Cloud Maturity Model

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Abstract. *Organizations are trying to migrate their IT Services and/or IT-enabled Services to the Cloud without having the needed knowledge to perform that change. This lack of knowledge delays the migration, thus postponing the benefits of the Cloud. In a previous publication we proposed the Cloud Maturity Model, a set of key activities to help organizations migrate their services to the Cloud based on the Capability Maturity Model Integrated (CMMI) and the outsourcing lifecycle. In this paper we demonstrate the Cloud Maturity Model in three real world organizations from different sectors that have migrated at least some services to the cloud. We conclude that the proposed solution was accepted and that organizations found it useful.*

Keywords: Cloud Computing, Maturity Model, Outsource, Lifecycle, IT Services, IT-enabled Services.

1 Introduction

Cloud computing appears as a new outsourcing buzz word and as a consequence of the technological evolution and the evolution of a distinctive service based perspective on computing [1,2]. Organizations started to move their services into the Cloud computing environment hoping to reduce costs and, at the same time, adopt services that are at least equivalents to the ones used in-house; that help to hide unnecessary complexity; that are automatically managed; and that allows tailoring the provided service.

Nevertheless, challenges such as security and legal issues, or be connected to a single Cloud provider can demote an uninformed and resource less client from moving to Cloud. Although these challenges the Cloud market will experience a significant grow rate in the upcoming years [1,2,3].

Due to its novelty, **Cloud computing has few guidelines and best practices available to help customers deciding what services migrate to Cloud and then how to manage those services** [4]. To solve this problem we propose the use of a lifecycle approach, in order to decompose the migration and management into discreet and manageable steps [4,5], and the creation of a maturity model for that lifecycle, which will provide an improvement path and an assessment way for each phase of the lifecycle in order to mature them. Thus, our proposal is a method based on a **Cloud Maturity Model**.

In order to demonstrate the proposed method we performed three demonstrations in three organization from different sectors. After that, using the results from those interviews, we evaluated the proposed method using the Moody and Shanks Quality Management Framework, and the Österle four principles [6] were used to evaluate the research.

Finally, this research was conducted using the Design Science Research Methodology (DSRM) since its propose is to create and evaluate artifacts that solve relevant organizational problems [7], and is structured accordingly with the DSRM steps.

2 Problem

In this section we will perform the *problem identification and motivation* step of DSRM. This step defines the specific research problem and justifies the value of the solution.

Nowadays, Cloud computing is experiencing fast adoption and a significant market growth, a trend which is expected to continue [3], **Fig. 1**.

Cloud adopters are moving to Cloud searching for costs benefits, increased flexibility and scalability, and the swift change from a Capital Expense (CapEx) to an Operational Expense (OpEx) model [4,5].

Fig. 1. Cloud Computing Market Forecasts ($bn) [3]

Nevertheless, clients are struggling to understand and overtake several issues and challenges. The most significant risks perceived by clients are Data security and privacy; Data being housed offshore; Exit strategy and lock-in risk; and Compliance/regulatory issues [2].

Those challenges and issues lead to uncertainty among the organizations when they think about moving to Cloud. Conway and Curry [4] argue that in order to overcome the challenges and issues, organizations need systematic means for reviewing their business needs and weighing the potential gains and opportunities brought by the Cloud against the challenges and risks. This way organizations will do a transition to Cloud based on a well-planned and understood strategy. The authors also argue a management framework for how a Cloud migration should be done and managed is needed . However, due to its novelty and fast evolution, Cloud computing has no guidelines or best practices available.

After analyzing the above challenges we define the problem as: organizations do not have a systematic approach, e.g., maturity models, to allow them to migrate and manage their services into Cloud. In particular, we define this research problem as: **many organizations do not know how to move and manage their services in the Cloud**.

The importance of solving this problem is related to the importance of guidelines and best practices, e.g., maturity models and frameworks. Considering this, the solution for the presented problem will provide a set of best practices and how those practices should be implemented and improved. By doing this, the solution provides organizations with a systematic means of migrating and managing their services in the Cloud.

3 Related Work

In this section we will infer the goals of the solution through the related work and the problem definition step *definition of the objectives for a solution* of DSRM. In order to do it, we do a brief explanation about Outsourcing, Cloud Computing and Maturity Models. After that, we analyze an existing solution and argue why it does not solve our problem. Finally, we put together the related work and infer our goals to the solution.

