Requirements Engineering for Cloud Systems: *A Mapping Study Design*

Fernando Wanderley[1,2], Eric Souza[2], Miguel Goulão[2], Joao Araujo[2], Gilberto Cysneiros[3], and Ananya Misra[4]

[1] Universidade Católica de Pernambuco, UNICAP, CCT, Brazil
fernando@unicap.br
[2] Universidade Nova de Lisboa, UNL, NOVA LINCS, Portugal
[3] Universidade Federal Rural de Pernambuco, UFRPE, Brazil
[4] Middle East Technical University, NCC, Turkey

Abstract. Cloud Computing gets increasingly established in industrial practice as an option for modelling cost-efficient and demand-oriented information systems. Despite the increasing acceptance of cloud computing within the industry, many important questions remain unanswered. Issues related to the best software architectures decisions for cloud-based systems are faced with the question of appropriate techniques applying at early phase like requirements engineering. The goal of this paper defines a design of a mapping study to verify and identify the existence of relevant research gaps, which refers mainly to requirements models, tools or methods for cloud systems (SaaS). The conclusion of this mapping study design reinforces and actively encourages the necessity of the complete execution (and replication) of a systematic mapping study regarding the synergy of requirements engineering (e.g.: with model-driven issues) applied for a cloud computing.

Keywords: Requirements Engineering, Cloud Systems, SaaS, Systematic Review, Mapping Study

1 Introduction

Cloud computing is considered a benefit for the small businesses because through it they will have access to technologies that before weren't accessible for them in terms of money spending; and these is an advantage for them because they can start competing with other small businesses or even with big ones. The cost implied for someone to come and fix/ install an application will be cut down and the company will save money, it is cheaper to use applications that are on cloud then to buy other ones, there is the possibility to use one multi-application cloud service for all the needs of the company, the applications that exist on the cloud will integrate perfectly within the company because of the API that is helping to find the application that is compatible with the companies goals. Because cloud computing is updated regularly the company doesn't need to spend money for this. Cloud computing is a way for companies to cut the expenses of the company.

Therefore, cloud computing has the potential to meet both enterprises' and individual end-users' needs, as observed by Marston *et al.* [4] and Kim [1]. While cloud computing has already found its way into industrial practice, there continue to be significant deficits in the scientific basis [1]. One such shortfall is requirements engineering (RE) for cloud computing. While some initial research initiatives have been carried out under the sub-domain of Software as a Service (SaaS) [1,3], none has yet been made for cloud computing overall.

Cloud computing brings numerous challenges in this area since the traditional methods need to be adapted and new RE methods [5], including the requirements modelling, has to be investigated. More specifically, the success of adopting the new paradigm highly depends on the degree to which requirements are correctly understood by both service providers and consumers (in cloud context) [5,6].Thus, as per context described above, the primary goal of this paper is to produce a consistent design of a systematic mapping study [8]. The protocol proposed here has an intentionality to find out a brief overview of the current practice, in an industry and academic contexts, for requirements engineering (eliciting and modelling) approaches for cloud computing services (especially for SaaS platform).

Thus, a protocol was developed to define the main guidelines for conducting this study. According to Brereton [9], a systematic mapping study is used to describe the kinds of research activity that have been undertaken and describes the studies rather than extracting specific details. That is, it does provide a context for the later synthesis. According to Kitchenham [7], a systematic map is a method that can be conducted to get an overview of a particular research area. After this, the state of evidence on specific topics can be investigated using a systematic review, if necessary. According to Budgen and others [10], in systematic mapping study, the research question itself is likely to be much broader than in a systematic review. It is necessary, to address the wider scope of the study. For constraints questions (this paper reports a just pilot) for a systematic mapping study in the available literature, including academic and industrial publications. It's important to detach that our first goal was to verify the research gaps in the requirements engineering deeply (especially requirements elicitation and modelling activities for cloud systems - SaaS platform). The mapping study [7,8,9] objective was to verify if exists relevant gaps, challenges and opportunities for requirements engineering researchers, as well as to guide practitioners regarding describing what is involved in the adoption of current cloud technologies.

