place (data center) but they can be accessed remotely and used over the web using the login authentication systems and respective passwords (Gupta et al., 2013).

These three services described above are deployed following four different models: i) *Public cloud* is available from a third party service provider via web and is a very cost effective option to deploy IT solutions (Mell and Grance, 2011); ii) *Private cloud* is managed within an organization and is suitable for large enterprises (managed within the walls of the enterprises). Private clouds provide the advantages of public clouds, but still incur capital expenditures (Mell and Grance, 2011);iii) *Community cloud* is used and controlled by a group of enterprises, which have shared interests (Mell and Grance, 2011);iv) *Hybrid cloud* is a combination of public and private cloud (Mell and Grance, 2011). This paper focuses on public cloud providers and the three types of cloud computing services: SaaS, PaaS and IaaS.

This study has the goal to shed some light on the practices involved in the adoption of cloud computing. The results of this study are expected to help different types of companies to decide for this adoption and how they can plan it. For this end, the study present different approaches, techniques and tools to overcome difficulties and challenges in the context of cloud computing. The scope of this review is specific to identify strategies that can help organizations to migrate and adopt cloud computing, their perception of the cost-benefit relationship of this adoption and how companies can select service providers that best fit their needs and profile.

The scope and coverage of this systematic review differ significantly from previous reviews. During the conduction of this study, we found four systematic literature reviews (SLRs) focusing on the following themes: migration to the cloud computing (Jamshidi et al., 2013), service composition (Jula et al., 2014), service evaluation (Li et al., 2013) and challenges and concerns when building cloud-based architectures (Breivold et al., 2014). Despite being relevant source of information for companies that plan to adopt the cloud computing paradigm, none of these previous SLRs focused specifically on the relationship among the issues target in this paper. This relationship is indeed relevant for both the adoption and migration to the cloud.

3 RESEARCH METHODOLOGY

In contrast to a non-structured review process, a Systematic Literature Review (SLR) (Brereton et al., 2007) and (Kitchenham and Charters, 2007) reduces bias and follows a precise and rigorous sequence of methodological steps to research literature. SLR rely on well-defined and evaluated review protocols to extract, analyze, and document results as the stages conveyed in Figure 1. This section describes the methodology applied for the phases of planning, conducting and reporting the review.

3.1 Planning the Review

Identify the Needs for a Systematic Review. Search for evidences in the literature regarding how companies decide towards cloud computing in terms of (i) strategies to identify migration opportunities to the cloud, (ii) relevant factors for the assessment of the cost-benefit of this adoption of cloud and finally (iii) the selection of providers according to their needs and profile.

Specifying the Research Questions. We aim to answers the following questions by conducting a methodological review of existing research:

RQ1. *Which strategies are used by companies to adopt and migrate to the cloud computing?* Identifying goals, proposals and motivations for the adoption of cloud computing, help organizations to better characterize their needs and therefore provide conditions to a successful migration.

RQ2. *Which factors companies consider to assess the cost-benefit relationship of adoption and migration to the cloud computing?* The knowledge of the costs and benefits of migration to the cloud computing can be used as a support for its planning and reference for other companies.

RQ3. *How companies select cloud computing service providers according to their needs and profile?* The knowledge of successful strategies and problems raised by inappropriate selection of cloud computing providers allow organizations to be more confident to identify providers that best fit their needs.

These three research questions are somehow related to each other. However, studies could have discussed them separately. Regarding the cost-benefit relationship addressed by RQ2, it is possible that this relationship could be analyzed considering a specific provider. Moreover, there is the possibility of studies addressing this scenario comparing various providers with their respective characteristics analyzing to which extent they fit a company profile. This fact establish a close relationship between RQ2 and RQ3.

Publications Time Frame. We conducted a SLR in journals and conferences papers from January 2005 to June 2015.

3.2 Conducting the Review

This phase is responsible for executing the review protocol.

Identification of Research. Based on the research questions, keywords were extracted and used to search the primary study sources. The search string is presented as follows and used the same strategy cited in (Chen and Babar, 2011):

> *(("Cloud Migration" OR "legacy-to-cloud migration" OR "Cloud adoption") OR ("Cost" OR "Return of investments" OR "ROI" OR "Cost-benefit") OR (("Cloud Service" OR "Cloud Provider") AND ("Evaluation" OR "Selection")) AND ("Cloud Computing" OR "Cloud Services" OR "Cloud Interoperability")*

Selection of Primary Studies. The following steps guided the selection of primary studies.

Table 1: Inclusion Criteria.

Criterion	Description
IC1	The publications should be journal or conference and written in English.
IC2	Works involving an empirical study or have "lessons learned" (experience report).
IC3	If several journal articles reporting the same study the latest article will be included.
IC4	The articles that address at least one of the research questions.

Table 2: Exclusion Criteria.

Criterion	Description
EC1	Studies not focused on cloud computing.
EC2	Studies merely based on expert opinion without locating a specific experience, as well as editorials, prefaces, summaries of articles, interviews, news, analysis/reviews, readers letters, summaries of tutorials, workshops, panels, and poster sessions.
EC3	Publications that are earlier versions of last published work.
EC4	Publications that were published out of the period January 1st, 2005 to June 2015.

Stage 1 - Search string results automatically obtained from the engines - Submission of the search string to the following repositories: Digital Library ACM, IEEE Xplore, Science Direct and Google Scholar. The justification for the selection of these libraries is their relevance as sources in software engineering (Zhang et al., 2011). The search was performed using the specific syntax of each database,

considering only the title, keywords, and abstract. The search was configured in each repository to select only papers carried out within the prescribed period. The automatic search was complemented by a manual search to obtain a list of studies from journals and conferences. The duplicates were discarded.

Stage 2 - Read titles & abstracts to identify potentially relevant studies - Identification of potentially relevant studies, based on the analysis of title and abstract, discarding studies that are clearly irrelevant to the search. If there was any doubt about whether a study should be included or not, it was included for consideration at a later stage.