3.1 Outsourcing

When outsourcing, organizations can choose what to outsource and where to outsource. Within the current literature, organizations can outsource their IT, or part of it, to an external organization or/and their business processes, or part of it. Regarding the location options clients can chose among Offshore outsourcing, Nearshoring outsourcing, Onshoring outsourcing, Rural outsourcing and Insourcing [1,2].

To help organizations manage their outsourcing process, Cullen et al. [8] have proposed an approach based on a lifecycle. This approach consists of four phases and nine building blocks. Each phase has one or more building blocks and each building block has several key activities.

This approach allows organizations to achieve better results from outsourcing [8]. Furthermore, it allows organizations to break down the process of outsourcing into discrete and manageable steps, thus allowing an organization to gather correct information in order to make a decision before moving to the next step, minimizing the risk, and committing resources to only one step at a time [4,5].

3.2 Cloud Computing

Willcocks and Lacity [1,2] see Cloud computing as a consequence of the technological evolution (based on virtualization and shared computer resources) and the evolution of a distinctive service based perspective on computing. Furthermore, they also look into Cloud computing as an evolution of outsourcing.

In this research we used the Cloud definition, the five essential elements, the five essential characteristics, and the four deployment models defined by the National Institute of Standards and Technology (NIST) [9].

Willcocks and Lacity [1,2] have presented a "desires framework" for Cloud computing: equivalence; abstraction; automation; and tailoring. However, when moving to the Cloud, managers need to look into the challenges they will face. Willcocks and Lacity [1,2] also defined four major challenges: weighing up the security and legal risks; the definition of the contract; the lock-in dilemma; and managing the Cloud.

As in the case of outsourcing, a lifecycle approach has also been suggested to mitigate the migration and management issues of the Cloud.

This approach has been proposed by Lindner et al. [5] and it is based on the outsourcing lifecycle mentioned in the Outsourcing section. The model is focused on the migration of IT services to the Cloud and has four phases and nine steps. Each phase has one or more steps and each step provides one or more outputs.

A lifecycle approach allows activities to be divided into discreet manageable steps, enabling organizations to smoothly migrate and manage their services into the Cloud and simultaneously minimize the associated risks [5].

3.3 Maturity Models

Maturity approaches came from the field of quality management [10] and were extended to the IT field in order to manage software development [11]. Later on, those approaches were applied to organizations' processes.

Maturity is described as *the state of being complete, perfect or ready* [12]. Therefore, in order to be 'mature', an organization needs to follow an evolutionary path to reach the desired state, starting from the initial state [13,14]. Maturity Models provide that path since they are composed of multiple maturity levels of a domain and can be used to assess an organization maturity level or for organizational development [14].

The inherent advantages when using maturity models come from the best practices and evolutionary paths they offer and to the fact that they can be used to assess the actual state of an organization and/or to define what and how organizations may improve their processes and capabilities [11,15].

In this research we studied the following maturity models: Capability Maturity Model (CMM), since it was the base for CMM-like models; IT-CMF because there is a Cloud maturity model based on it; and CMMI for services as it is an evolution of CMM, and it is a well-known and tested model that is focused on services (nowadays the services sector represents the majority of the global GDP [16]).

3.4 Cloud Maturity Models

During this research only a Cloud maturity model for Cloud adoption and management was found. The model is presented in the following section.

Nevertheless, three maturity models published by Cloud vendors were surveyed [17,18,19] in order to understand their characteristics and activities. These models do not solve this research's problem since they are focused in private Cloud implementation and management.

IT-CMF Cloud Master Deck Conway and Curry [4] have proposed and validated a Cloud maturity model that uses the IT-CMF capabilities in order to migrate and manage IT services in the Cloud. This approach is based on the Cloud lifecycle [5] and it results in a Cloud lifecycle with an associated maturity model [4].

The model uses the IT-CMF in order to define the critical processes that costumers need to address before migrating their IT services to the Cloud [4].

Although this model solves the problem of migrating and managing IT services in the Cloud, it lacks a vision of IT-enabled services. Furthermore, since this model is based on and uses IT-CMF capabilities it requires organizations to have an IT department that uses IT-CMF. Finally, according to the authors, the model can only be used to migrate and manage IT services in the public Cloud.

The above limitations led us to conclude that this solution does not solve of this research's problem, mainly because it is just focused on IT services and it can only be applied if the organizations want to use a public Cloud supplier.