Our research method and findings are described in the remainder of this paper. First, we discuss a brief background (Section 2) on cloud computing and related concepts; Next (Section 3), we describe the systematic mapping study process, including the search protocol (search string and index research databases), the adopted criteria and some interesting data related to the study. In Section 4 we present the pilot execution. Section 5 presents the result of the pilot execution. Section The next section (Section 6) we discussion main threats to validity identified in the review. 7 describe a brief discussion of results and, finally,(Section 8) the conclusions of this study.

2 Background

Cloud computing is a way of computing that has as main base sharing computing resources instead of having local servers or personal devices to give access to applications. The word cloud from cloud computing is used as a another name for the internet, so cloud computing means a type of internet based computing, where services are delivered to organizations with the help of the internet. The concept of cloud did not arise as a new technology model but as the integration of technologies from the past [3], which resulted in a new way to use and provide computing power as a service through the Internet.

The impact of cloud computing brings changes not only in terms of the global performances of a company, but also in terms of internal organization, especially in the IT department. This opportunity is modifying the usual methods of back-up for data, cloud computing is bringing new tools and new perspectives of evolution for the company that is using it. *"Clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically reconfigured to adjust to a variable load (scale), allowing also for optimum resource utilization. This pool of resources is typically exploited by a pay-per-use model in which guarantees are offered by the Infrastructure Provider by means of customized Service Level Agreements SLAs" [3, 4].*

One technical commonly cited and largely accepted definition is provided by the United States Government's National Institute of Standards and Technologies (NIST) [2], which in its 16th and final report related to this area in 2011:

"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". The cloud model, mentioned in the NIST's definition, is composed of five essential characteristics: on-demand self-service, broad network access, resource pooling, rapid elasticity and measured service.

3 A Systematic Mapping Study Process

In this study, as a mapping study pilot to verify the feasibility of the future replication, we followed a formal systematic literature review process [7, 8, 9]. A systematic mapping study (as well a Systematic Literature process) proposes a fair assessment of the research topic as it uses a rigorous and reliable review methodology, together with auditing tasks to reduce the researcher bias [9].

There are several reasons to perform a systematic re view, and the usual ones are [8,9]:

- To review existing evidences about a reminder or a technology;
- To identify research gaps in current research;

– To provide a framework/background for new research activities and;
– To support the generation of new hypotheses.

Based on the motivation described above, the second reason fits the purpose of this review. Our goal in this definition of a pilot of the mapping study is very if exist relevant research gaps, forwarding to a replication (more rigorous) in a systematic study of this topic. Furthermore, the initial results achieved with the review can also provide a background for new researchers interested in requirements engineering (eliciting methods, models or tools) for cloud computing environments.

The systematic review described here was based on Kitchenham and Charters' guidelines [7], which is divided in three main phases: Planning, Conduction and Reporting. Each of these phases contains a sequence of stages, but the execution of the overall process involves iteration, feedback, and refinement of the defined process, according to Figure 1.

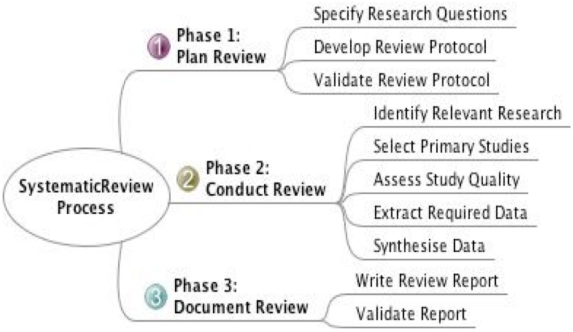

Fig. 1. Mind Map of Systematic Review.