Stage 3 - Apply inclusion and exclusion criteria on reading the introduction, methods and conclusion - Selected studies in previous stages were reviewed, by reading the introduction, methodology section and conclusion. Afterwards, inclusion and exclusion criteria were applied. At this stage, in case of doubt preventing a conclusion, the study was read in its entirety.

Stage 4 - Obtain primary studies and make a critical assessment of them - A list of primary studies was obtained and later subjected to critical examination using the 11 quality criteria (Dyba and Dingsoyr, 2008) set out in Table 3.

Table 3: Quality Criteria (Dyba and Dingsoyr, 2008).

Criterion	Description
QC1	Is the paper based on research (or is it merely a lessons learned report based on expert opinion)?
QC2	Is there a clear statement of the aims of the research?
QC3	Is there an adequate description of the context in which the research was carried out?
QC4	Was the research design appropriate to address the aims of the research?
QC5	Was the recruitment strategy appropriate to the aims of the research?
QC6	Was there a control group with which to compare treatments?
QC7	Was the data collected in a way that addressed the research issue?
QC8	Was the data analysis sufficiently rigorous?
QC9	Is there a clear statement of findings?

Data Extraction. All relevant information on each study was recorded on a spreadsheet. This information was helpful to summarize the data and map them with its source. The following data were extracted

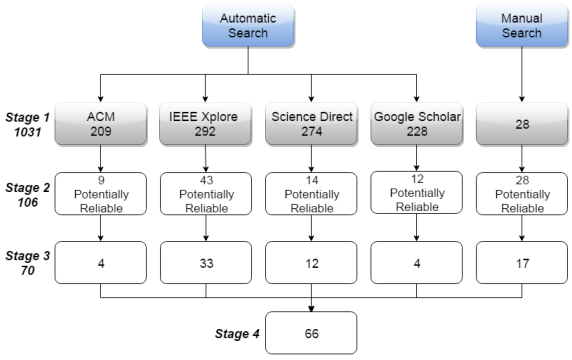

Figure 1: Stages of the Study Selection Process.

from the studies: (i) name and authors; (ii) type of article (journal, conference, workshop); (iii) aim of the study; (iv) research question; (v) scenario(s); (vi) results and conclusions; (vii) benefits; (viii) limitations and challenges.

Data Synthesis. This synthesis aimed at grouping findings from the studies in order to: identify the main concepts (organized in spreadsheet form), conduct a comparative analysis on the characteristics of the study, type of service adopted, cloud deployment model, and issues regarding three research questions (*RQ1, RQ2* and *RQ3*) from each study. Other information was synthesized when necessary. We used the meta-ethnography method (Noblit and Hare, 1988) as a reference for the process of data synthesis.

Conducting the Review. We started the review with an automatic search followed by a manual search to identify potentially relevant studies and afterwards apply the inclusion/exclusion criteria. The first tests using automatic search began in March 2015. We had to adapt the the search string in some engines without losing its primary meaning and scope. The manual search consisted in studies published in conference proceedings and journals that were included by the authors while searching the theme in different repositories. These studies were equally analyzed regarding their titles and abstracts. Figure 1 conveys them as 28 studies. We tabulated everything on a spreadsheet so as to facilitate the subsequent phase of identifying potentially relevant studies. Figure 1 presents the results obtained from each electronic database used in the search, which resulted in 1003 articles considering all databases.

Potentially Relevant Studies. The results obtained from both the automatic and manual search were included on a single spreadsheet. Papers with identical title, author(s), year and abstract were discarded as redundant. At this stage, we registered an overall of 1031 articles, namely 1003 from the automated search plus 28 from the separate manual search *(Stage 1)*. We then read titles and abstracts to identify relevant

studies resulting in 106 papers *(Stage 2)*. At *(Stage 3)* we applied the quality criteria in each study and then we read introduction, methodology and conclusion to decide to consider 70 studies for the next stage. After applying the quality criteria, remained 66 articles to answer the three research questions - RQ1, RQ2 and RQ3 *(Stage 4)*.

4 RESULTS AND ANALYSIS

This section presents the results of this SLR to answer the research questions RQ1, RQ2 and RQ3. Figure 2 conveys the selected studies and the respective research questions they focus on. As can be seen in the same Figure, 36 studies addressed issues related to RQ1, while 25 studies discussed RQ2 issues and, finally, ten papers addressed RQ3 issues. All selected studies are listed in *Appendix* and referenced as *"S"* followed by the number of the paper.

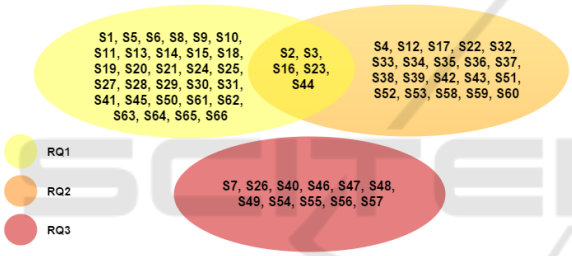

Figure 2: Selected Studies per Research Question (RQ).

Table 4 presents the top ten papers included in the review according to Google Scholar citations. These papers are evidences of the relevance of the issues discussed in this SLR and the influence these papers exert on the literature as can be confirmed by their respective citation numbers. Table 4 shows an overview of the distribution of the most relevant papers according to the addressed research questions. In the following paragraphs we briefly describe these papers. The paper [S41] that addresses RQ1 has the highest number of citations (483)[1]. It is related to RQ1 and RQ2 and analyzes the use of cloud computing in manufacturing business companies. It has been extensively used as a successful case of cloud computing adoption having as a reference parameters of a cost-benefit relationship to guide such adoption. The paper [S55] has 477 citations according to Google Scholar and discusses issues related to RQ3. It describes the use of a tool called CloudCmp to perform benchmark suite for cloud platforms. This tool has been recognized as an important reference for benchmarking. To this end, it identifies a common set of services offered by cloud providers, including *elastic computing*, *persistent storage*, and *intra-cloud* and *wide-area networking*. The authors argue that CloudCmp enables predicting application performance without having to first port the application onto every cloud provider.