3.5 Objectives of the Solution

To overcome the problem statement, we have presented several approaches, such as the use of maturity models, lifecycles, or both. Nevertheless, as we explained, those approaches do not solve the research problem.

In short, we intend to propose a method based on a lifecycle and a maturity model approach to create a systematic method for organizations to migrate and manage their services in the Cloud. In this research we intend to demonstrate the proposed method and evaluate it using the Moody and Shanks Quality Management Framework. Finally, we intend to evaluate the research itself using the Österle four principles.

4 Proposal

This section corresponds to the *design and development* step of DSRM, in which we will present a *new* method [6] to solve the problem presented in Section 2.

We propose a method based on a **Cloud Maturity Model**, **Fig. 2** . The Cloud Maturity Model was based on the outsourcing lifecycle [8] and on the continuous approach for processes' improvement of CMMI-model [11]. More specifically, we have defined a set of activities that will allow organizations to migrate and manage their services in the Cloud. Along with that, we also propose the use of the continuous approach for processes' improvement of CMMI-model to increase the capability level of the proposed activities.
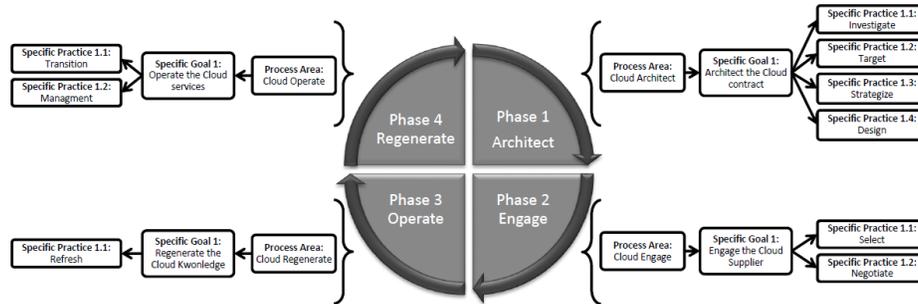

Fig. 2. Final Cloud Lifecycle with Process Areas

In order to build the Cloud Maturity Model, first we performed semi-structured interviews in a set of twelve organizations, seven Cloud clients and five Cloud suppliers. For the detailed results and analysis consult our previous publication [20].

The key activities, building blocks, and phases were then used to construct the Cloud Maturity Model. The maturity model is composed by four process areas (one for each lifecycle phase). The process areas are composed by one or more generic practices (corresponding to building blocks). Finally, the generic practices have a set of specific practices that corresponds to the key activities. The full Cloud Maturity Model is presented in **Fig. 2**.

In order to support the Cloud Maturity Model we have created two books that follow the CMMI-model structure. The first one with the process areas and the second one with the generic goals for each one of the process areas. The process areas book is entirely new and the generic goals book only presents the elaborations of the Cloud process areas as new content (the generic goals, specific goals and their descriptions were retrieved from the CMMI-model).

Regarding the usage of the maturity model there are two assumptions to consider. First, we consider that the decision to migrate services to Cloud has already be made, i.e., although the maturity model can be used to select which services to migrate, if any, it is out of the scope to provide guidance for decide if Cloud should, or should not, be part of organization's strategy. Second, organizations have to take into account that the migration of core services or non-core services have different impacts and risks associated and when the migration of services are made to Cloud organizations need to use different weighs for the criteria [1,2].

The proposed maturity model can be used as a way to assess the processes used by organizations to migrate and manage services in the Cloud and to create a road map to improve those processes. Organizations that are not using Cloud services can use the maturity model as basis to perform the migration and management

processes and be conscious of the key activities that should be performed when migrating and managing services in the Cloud.

When using the proposed maturity model, organizations need to see it as an iterative and cyclic process that allows improvements in the process areas after, or during, each cycle. Those changes can be changes in the way that the processes are performed or changes in the way that the process is managed, the first ones are expected to be chosen by the organization itself, for the second ones organizations should use the proposed generic goals.

Organizations are free to choose in which process area they should focus and to decide the implementation order, or to implement all of them at once.

An important note is that the key activities are not mandatory, organizations are free to use their own set of best practices in order to implement the specific practices proposed, as long as them can justify that their best practices support the specific practices goals.

Finally, the assessment should be performed using the generic goals and their elaborations, starting with the Generic Goal 1 and moving to the next one if all of the generic practices of the previous generic goal are fulfilled. Afterward, organizations should decide if there are any process area to improve in accordance with the organization's Cloud strategy.