3.1 Specify Research Question

As described before, the objective of this review is to find out answers about the *current state of the art and current challenges of the requirements engineering approaches for cloud computing.*

According to the systematic review process [7, 8], we frame our research goal according to the **PICOC** (**P**opulation, **I**ntervention, **C**omparison, **O**utcome, and **C**ontext) structure.

Thus, the research goal was defined as:

"What requirements engineering approaches have been proposed for cloud computing?"

Table 1. PIPOC Applying

Population	The most recent works related with the treatment of the requirements engineering approaches (elicitation, analysis or modelling tasks) with the new issues and challenges introduced by cloud computing environment. Thus, Requirements Engineers and Requirements Engineering researchers compose the population, seeking to provide a set of new challenges through of the current state of the art, as well as the others stakeholders like Cloud Service Providers, Cloud Service Consumers and Cloud Server Creators.
Intervention	Requirements engineering approaches for development of the cloud-based systems.
Comparison	Not applicable: our intention is to classify the existing requirements engineering approaches for cloud computing to identify challenges and the current state of the art, not to compare the approaches with other approaches.
Outcomes	The objective of this study is revealing existing gaps between requirements engineering approaches and the new dynamic environment of the cloud computing.
Context	Research papers. We are working in a research context with experts in the domain as well as other practitioners, academics, consultants and students.

3.2 Search String and Research Sources

Based on the structure and the research question, keywords were extracted and used to search the primary studies. Furthermore, sophisticated search strings could then be constructed using Boolean *AND* and *OR* operators. Thus, we final search string was defined as: *"requirements engineering" AND "cloud computing"*. In the next sections (Discussion) we'll detail the reason and a primary rationale to simplify the research string only in these two keywords.

The search for primary studies was based on the following digital libraries: ACM Digital Library, IEEE Computer Society Digital Library, SpringerLink, and Science Direct. These searches had as target some journals and conferences, which are detailed in *Appendix A*, but if relevant results from different journals or conferences were found, they were not discarded. These libraries were chosen because they are some of the most relevant sources in software engineering [8, 9].

3.3 Primary Study Selection

We defined inclusion and exclusion criteria to help selecting the relevant studies for analysis and data extraction through reading of following studies' sections: title, abstract, and conclusion. We included peer-reviewed papers from journals and conferences, that presented requirements engineering approaches for cloud computing (I1). Additionally, we plan to use snowball search by including relevant studies cited by authors of the papers we read during the conduction process (I2). On the other hand, we excluded informal literature (slide shows, conference reviews, informal reports), secondary and tertiary studies (reviews, surveys) and studies from conferences, workshops and journals without peer-review (E1), duplicated studies (E2), studies that did not answer the research questions(E3),

studies that were not written in English (E4), and papers that were not available for download from the source bases (E5).

Aiming at improving the understanding of the area and facilitating the data extraction, we decomposed our Research Question according to two perspectives: context and validation. In relation to context perspective, we wish to analyse: *What is the requirements model used by approach?*, *What is the requirements engineering area that the approach has focused?*, and *What is the coverage of approach to cloud infrastructure with respect to SaaS, Paas or IaaS?*

Regarding the validation perspective, we wish to analyze: *How is the approach evaluated?*

3.4 Quality Assessment

Although there is no agreed definition of what a high quality study is, there is a common agreement that the quality of the chosen primary studies is critical for obtaining trustable results in systematic literature reviews and mapping studies. Thus, we will select studies published in the best conferences and journals of area. In *Appendix A* we described some of these journals and conferences.

4 Pilot Execution

This work aims to perform a pilot of research protocol to evaluate its complete applicability in the future. In addition, this paper is a deliverable to Empirical Software Engineering discipline of the doctoral course in Science Computer of New University of Lisbon.

For execution of the pilot, we ran the search string in IEEE Xplore (returning 48 studies), ACM Digital Library (returning 4 studies), Science Direct (returning 97 studies) and SpringerLink (returning 270 studies). Furthermore, we selected a subset of studies (first four papers) returned from each source library to evaluate the research protocol. Table 2 depicts the set of evaluated studies.