The paper [S3] has 207 citations according to Google Scholar. The authors discuss how a proposed model can support companies to analyze several characteristics of their own business as well as pre-existing IT resources to identify their favorability in the migration to the Cloud Architecture (RQ1). A general Return on Investment model has also been developed here taking into consideration various intangible impacts of Cloud Computing, apart from the cost (RQ2).

The paper [S57] with 201 citations according to Google Scholar, proposes a framework and a mechanism to measure the quality and prioritize Cloud services providers. According to the authors, given the diversity of Cloud service offerings, an important challenge for customers is to find out appropriate Cloud providers that can satisfy their requirements (RQ3). This makes it difficult to evaluate service levels of different Cloud providers, justifying the use of a Analytical Hierarchical Process (AHP) based ranking mechanism to provide a quantitative basis for the ranking of Cloud services where the final ranking is based on the cost (RQ2) and quality (Garg et al., 2013).

Table 4: Top Ten Cited Papers according to Google Scholar.

Studies	Cited by	Research Question
S41	483	RQ1
S55	477	RQ3
S3	207	RQ1 and RQ2
S57	201	RQ3
S65	196	RQ1
S4	170	RQ2
S2	153	RQ1 and RQ2
S54	132	RQ3
S59	77	RQ2
S64	74	RQ1

We have identified that six (S42, S51, S54, S58, S60, S61, S64) of the 66 selected studies reference the Technological Organizational Environmental (TOE) framework (Tornatzky and Fleischer, 1990). It is an organization-level theory aimed at supporting organizations in the adoption and implementation of innovations. Based on this framework, the innovation adoption process is influenced by three aspects of the enterprise [S64]: i) *technological context*, which represents the internal and external technologies related

[1]Data obtained in 11/01/2015

to the organization; both technologies that are already in use at the firm, as well as those that are available in the marketplace but not currently in use; ii) *organizational context* is related to the resources and the characteristics of the firm, e.g. size and managerial structure; iii) *environmental context*, which refers to the arena in which a firm conducts its business; it can be related to surrounding elements such as industry, competitors and the presence of technology service providers. These papers are evidences that this framework is useful to guide organizations toward the adoption of cloud computing.

4.1 Strategies for the Adoption and Migration to the Cloud (RQ1)

This subsection has the goal to discuss how selected papers addressed RQ1: *Which strategies are used by companies to identify scenarios of migration opportunities to the cloud computing?*

RQ1 Analysis. As can be seen in Table 5, 25 papers proposed and discussed processes, strategies and frameworks to help companies in the decision of adoption and migration to the cloud. In the following paragraphs we contextualize how each of these papers contributes to RQ1.

Table 5: Types of support for adoption of cloud computing.

Adoption Support Type	Reporting Studies
Experiences and Case Reports	S11, S18, S24, S25, S30, S31, S41, S44, S45, S66
Processes, strategies and frameworks	S1, S3, S8, S9, S10, S14, S15, S16, S19, S20, S21, S23, S27, S28, S29, S50, S61, S62, S63, S64, S65
Tools	S2, S5, S6, S13

The result of the analysis of the selected papers indicated that four studies proposed the use of tools to support companies to identify and evaluate scenarios of migration opportunities to the cloud. The studies and the respective tools are listed as follows: [S2] describes a cloud Adoption Toolkit that uses Cost Modeling techniques to examine cost of deploying IT system to the cloud. [S5] describes an evaluation of the tools (CPTS, CSA STAR, C.A.RE and CloudTrust) to compare them. [S6] discusses the use of CloudMIG to support Software as a Service (SaaS) providers in semi-automatically migration of legacy software systems to the cloud. The desktop-to-cloud-migration (D2CM) tool that supports transformation and migration of virtual machine images, deployment description and life-cycle management for applications was designed to help researchers to migrate their applications to the cloud [S13].

On the other hand, 21 of the selected studies proposed approaches to guide the migration to the cloud:

The authors of [S1] performed an analysis of existing migration methods, classifying them in five migration strategies as presented as follows: (i) migrate to IaaS, (ii) migrate to PaaS, (iii) replace by SaaS, (iv) revise based on SaaS, and (v) re-engineering to SaaS. The similarities and differences between the migration strategies are discussed, and the challenges and future work about legacy system migration to the cloud are proposed. According to [S3], Cloud Computing adoption is influenced by characteristics such as size of IT resources, utilization pattern of the resources, sensitivity of the data they are handling, and criticality of the work performed by the company. [S8] identifies resources rationalization by type of organization. A decision process aimed at supporting Information system migration to the Cloud, and propose a synthesis for the choice of Cloud structures according to type of organization. [S9] describes a strategy to help software companies to decide of what is more convenient: to migrate or to start from scratch based on evaluation of costs, ROI, efforts and migration tasks.

Cloud Services Brokerages (CSBs) act as intermediaries between the consumer and providers. They are considered as a viable solution to address migration issues [S10]. [S14] shows that even small and medium-sized companies may have competitive advantages to migrate their applications to the cloud, presents a step-by-step process to support cloud adoption and migration decisions in the enterprise using for this the Decision Process called Cloudstep to support the migration decision. The author of [S15] uses InCLOUDer to assists organizations in adapting their applications to cloud environments according to their many interdependent criteria for cloud migration. [S16] analyzes features of cloud computing services to determine the practicability and methodology to migrate legacy applications to the cloud and a compatibility checklist was used to estimate the cost of the migration. [S19] proposes an approach based on Model-Driven Engineering (MDE) techniques to migrate legacy systems to the cloud. In fact, it used business and technical factors to reverse engineer legacy software into models from which cloud-based software can be generated. [S20] proposed a migration process framework outlining major steps and their concerns. This has served as a basis to extract critical problems in business and technical terms.