Demonstrations of the proposed maturity model are presented in Section 5 and their respective evaluations in Section 6.

5 Demonstration

This section corresponds to the *demonstration* step of DSRM in which we will demonstrate that the proposal (Section 4) can be used to solve one or more instances of the problem stated on Section 2.

In order to perform the demonstration we have used the proposed method to assess the capability level of Cloud adoption and management process areas of organizations and then propose a target state.

We have have chosen organizations from three different sectors in order to show that the model is abstract and not specific to a given sector. This choice also allows us to learn more about the differences among sectors. The summary of the organizations, and the interviewees, in which the demonstrations were performed is presented in **Tab. 1**.

Sector	Role	Years of experience	Number of employees
IT Services	Product Manager	6	215
	Sales Operations	7	
	IT Director	16	
	IT Manager	21	
Banking	Collaborator of the IS Department	11	>1000
Insurance	Director and Coordinator of Organization and Systems	10	856

Table 1. Summary of organizations used in the demonstration

In the next sections we present the demonstrations performed in three organizations that have migrated services to the Cloud and are currently managing those services.

After that, we present the outcomes of the demonstration in Section 6.

5.1 IT Services

The first demonstration was performed in an organization that provides IT services. The organization was chosen because of their dimension, they are a SME [21], they have a structured IT department, and because they are

using Cloud services to provide their own services. In order to ensure the confidentiality of the organization it will be refereed as Organization A.

Organization A have moved their email services, productivity tools (office), and Costumer Relationship Manager (CRM) to the Cloud and are waiting for new opportunities to migrate more services. They have opted to use the Public Cloud.

This demonstration was performed in two interviews, the first one with the Product Manager and the Sales Operations, and the second one with the IT Manager and the IT Director. The interviews provided two assessments of the processes that the organization was using to migrate and manage services in the Cloud.

The interviewees were asked to explain which processes they use to migrate and manage services in the Cloud and to justify how the processes are implemented in the organization. After that we aligned the answers with the Cloud Maturity Model and defined the maturity level of the process areas.

Since we have two assessments the final result was found through the analysis of both assessments. This allowed us to check for misunderstandings and to check if all the interviewees were in accordance when talking about the processes used to migrate and manage services in the Cloud. Our final assessment is present in **Fig. 3** in dark gray.
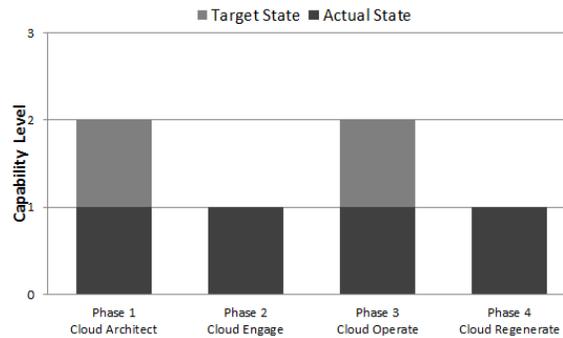

Fig. 3. Target state of Organization A

Organization A have a capability level of one in all the process areas. This is justified because they perform the specific goals and practices, using some of the key activities proposed in the Cloud Maturity Model, and were able to justify how they perform those activities. Nevertheless, they are performing the activities in an ad-hoc basis, i.e., the processes are performed but none of them are managed or defined.

After the assessment we proposed the improvement of Phase 1 and Phase 3 to Organization A to capability level 2, managed. This suggestion was made since they are open to move more services to Cloud, being Phase 1 important for that, and because the services they are using are supporting their business, so the management of the services that are in the Cloud, Phase 3, are important to ensure good results. **Fig. 3** presents the target state for Organization A.

5.2 Banking

The second demonstration was performed in an organization that operates in the bank sector. The organization was chosen because of the dimension, it is a large organization [21], and because they are using a private Cloud, implemented by themselves, to provide internal services. In order to ensure the confidentiality of the organization it will be refereed as Organization B.

Organization B have moved their development services to a Private Cloud implemented in-house. In the future they expect to migrate more services into their own Cloud.

This demonstration was performed with one interview, in which we explain our proposal. After the interview, Organization B has provided the list of processes used to migrate and manage the services in their own Cloud, allowing us to map them with the Cloud Maturity Model.

After the analysis of the provided processes our final assessment is present in **Fig. 4** in dark gray.