4.1 Filtering Process

After to define the studies that should be evaluated, we applied the inclusion and exclusion criteria (with exception of I2 - snowballing approach) and read the title, abstract and conclusion of selected studies; we discovered that some topics of the papers were different to that of our study. These filtering process decreased the number of selected studies from 12 to 9. The Table 3 lists the result of the filtering process.

Once the filtering process was completed, we verified the journals and conferences where the studies were published to assess the quality of our research. This process eliminate more 2 studies (ID8 and ID9).

Table 2. Set of Evaluated Studies

ID	Paper Title	Source
1	Table of Contents (CLEI)	IEEE
2	Modelling secure cloud systems based on system requirements	IEEE
3	Requirements Engineering process for Software-as-a-Service (SaaS) cloud environment	IEEE
4	Pattern-Based Support for Context Establishment and Asset Identification of the ISO 27000 in the Field of Cloud Computing	IEEE
5	Crowd-centric Requirements Engineering	ACM
6	Cloud adoption: prioritizing obstacles and obstacles resolution tactics using AHP	ACM
7	Towards bridging the communication gap between consumers and providers in the cloud	ACM
8	Cloud adoption: a goal-oriented requirements engineering approach	ACM
9	Global Collaboration Requirement Analysis System in Cloud Computing	ScienceDirect
10	A goal-oriented simulation approach for obtaining good private cloud-based system architectures	ScienceDirect
11	Energy-Aware Profiling for Cloud Computing Environments	ScienceDirect
12	Cost-aware challenges for workflow scheduling approaches in cloud computing environments: Taxonomy and opportunities	ScienceDirect
13	Requirements Engineering for Cloud Computing in University Using i*(iStar) Hierarchy Method	SpringerLink
14	Requirements Engineering for Security, Privacy and Services in Cloud Environments	SpringerLink
15	A Methodology for the Development and Verification of Access Control Systems in Cloud Computing	SpringerLink
16	Requirements Engineering for Cloud Computing: A Comparison Framework	SpringerLink

Table 3. Filtering Process

Criteria	IEEEXplore	ACM	ScienceDirect	Springerlink	Total
I1	ID1, ID2, ID3, ID4	ID5, ID6, ID7, ID8,	ID9, ID10, ID11, ID12	ID13, ID14, ID15, ID16	16
E1	ID1	-	-	-	15
E2	-	-	-	-	15
E3	-	-	ID11, ID12	ID15	12
E4	-	-	-	-	13
E5	-	-	-	ID13, ID14, ID16	9

5 Pilot Result

This section presents the results of the mapping study (piloting) for the resulting research questions. Initially, we present a demographic data and, soon after, the research result.

5.1 Demographic Data

The goal of our demographic analysis was verify where the requirements engineering for cloud approaches have been published. The Figure 2 shows the distribution in relation to the research databases, using as main databases of our protocol. The SpringerLink has the major percentage (64%), the second one was the Science Direct with 23%, after that the IEEE with 12% and with 4 studies (1%) of total the ACM portal.

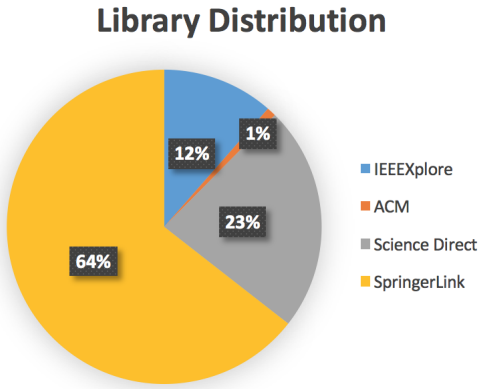

Fig. 2. Library Distribution

The result of this pilot shows that most publications have been published in conferences (86%), follows to journals (14%). Despite the count of selected studies is not statistically significant, we suspected that most part of publication is in conferences because the approaches are not mature enough, maybe because the research area is still recent. The Figure 3 presents the venue distributions.