The Study [S21] presents Cloud-Assisted Live

Media Streaming (CALMS), a generic framework that facilitates a migration to the cloud. [S23] discusses the methodology of migrations along with the challenges and issues that usually acts as a barrier for organizations trying to pursue this goal. A set of migration patterns which span the continuum from legacy IT environment to the cloud is included as a common framework for aligning the various migration approaches developed. [S27] combined the concept of BPR and GBPR to propose a framework based on paradigms to support migration to cloud. Three paradigms are proposed. The process paradigm refers to the jobs to be accomplished during cloud migration in terms of the examination of current processes, the development of new processes under cloud context, and the determination of the key performance indicators and key ecological indicators for new processes. [S28] proposed a framework, namely Plan-Negotiate-Implement-Check (PNIC), to analyze the customer concerns, categorize them from the perspective of trust and security, and develop a plan for building and sustaining trust. [S29] discussed a cloud migration framework along with a successful migration case study of existing on-premise applications onto cloud using this factory based approach and migration framework. [S50] proposed a flexible deployment environment to migrate existing application using Hadoop. The authors illustrated the migration of a text-mining application by a number of stages towards deployment in a cloud environment.

In [S61] a research model was developed based on the innovation characteristics from the diffusion of innovation (DOI) theory and the technology-organization-environment (TOE) framework. The [S62] study presented an extensible architecture for detecting software systems violations against limited access to the underlying file system or enforced restrictions regarding provided standard APIs. The violation detection process and the highlighting of crucial system parts are essential early-phase activities of the CloudMIG approach to support the migration of legacy systems to the cloud. Based on theoretical models and qualitative interviews, a model of relevant factors was developed. This model provides individual, organizational, technical, and environmental factors influencing the diffusion and acceptance of Cloud Computing among Small and Medium Enterprises (SMEs) [S63]. [S64] discussed the main factors that were identified as playing a significant role in SME adoption of cloud services: relative advantage, uncertainty, geo-restriction, compatibility, size, top management support, prior experience, innovativeness, industry, market scope, supplier efforts and external computing support. [S65] proposes a research model to assess SaaS-adoption at the application level, based on the transaction cost theory, the resource-based view, and the theory of planned behavior.

Finally, ten studies discussed case studies to illustrate the migration process. The [S11] presented a case study moving a traditional FTP server to the cloud implemented on Windows Azure. [S18] discussed the motivation, requirements and feasibility of migrating CiteSeerX digital library to provide an IaaS model in a private cloud are discussed in [S18], the challenges encountered prior to and during the migration and the post-migration issues and possible solutions are reported. In [S24] legacy systems are expanded and updated effectively with the use of open source virtualization server management software cloudstack. The security risk and solution relevant to an EHR (electronic health records) system deployment in a IaaS cloud is presented in [S25] cover only a fraction of the challenges facing a large-scale migration of public e-health systems to IaaS clouds. [S30] discusses when to migrate software testing to the cloud from two perspectives: the characteristics of an application under test, and the types of testing performed on the application. [S31] provides researchers and practitioners with empirical insights into the motivations for and experiences of implementing cloud enterprise systems based on two case studies.

The paper [S41] describes the possibilities of adoption cloud computing in the manufacturing sector and suggests two types of cloud computing adoptions, manufacturing with direct adoption of cloud computing technologies and cloud manufacturing. The migration of an on-premises web application, used on a secondary vocational school, to the cloud was analyzed in [S44]. It then compares the applications performance when deployed to a traditional Windows server versus its deployment to Windows Azure. [S45] abstracts from current market prices and investigates the interaction of cloud provider and clients from an analytical perspective. A general understanding of how providers and clients potentially benefit financially from Infrastructure-as-a-Service (IaaS) can help clients to appraise price uncertainty in strategic resource planning decisions. [S66] report an empirical study aimed at examining cloud computing adoption challenges and difficulties in the context of Small and Medium Enterprises (SMEs) in Ireland.

4.2 The Cost-benefits Relationship in the Adoption and Migration (RQ2)

This subsection discusses how selected papers ad-

dressed RQ2: *Which factors are considered by companies to assess the cost-benefit relationship of adoption and migration to the cloud computing?*

During the analysis of RQ2, we identified that there is a myriad of factors proposed and used to analyze the cost-benefit relationship of cloud computing adoption. There is no consensus of which factors should be used for this end.

In [S3] a formula is defined to calculate the Return of Investments (ROI) of adopting Cloud Computing. An approach to detect performance antipatterns before migrating to CC based on static analysis was presented in [S12]. In [S4] the architectural features of CC are explored and classified according to the requirements of end-users, enterprises, and cloud providers themselves to support the cloud adoption. The [S2] study describes the Cloud Adoption Toolkit that provides a framework and a cost modelling tool to support decision makers. In [S16] the authors presented a compatibility checklist that is used to estimate the cost of application migration to PaaS. The migration of legacy applications to cloud computing was discussed in [S17], focusing on application performance analysis and providers characteristics. [S22] discussed migration of agile based project to cloud in terms of cost, time and quality. [S23] Discusses some of the potential issues and challenges that organizations may face while considering to migrate workloads to cloud: Efficiency, agility, quality, security, governance and standardization in the delivery, consumption and operation of IT services, all at reduced capital and operational expense. In [S32] an analysis of the difficulties of companys traditional accounting system have been investigated. The factors affecting migration and adoption were studied and the best cloud deployment and service models complying with company requirements suggested.

The paper [S33] attempts to reflect on the issues associated with interoperability and portability, but with a focus on vendor lock-in. Moreover, the paper demonstrates the importance of interoperability, portability and standards applicable to cloud computing environments, provides a foundation for future analysis and review regarding the impact of vendor neutrality for corporate cloud computing application and services. In [S34] a critical review of pertinent business, technical and legal issues associated with vendor lock-in, and how it impacts on the widespread adoption of cloud computing was presented. A probabilistic model was adopted to evaluate the decision to migrate to cloud storage against the alternative to buy the storage devices and facilities under a probabilistic model for the evolution of storage characteristics, disk failures, and prices based on the Value-at-Risk as a risk metric [S35]. Within the [S36] study proposes the use of a real option model to help think about when to switch to cloud based on the expected benefits, uncertainties and the value a company puts on money.