5.2 What is the requirements model used by approach?

The authors did not specify a requirement model used by their approaches in 3 studies (ID3, ID5, and ID7). The Figure 4 presents the distribution of studies according the requirements model. In ID3 the authors evolve by considering a CMMI modification by adding a new element in such a process, specifically devoted to SaaS and proposed a modification in the traditional Requirements Engineering process. The ID5 presents a method for requirements engineering where users become primary contributors, resulting in higher-quality requirements and increased user satisfaction. Finally, the study ID7 presents a platform which will act as a cloud resources marketplace, allowing consumers to input their needs and providing them with matching cloud services. The most requirement model used in the approaches was goal-oriented (ID2, ID6, and ID10).

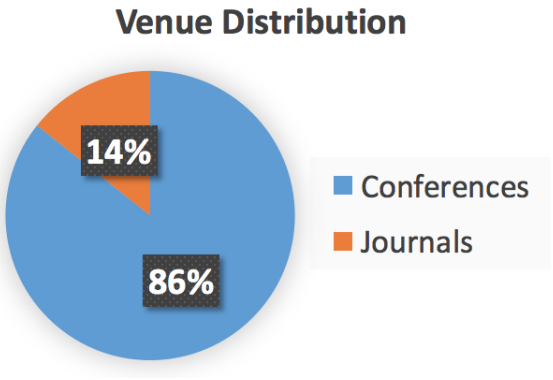

Fig. 3. Venue Distribution

In ID2, the authors demonstrate how components of the cloud infrastructure can be identified from existing security requirements models using goal-oriented model. The ID6 proposes a novel systematic method for prioritising obstacles and their resolution tactics using Analytical Hierarchy Process (AHP). Finally, the study ID10 proposes a goal-oriented simulation approach for cloud-based system design whereby stakeholder goals are captured, together with such domain characteristics as workflows, and used in creating a simulation model as a proxy for the cloud-based system architecture. The ID4 is the unique study using UML. it presents a way to support the asset identification described in ISO 27005 focusing on the scope of cloud computing systems. The ISO 27005 is a well-established series of information security standards.

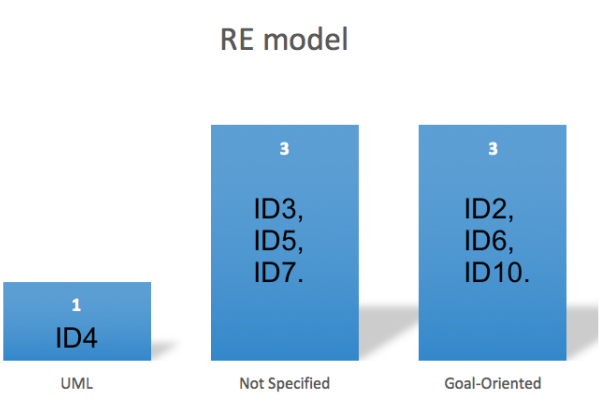

Fig. 4. Requirement Model Distribution

5.3 What is the requirements engineering area the approach has focused?

The two most Requirements Engineering area which the studies have focused is Requirements Analysis (37%) and Requirements Elicitation (27%), followed by Requirements Prioritization (18%) and Requirements Specification (18%). The Figure 5 presents the distribution of studies according the Requirements Engineering Area.