The [S37] study how mechanisms, namely, check pointing and migration, can be used to minimize the cost and volatility of resource provisioning. Based on the real price history of Amazon EC2 spot instances, several adaptive check pointing schemes in terms of monetary costs and improvement of job completion times are compared, schemes that apply predictive methods for spot prices and a study how work migration can improve task completion in the midst of failures while maintaining low monetary costs are evaluated. Other study focuses on factors as namely availability, portability, integration, migration complexity, data privacy and security [S38]. Study [S39] identifies and investigates a number of cognitive factors that contribute to shaping user perceptions of and attitude toward mobile cloud computing services by integrating these factors with the technology acceptance model. A structural equation modeling analysis is employed and results reveal that user acceptance of mobile cloud services is largely affected by perceived mobility, connectedness, security, quality of service and system, and satisfaction. A literature review on technological innovation characteristics in this context is conducted to identify potential gaps in ongoing research. The review also provides an overview of relevant empirical studies on cloud computing that are based on the Diffusion of Innovation (DoI) theory (Rogers, 2003) and the Technology Acceptance Model (TAM) (Davis, 1987). Consequently, the focus is set on the examination of the factors compatibility, relative advantage, complexity, image and security & trust [S42].

The [S43] study presents an analysis of how mobile device resources such as energy and bandwidth, along with cloud infrastructure resources, can be managed effectively in the mobile cloud domain. The best practice approaches for implementations is applied to existing works in the area, along with our Context Aware Mobile Cloud Services (CAMCS) cloud middleware and the Cloud Personal Assistant (CPA), the representative of the user within the middleware. In [S44] the cloud model discussed is composed of five essential factors: On-demand self-service, Broad network access, Resource pooling, Rapid elasticity, Measured service. [S51] proposes a tripod model of SaaS readiness that suggests that organizational users need to get prepared from technological, organizational and environmental aspects for the adoption of SaaS. A taxonomy to help profile and

standardize the details of performance evaluation of commercial Cloud services [S52].

In [S53] the de facto metrics adopted in the existing Cloud services evaluation work were collected and arranged following different Cloud service features to be evaluated, which essentially constructed an evaluation metrics catalogue. This metrics catalogue can be used to facilitate the future practice and research in the area of Cloud services evaluation. In [S58] the TOE (Technology-Organization-Environment) framework and HOT-fit (Human-Organization-Technology fit) model were used to investigate the critical factors affecting hospitals decisions regarding the adoption of cloud computing technology. Another study presents five factors influencing the cloud usage: ease of use and convenience, security and privacy, cost reduction, reliability, sharing and collaborating [S59]. The study [S60] discussed how cloud adoption intention, pricing and deployment options were derived from the TOE framework. The authors argued that the preferred pricing strategy results in part from a costbenefit analysis, and the deployment strategy results in part from risk analysis, were important issues that previous cloud studies have seldom investigated.

Table 6: Types of support for the cost-benefit relationship in cloud computing adoption.

Adoption Support Type	Reporting Studies
Experiences and Case Reports	S44
Processes, strategies and frameworks	S2, S3, S12, S14, S16, S17, S23, S32, S33, S34, S35, S36, S37, S38, S43
Tools	S2

4.3 Selecting Cloud Computing Service Providers (RQ3)

This subsection discusses how selected papers addressed RQ3: *How companies select cloud computing service providers according to their needs and profile?*

According to Table 7, eight papers proposed and discussed processes, strategies and frameworks to help companies to select Cloud Service Providers (CSP). Two papers propose tools to support this scenario and one paper focused on case studies to illustrate this situation. In the following paragraphs we contextualize how each of these papers contributes to RQ3.

According to (Garrison et al., 2012), IT-related success is described through three categories of derived benefit: strategic, economic and technological. Strategic refers to an organizations renewed focus on its core business activities that can accompany a move to cloud computing when its IT functions, whole or in part, are hosted and/or managed by a cloud vendor. Economic refers to an organizations ability to tap the cloud vendors expertise and technological resources to reduce in-house IT expenses. Technological refers to an organizations access to state-of-the-art technology and skilled personnel, eliminating the risk and cost of in-house technological obsolescence. Deployment is defined in terms of the strategic, economic,and technological benefits realized through cloud computing, setting the organization apart from its competitors.

Table 7: Types of support for the selection of CSPs.

Selection Support Type	Reporting Studies
Experiences and Case Reports	S56
Process, strategies and frameworks	S26, S40, S46, S47, S48, S49, S54, S57
Tools	S7, S55

According to Figure 2, eleven papers discuss issues related to RQ3. [S56] evaluates Google Compute Engine (GCE) and compare it with Amazon EC2 services to support the deployment of scientific applications. [S26] uses a migration decision support system (MDSS) to select providers. The paper also evaluate the decision support system in a real scenario with two providers (Microsoft Azure e Google). [S40] proposes an approach to support migration of computing infrastructure to the cloud by selecting the most suitable cloud configuration in terms of infrastructural requirements and cost. [S46] proposes a framework to support requirements elicitation to select providers focused on security and privacy issues. The paper [S47] describes in detail an approach to select providers based on multi-criteria decision-making (MCDM) and optimization based approaches. [S48] proposes an approach called Complete-Auditable-Reportable (C.A.RE) to select CSPs The C.A.RE approach helps to determine the adequacy of a CSP sponsored security by assessing its completeness in addressing the possible risks that a service may be exposed to. Paper [S49] proposes an approach that considers Function, Auditability, Governability and Interoperability(FAGI) to help cloud service consumers in selecting a trusted CSP. The [S54] study proposes a taxonomy of eight important Cloud computing elements covering service type, resource deployment, hardware, runtime tuning, business model, middleware, and performance. Another study [S57] proposes a framework SMICloud

that compares differents CSPs and measure QoS attributes defined by Cloud Service Measurement Index Consortium (CSMIC). At last 2 articles presented tools: [S7] that proposed a simulation tool CDOSIM that can simulate cost and performance. It extends the cloud simulator CloudSim and integrates into our cloud migration framework CloudMIG e [S55] that presents a tool called CloudCmp to compare performance and costs of cloud providers by measuring the elastic computing, persistent storage, and networking services. Papers [S46], [S48] and [S49] focus on security and privacy issues to select providers.