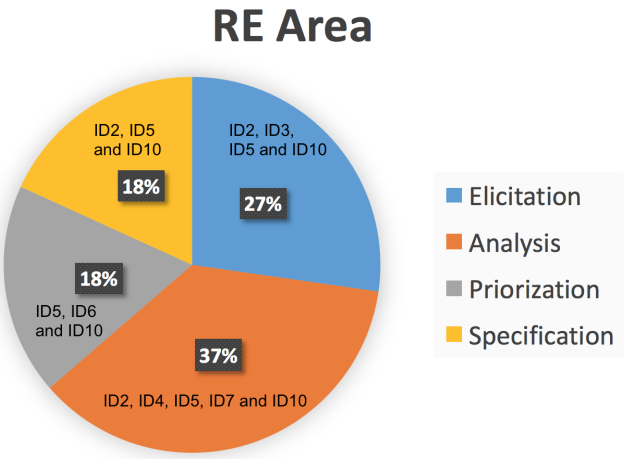

Fig. 5. Requirements Engineering Area Distribution

5.4 What is the coverage of approach with respect to Cloud Service Model (SaaS, Paas or IaaS)?

Regarding the coverage of approaches with respect to Cloud Service Model, we verified that SaaS was the most researched cloud layer with 5 studies (ID2, ID3, ID4, ID7, and ID10), followed by PaaS with two studies (ID4 and ID10). We also note that two studies does not specify the cloud service layers (ID4 and ID10) and no study focuses on IaaS. It is important to notice that all studies focusing on PaaS, also focus on SaaS. The Figure 5 depicts the Cloud Coverage Distribution.

5.5 How is the approach evaluated?

The most part of approaches found have been evaluated through examples (57%) and, subsequently, case study (29%). This suggests that the area of research is still immature. The Figure 7 depicts the study evaluation Distribution.

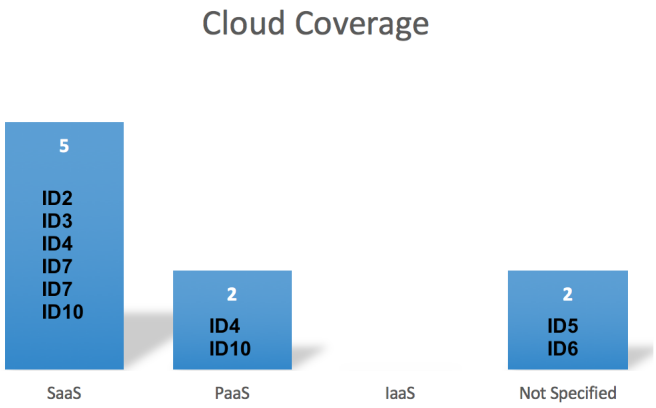

Fig. 6. Cloud Coverage Distribution

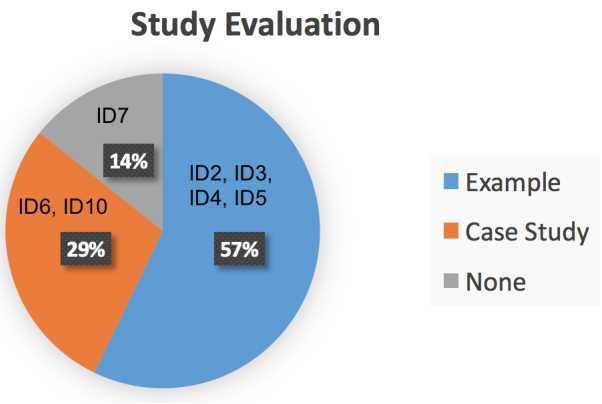

Fig. 7. Evaluation Distribution

6 Threats to Validity

The threat to validity of this study are related to potential problems in the completeness of our search queries, the primary studies selection process, and potential inaccuracies in data extraction, classification and interpretation.

Because of this, all steps were independently validated by PhD students who are not authors of this paper. The goal was to mitigate possible bias in selecting or interpreting the studies, hence minimizing the risk of not including the relevant papers or not interpreting the author's goal correctly.

7 Discussion

This work had an initial motivation: to elaborate a protocol of a mapping study with focus on identify relevant research gaps in requirements modelling strategies (models or tools) for cloud systems, specially to SaaS platform. So, the first search string that we had defined cited keywords as: "model-driven" and their variations with "Requirements Analysis" OR "Requirements Elicitation" for examples, but the first calibration test of this string showed us a minimal set of works (models or tools) using model-driven techniques applied in Requirements Engineering for Cloud Systems. This is the rationale to define our search string more embracing with these two keywords.