This systematic review provides evidence of strategies used by companies to identify opportunities to migrate and adopt cloud computing, how they assess the cost-benefit relationship and strategies behind the rationale to select providers. A spectrum of techniques and approaches has been identified that cope with various concerns, i.e., security and trustworthiness, elasticity, portability and interoperability, and cloud resilience. In addition, many studies look into reference architectures and cloud-based architecture design methods as well.

4.4 Implications for Research and Practice

The following types of validity issues were considered when interpreting the results from this review. *Conclusion validity.* There may be bias in data extraction. However, this was addressed through defining a data extraction form to ensure consistent extraction of relevant data to answering the research questions. The findings and implications are based on the extracted data. *Internal validity.* One possible threat is the selection bias. We addressed this threat during the selection step of the review, i.e. the studies included in this review were identified through a thorough selection process which comprises of multiple stages. *Construct validity.* The studies identified from the systematic review were accumulated from multiple literature databases covering relevant journals and proceedings. One possible threat is bias in the selection of publications. This is addressed through specifying a research protocol that defines the research questions and objectives of the study, inclusion and exclusion criteria, search strings that we intend to use, the search strategy and strategy for data extraction.

5 CONCLUSIONS

This paper presented a Systematic Literature Review (SLR) to identify, classify, and compare existing evidence on the strategies used by companies to identify scenarios of migration opportunities to the cloud, as well as the cost-benefit relationship of this migration and selection of CSP. Far from being anecdotal, the evidences collected and discussed in this SLR have the goal to gain and share insight from the literature so that companies can have more confidence and hence decide towards cloud computing. The major contribution of this paper is to identify new factors as well as to develop a sense of the relative weight of the cost-benefit relationship and the selection of providers and their respective services. As future work, we plan to characterize how providers perceive the clients adoption and migration to the cloud computing paradigm and how they may adjust their strategies to better meet the needs of customers. We also plan to perform the snowballing technique by checking references of the selected studies in order to extend the number of relevant studies related to the research questions.

REFERENCES

Breivold, H. P., Crnkovic, I., Radosevic, I., and Balatinac, I. (2014). Architecting for the cloud: A systematic review. In *Computational Science and Engineering (CSE), 2014 IEEE 17th International Conference on*, pages 312–318. IEEE.

Brereton, P., Kitchenham, B. A., Budgen, D., Turner, M., and Khalil, M. (2007). Lessons from applying the systematic literature review process within the software engineering domain. *Journal of systems and software*, 80(4):571–583.

Buyya, R., Yeo, C. S., Venugopal, S., Broberg, J., and Brandic, I. (2009). Cloud computing and emerging it platforms: Vision, hype, and reality for delivering computing as the 5th utility. *Future Generation computer systems*, 25(6):599–616.

Chen, L. and Babar, M. A. (2011). A systematic review of evaluation of variability management approaches in software product lines. *Information and Software Technology*, 53(4):344–362.

Davis, F. D. (1987). User acceptance of information systems: the technology acceptance model (tam).

Dyba, T. and Dingsoyr, T. (2008). Empirical studies of agile software development: A systematic review. *Information and Software Technology*, 50(9-10):833–859.

Garg, S. K., Versteeg, S., and Buyya, R. (2013). A framework for ranking of cloud computing services. *Future Generation Computer Systems*, 29(4):1012–1023.

Garrison, G., Kim, S., and Wakefield, R. L. (2012). Success factors for deploying cloud computing. *Communications of the ACM*, 55(9):62–68.

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.

Jamshidi, P., Ahmad, A., and Pahl, C. (2013). Cloud Migration Research: A Systematic Review. *IEEE Trans. Cloud Comput.*, 1(2):142–157.

Jula, A., Sundararajan, E., and Othman, Z. (2014). Cloud computing service composition: A systematic literature review. *Expert Systems with Applications*, 41(8):3809–3824.

Kitchenham, B. and Charters, S. (2007). Guidelines for performing systematic literature reviews in software engineering. In *Technical report, Ver. 2.3 EBSE Technical Report. EBSE*.

Li, A., Yang, X., Kandula, S., and Zhang, M. (2010). Cloudcmp: comparing public cloud providers. In *Proceedings of the 10th ACM SIGCOMM conference on Internet measurement*, pages 1–14. ACM.

Li, Q., Wang, C., Wu, J., Li, J., and Wang, Z.-Y. (2011). Towards the business–information technology alignment in cloud computing environment: an approach based on collaboration points and agents. *International Journal of Computer Integrated Manufacturing*, 24(11):1038–1057.

Li, Z., O'Brien, L., Cai, R., and Zhang, H. (2012a). Towards a taxonomy of performance evaluation of commercial cloud services. In *Cloud Computing (CLOUD), 2012 IEEE 5th International Conference on*, pages 344–351. IEEE.

Li, Z., O'Brien, L., Zhang, H., and Cai, R. (2012b). On a catalogue of metrics for evaluating commercial cloud services. In *Proceedings of the 2012 ACM/IEEE 13th International Conference on Grid Computing*, pages 164–173. IEEE Computer Society.

Li, Z., Zhang, H., OBrien, L., Cai, R., and Flint, S. (2013). On evaluating commercial cloud services: A systematic review. *Journal of Systems and Software*, 86(9):2371–2393.

Mahesh, S., Landry, B. J., Sridhar, T., and Walsh, K. R. (2013). A decision table for the cloud computing decision in small business. *Managing Information Resources and Technology: Emerging Applications and Theories: Emerging Applications and Theories*, page 159.

Mell, P. and Grance, T. (2011). The nist definition of cloud computing.

Noblit, G. W. and Hare, R. D. (1988). *Meta-ethnography: Synthesizing qualitative studies*, volume 11. Sage.

Rogers, E. (2003). Diffusion of innovations, 5th edn free press. *New York*.