One first reason for this after-clap is probably correlated with the "Cloud" - is new hype technology - this term has also been used in various contexts such as describing large ATM networks in the 1990s. However, it was after Google's CEO Eric Schmidt used the word to describe the business model of providing services across the Internet in 2006, that the term really started to gain popularity. So, it's a good indication that is a hot research topic when combine with Model-Driven in Requirements Engineering for Cloud Computing.

What is point out here for us, which a good challenge for new Requirements Engineers Researcher, of course, with a clear care of execute a systematic study to prove this hypothesis.

Regarding to increase our suspicion about no exists relevant primary studies point out RE tools of models for Cloud Computing, the recent tertiary study [21] reported has identified 53 unique SLR from 64 publications in the period 2006-2014. This tertiary study paper represents the first ever tertiary study in the RE research literature and just reinforce the necessity of the execution of a formal and systematic review process in our topic here: requirements engineering (eliciting and modelling) for cloud Computing.

Also according this recent tertiary study, two central SLR(s) was performed with the goal to identify gaps in Security Requirements (Non-Functional Requirements) for cloud systems and cloud infrastructure.

Thus, there are many primary studies referencing the methods (or process) and tools applied in requirements analysis, see Fig 7, (notedly non-functional requirements - security requirements - and important studies with goal-oriented approaches to verify the essential conflicts in choice of cloud providers to establish the cost involved.

Another important point of this protocol is the exclusion criteria definition, the quality assessment. Because, the requirements engineering with model-driven for cloud is very recent topic (all these areas together). For this reason, some papers probably are founded in work in progress, and thus, indexed in Workshops or in a not very relevant conferences. In others words, this protocol requires a reflection about the quality assessment of the "work in progress" intending improve the set of selected papers and consequently their discussion about our research questions.

And a final and not more important question was an limited access of the important papers (e.g: ID13, ID14 e ID16) letting us with a just choice of the

send an email to authors. So, we need more time, waiting their considerations in send us his papers.

8 Conclusion

The goal of this work was identify the feasibility of the protocol in a future replication on the systematic literature review process. This paper aims to perform a pilot execution of a research protocol to evaluate the complete applicability of a systematic mapping study. Our research question, *"What requirements engineering approaches have been proposed for cloud computing?"*, was analysed from the point of view of its context and evaluation perspectives. From the initial 419 papers obtained by querying the most relevant four research libraries, we selected a subset these studies only for evaluation. The results obtained in this pilot encourages to the full execution of research as future work.

Acknowledgment

This research is supported by the UNICAP, NOVA LINCS Research Laboratory (Ref. UID/CEC/04516/2013), and the programa Ciência sem Fronteiras from CAPES.

References

1. W. Kim, "Cloud Computing: Today and Tomorrow," Journal of Object Technology, vol. 8, no. 1, pp. 65-72, 2009.
2. NIST Definition of cloud computing v15, NIST, Editor. 2009, National Institute of Standards and Technology: Gaithersburg, MD (2009).
3. R. Buyya, C. S. Yeo, S. Venugopal, J. Broberg, and I. Brandic, "Cloud Computing and Emerging IT Platforms: Vision, Hype, and Reality for Delivering computing as the 5th Utility," Future Generation Computer Systems, vol. 25, no. 6, pp. 599-616, 2009.
4. S. Marston, Z. Li, S. Bandyopadhyay, J. Zhang, and A. Ghalsasi, "Cloud Computing - The Business Perspective," Elsevier Decision Support Systems, vol. 51, pp. 176-189, 2011.
5. B. Verlaine, I. J. Jureta, and S. Faulkner, "Towards Conceptual Foundations of Requirements Engineering for Services," Proc. RCIS 2011: Fifth International Conference on Research Challenges in Information Science, pp. 1-11, Gosier, 2011.
6. L. Liu, E. Yu, and H. Mei, "Guest Editorial: Special Section on Requirements Engineering for Services - Challenges and Practices," IEEE Transactions on Services Computing, vol. 2, no. 4, pp. 318-319, 2009.
7. Kitchenham, B. Guidelines for performing Systematic Literature Reviews in Software Engineering. vol 2. 3 EBSE Technical Report. 2007.
8. Petersen, K., Feldt R., Mujtaba, S., Mattsson, M. Systematic Mapping Studies in Software Engineering. In: 12th International Conference on Evaluation and Assessment in Software Engineering. 2008.

9. Brereton, P., Kitchenham, B., Budgen D., Turner M., Khalil, M. Lessons from applying the systematic literature review process within the software engineering domain. The Journal of Systems and Software. pp 571-583. 2007.
10. Budgen, D., Turner, M., Brereton, P. Kitchenham, B. Using Mapping Studies in Software Engineering. Proceedings of PPIG 2008, pp. 195–204. 2008.
11. Vaquero L.M., Rodero-Merino L., Caceres J, Lindner M. (2009) 'A Break in the Clouds: Towards a Cloud Definition' ACM SIGCOMM Computer Communication Review 39, 1 January 2009.
12. T. Alford, G. Morton, The Economics of cloud computing, Booz Allen Hamilton, 2009.
13. L. Wang, G. von Laszewski, A. Younge, X. He, M. Kunze, J. Tao, and C. Fu, "Cloud Computing: a Perspective Study," New Generation Computing, vol. 28, no. 2, pp. 137–146, 2010.
14. Y. Chen, X. Li, and F. Chen, "Overview and analysis of cloud computing research and application," in E -Business and E -Government (ICEE), 2011 International Conference on, 2011, pp. 1–4.
15. G. Candea, S. Bucur, and C. Zamfir, "Automated software testing as a service," in Proceedings of the 1st ACM symposium on Cloud computing, ser. SoCC '10. New York, NY, USA: ACM, 2010, pp. 155–160.
16. W. K. Chan, L. Mei, and Z. Zhang, "Modeling and testing of cloud applications," in Services Computing Conference, 2009. APSCC 2009. IEEE Asia-Pacific, 2009, pp. 111–118
17. M. Armbrust, A. Fox, R. Griffith, A. D. Joseph, R. Katz, A. Konwinski, G. Lee, D. Patterson, A. Rabkin, I. Stoica, and M. Zaharia, "A view of cloud computing," Commun. ACM, vol. 53, no. 4, pp. 50–58, 2010.
18. B. P. Rimal, E. Choi, and I. Lumb, "A Taxonomy and Survey of Cloud Computing Systems," in INC, IMS and IDC, 2009. NCM '09. Fifth International Joint Conference on, 2009, pp. 44–51.
19. Chung, L., et al., A goal-oriented simulation approach for obtaining good private cloud-based system architectures. J. Syst. Software (2012)
20. Zardari, S., Bahsoon, R., 2011. Cloud adoption: a goal-oriented requirements engineering approach. In: Proceedings of the 2nd International Workshop on Software Engineering for Cloud Computing, pp. 29–35
21. M. Bano, D. Zowghi, and N. Ikram, "Systematic reviews in requirements engineering: A tertiary study.," EmpiRE, pp. 9–16, 2014.

Appendix A: Journals and Conferences

The selected target journals were:

- ACM Computing Survey;
- Requirements Engineering Journal;
- Annals of Software Engineering;
- IEEE Software;
- IEEE Transactions on Software Engineering;
- International Journal of Systems and Service oriented Engineering;
- Journal of Network and Computer Applications;
- Information and Software Technology;
- Journal of Systems and Software;

– Software and System Modelling;
– Computers and Electrical Engineering;
– Software Practice and Experience; and
– Future Generation Computer Systems;

And the target conferences were:

– Computer Software and Applications Conference (COMPSAC);
– International Requirements Engineering (RE);
– International Conference on Software Engineering (ICSE);
– International Conference on Cloud Computing (CLOUD);
– International Conference on Web Services (ICWS);
– International Conference on Service Computing (SCC);