Tornatzky, L. and Fleischer, M. (1990). The process of technology innovation, lexington, ma. *Lexington Books. Trott, P.(2001). The Role of Market Research in the Development of Discontinuous New Products. European Journal of Innovation Management*, 4:117–125.

Weiss, A. (2007). Computing in the clouds. *Computing*, 16.

Zhang, H., Babar, M. A., and Tell, P. (2011). Identifying relevant studies in software engineering. *Information and Software Technology*, 53(6):625–637.

APPENDIX

Table 8: Studies included in the review.

ID	Author, Title	Venue	Year
S1	J.-F. Zhao and J.-T. Zhou, **Strategies and Methods for Cloud Migration.**	IJAC	2014
S2	A. Khajeh-Hosseini, D. Greenwood, J. W. Smith and I. Sommerville, **The Cloud Adoption Toolkit: Supporting Cloud Adoption Decisions in the Enterprise.** ***Top Ten Cited Paper According to Google Scholar***	SPE	2012
S3	S. C. Misra and A. Mondal, **Identification of a Companys Suitability for the Adoption of Cloud Computing and Modelling Its Corresponding Return on Investment.** ***Top Ten Cited Paper According to Google Scholar***	MCM	2011
S4	B. Rimal, A. Jukan, D. Katsaros and Y. Goeleven. **Architectural requirements for cloud computing systems: an enterprise cloud approach.** ***Top Ten Cited Paper According to Google Scholar***	JGC	2011
S5	M. I. M. Almanea **A Survey and Evaluation of the Existing Tools that Support Adoption of Cloud Computing and Selection of Trustworthy and Transparent Cloud Providers.**	INCoS	2014
S6	S. Frey and W. Hasselbring **An Extensible Architecture for Detecting Violations of a Cloud Environments Constraints during Legacy Software System Migration.**	CSMR	2011
S7	F. Fittkau, S. Frey and W. Hasselbring, **CDOSim: Simulating cloud deployment options for software migration support.**	MESOCA	2012
S8	O. Sefraoui, M. Aissaoui and M. Eleuldj, **Cloud computing migration and IT resources rationalization.**	ICMCS	2014
S9	J. Alonso, L. Orue-Echevarria, M. Escalante, J. Gorronogoitia and D. Presenza, **Cloud modernization assessment framework: Analyzing the impact of a potential migration to Cloud.**	MESOCA	2013
S10	B. Wadhwa, A. Jaitly, and B. Suri, **Cloud Service Brokers: An Emerging Trend in Cloud Adoption and Migration.**	APSEC	2013
S11	L. Zhou, **CloudFTP: A Case Study of Migrating Traditional Applications to the Cloud.**	ISDEA	2013
S12	V. S. Sharma and S. Anwer, **Detecting Performance Antipatterns before Migrating to the Cloud.**	CloudCom	2013
S13	S. N. Srirama, V. Ivanistsev, P. Jakovits, and C. Willmore, **Direct migration of scientific computing experiments to the cloud.**	HPCSim	2013
S14	P. R. M. Andrade, R. G. Araujo, J. C. Filho, T. R. Pereira, A. B. Albuquerque, and N. C. Mendonca, **Improving Business by Migrating Applications to the Cloud Using Cloudstep.**	WAINA	2015
S15	A. Juan-Verdejo, S. Zschaler, B. Surajbali, H. Baars, and H.-G. Kemper, **InCLOUDer: A Formalised Decision Support Modelling Approach to Migrate Applications to Cloud Environments.**	SEAA	2014
S16	Q. H. Vu and R. Asal, **Legacy Application Migration to the Cloud: Practicability and Methodology.**	SERVICES	2012
S17	G. Kousiouris and D. Kyriazis, **Legacy applications on the cloud: Challenges and enablers focusing on application performance analysis and providers characteristics.**	SERVICES	2012

Table 8: Studies included in the review (cont.).

S18	J. Wu, P. Teregowda, K. Williams, M. Khabsa, D. Jordan, E. Treece, C. L. Giles, **Migrating a Digital Library to a Private Cloud.**	IC2E	2014
S19	A. Bergmayr, H. Brunelire, J. L. C. Izquierdo, J. Gorroogoitia, G. Kousiouris, D. Kyriazis, M. Wimmer, **Migrating legacy software to the cloud with ARTIST.**	CSMR	2013
S20	C. Pahl, and H. Xiong, **Migration to PaaS clouds - Migration process and architectural concerns.**	MESOCA	2013
S21	F. Wang, J. Liu, M. Chen and H. Wang, **Migration Towards Cloud-Assisted Live Media Streaming.**	TNET	2014
S22	M. Manuja, **Moving agile based projects on Cloud.**	IAdCC	2014
S23	J. Banerjee, **Moving to the cloud: Workload migration techniques and approaches.**	HiPC	2012
S24	B. Cai, F. Xu, F. Ye and W. Zhou, **Research and application of migrating legacy systems to the private cloud platform with cloudstack.**	ICAL	2012
S25	A. Michalas, N. Paladi and C. Gehrmann, **Security aspects of e-Health systems migration to the cloud.**	HealthCom	2014
S26	V. Andrikopoulos, Z. Song and F. Leymann, **Supporting the migration of applications to the cloud through a decision support system.**	CLOUD	2013
S27	H.-I. Wang, and C. Hsu, **The paradigm framework of cloud migration based on BPR and gBPR.**	ICAwST	2013
S28	S. Saadat and H. R. Shahriari, **Towards a process-oriented framework for improving trust and security in migration to cloud.**	ISCISC	2014
S29	B. P. Peddigari, **Unified Cloud Migration Framework Using factory based approach.**	INDCON	2014
S30	T. Parveen and S. Tilley, **When to Migrate Software Testing to the Cloud?**	ICSTW	2010
S31	T. Boillat and C. Legner, **Why Do Companies Migrate Towards Cloud Enterprise Systems? A Post-Implementation Perspective.**	CBI	2014
S32	M. Sadighi, **Accounting System on Cloud: A Case Study.**	ITNG	2014
S33	B. C. Tak, B. Urgaonkar and A. Sivasubramaniam, **Cloudy with a Chance of Cost Savings.**	TPDS	2012
S34	J. Opara-Martins, R. Sahandi and F. Tian, **Critical review of vendor lock-in and its impact on adoption of cloud computing.**	i-Society	2014
S35	L. Mastroeni and M. Naldi, **Long-range Evaluation of Risk in the Migration to Cloud Storage.**	CEC	2011
S36	C. -Y. Yam, A. Baldwin, S. Shiu and C. Ioannidis**Migration to Cloud as Real Option: Investment Decision under Uncertainty.**	TrustCom	2011
S37	S. Yi, A. Andrzejak and D. Kondo **Monetary Cost-Aware Checkpointing and Migration on Amazon Cloud Spot Instances.**	TSC	2011
S38	N. Phaphoom, X. Wang, S. Samuel, S. Helmer and P. Abrahamsson**A survey study on major technical barriers affecting the decision to adopt cloud services.**	JSS	2015
S39	E. Park and K. J. Kim**An Integrated Adoption Model of Mobile Cloud Services: Exploration of Key Determinants and Extension of Technology Acceptance Model.**	TELE	2014

Table 8: Studies included in the review (cont.).

S40	J. Garca-Galn, P. Trinidad, O. F. Rana and A. Ruiz-Corts**Automated configuration support for infrastructure migration to the cloud.**	FGCS	2015
S41	X. Xu **From cloud computing to cloud manufacturing.** ***Top Ten Cited Paper According to Google Scholar***	RCIM	2012
S42	M. Stieninger, D. Nedbal, W. Wetzlinger, G. Wagner and M. A. Erskine **Impacts on the Organizational Adoption of Cloud Computing: A Reconceptualization of Influencing Factors.**	PROTCY	2014
S43	M. J. OSullivan and D. Grigoras **Integrating mobile and cloud resources management using the cloud personal assistant.**	SIMPAT	2014
S44	P. J. P. da Costa and A. M. R. da Cruz. **Migration to Windows Azure Analysis and Comparison.**	PROTCY	2012
S45	J. Knsemller and H. Karl **A game-theoretic approach to the financial benefits of infrastructure-as-a-service.**	FGCS	2014
S46	H. Mouratidis, S. Islam, C. Kalloniatis and S. Gritzalis. **A framework to support selection of cloud providers based on security and privacy requirements.**	JSS	2013
S47	S. Le, H. Dong, F. K. Hussain, O. K. Hussain, E. Chang, L. Sun, E. Chang.**Cloud service selection: State-of-the-art and future research directions.**	JNCA	2014
S48	M. Ouedraogo and H. Mouratidis **Selecting a Cloud Service Provider in the age of cybercrime.**	COSE	2013
S49	C. Tang and J. Liu.**Selecting a trusted cloud service provider for your SaaS program.**	COSE	2015
S50	F. CRowe, J. Brinkley and N. Tabrizi.**Migrating Legacy Applications to the Cloud.**	CLOUDCOM	2013
S51	Z. Yang, J. Sun, Y. Zhang and Y. Wang.**Understanding SaaS adoption from the perspective of organizational users: A tripod readiness model.**	CHB	2014
S52	Z. Li, L. OBrien, R. Cai and H. Zhang. **Towards a Taxonomy of Performance Evaluation of Commercial Cloud Services.**	CLOUD	2012
S53	Z. Li, L. OBrien, H. Zhang and R. Cai. **On a Catalogue of Metrics for Evaluating Commercial Cloud Services.**	IWGC	2012
S54	R. Prodan and S. Ostermann. **A Survey and Taxonomy of Infrastructure as a Service and Web Hosting Cloud Providers.** ***Top Ten Cited Paper According to Google Scholar***	IWGC	2009
S55	A. Li, X. Yang, S. Kandula and M. Zhang. **CloudCmp: Comparing Public Cloud Providers.** ***Top Ten Cited Paper According to Google Scholar***	IMC	2010
S56	Z. Li, L. OBrien, R. Ranjan and M. Zhang. **Early Observations on Performance of Google Compute Engine for Scientific Computing.**	CLOUDCOM	2013
S57	S. K. Garg, S. Versteeg and R. Buyya. **A framework for ranking of cloud computing services.** ***Top Ten Cited Paper According to Google Scholar***	FGCS	2013
S58	J. W. Lian, D. C. Yen, Y. T. Wang**An exploratory study to understand the critical factors affecting the decision to adopt cloud computing in Taiwan hospital.**	IJIM	2014

Table 8: Studies included in the review (cont.).

S59	P. Gupta, A. Seetharaman, and J. R. Raj. **The usage and adoption of cloud computing by small and medium businesses.** ***Top Ten Cited Paper According to Google Scholar***	IJIM	2013
S60	P. F. Hsu, S. Ray and Y. Y. Li-Hsieh. **Examining cloud computing adoption intention, pricing mechanism, and deployment model.**	IJIM	2014
S61	T. Oliveira, M. Thomas and M. Espadanal. **Assessing the determinants of cloud computing adoption: An analysis of the manufacturing and services sectors.**	IM	2014
S62	S. Frey, W. Hasselbring and B. Schnoor. **Automatic conformance checking for migrating software systems to cloud infrastructures and platforms.**	JSEP	2013
S63	M. Stieninger and D. Nedbal. **Diffusion and Acceptance of Cloud Computing in SMEs Towards a Valence Model of Relevant Factors.**	HICSS	2014
S64	Y. Alshamaila, S. Papagiannidis and F. Li. **Cloud computing adoption by SMEs in the north east of England.** ***Top Ten Cited Paper According to Google Scholar***	JEIM	2013
S65	A. Benlian, T. Hess and P. Buxmann. **Drivers of SaaS-Adoption An Empirical Study of Different Application Types.** ***Top Ten Cited Paper According to Google Scholar***	BISE	2009
S66	M. Carcary, E. Doherty and G. Conway. **The Adoption of Cloud Computing by Irish SMEs an Exploratory Study.**	EJISE	2014