Organization B have the Cloud Architect (Phase 1) and the Cloud Operate (Phase 3) process areas in Level 1. This is justified because they perform the specific goals and practices, using some of the key activities
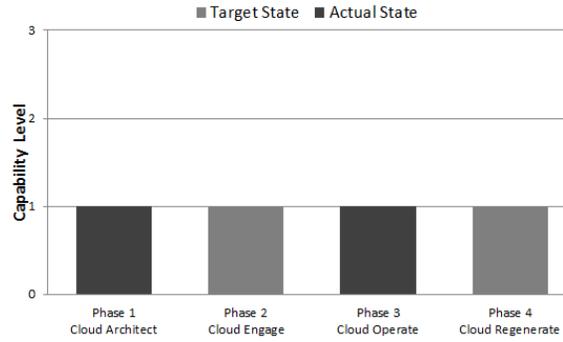
Fig. 4. Target state of Organization A

proposed in the Cloud Maturity Model, and were able to justify how they perform those activities. Nevertheless, they are performing the some of the specific practices in an ad-hoc basis, i.e., the processes are performed but none of them are managed or defined.

After the assessment we had proposed the improvement of the Cloud Engage (Phase 2) and the Cloud Regenerate (Phase 4) process areas to Level 1. For the first phase Organization B are not using any activities since they are implementing their own private Cloud, nevertheless, they are still dependent of hardware suppliers and other services suppliers, for this reason we propose to Organization B to improve their Cloud Engage process area. For the fourth phase, we propose Organization B to implement specific processes to deal with the Cloud Regenerate, since this is an important phase that will be used as input to the next cycle. **Fig. 4** represents the target state for Organization B.

5.3 Insurance

The third demonstration was performed in an organization that operates in the insurance sector. The organization was chosen because of the dimension, it is a large organization [21], and because they are have migrated services to the Cloud recently. In order to ensure the confidentiality of the organization it will be refereed as Organization C.

Organization C have moved their email service, productivity tools (office), Costumer Relationship Manager (CRM), and storage to the Cloud and are expecting to move their entire data center to Public Clouds until 2015.

This demonstration was performed in one interview with the Director and Coordinator of Organization and Systems. The interviewee explained what processes they are using to migrate and manage services in the Cloud and justified how those processes are implemented within the organization.

The interview allow us to align the gathered information with the Cloud Maturity Model and define the maturity level of the process areas, **Fig. 5** in dark gray.
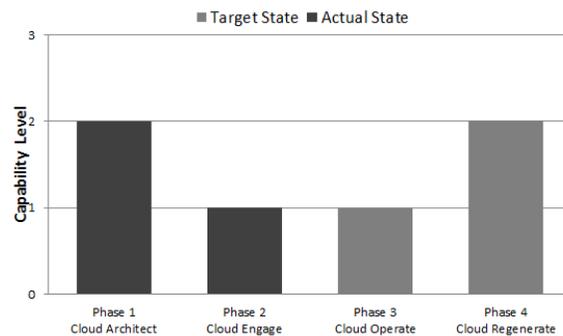

Fig. 5. Target state of Organization C

Organization C have the Cloud Architect (Phase 1) process area in Level 2. This is justified because they perform the specific goals and practices, using some of the key activities proposed in the Cloud Maturity Model, and were able to justify how they perform those activities. Along with that, they have processes in place ensuring that the process area is managed. Nevertheless, the processes are not defined, i.e., they do not have a rigorous description of the processes and the outputs can be different depending on the work group.

The Cloud Engage (Phase 2) process area was classified as Level 1. Organization C executes the proposed specific practices but in an ad-hoc way, not having the process managed.

After the assessment we had proposed the improvement of the Cloud Operate (Phase 3) process area to Level 1. This was advisable since the organization already performs the specific practice relative to the transition of services to the Cloud. Nevertheless, the organization is unable to manage the contracts due to the lack of processes that allow the measurement of the contracted services.

Regarding the Cloud Regenerate (Phase 4) process area our suggestion was to achieve Level 2. The main justification to this improvement is the fact that Organization C is finishing some of their contracts and soon they will need to have in place processes that allow them to refresh their Cloud knowledge and to perform an analysis about what have gone well or wrong in the previous contract. The choice of Level 2 comes from the fact that this phase will be used as the input for the new iteration cycle of the method, so it is advisable to ensure a good performance of the phase.

Finally, our improvement proposal is shown in **Fig. 5**.

5.4 Summary

The overall results from the demonstrations showed us that the proposed method can be used to assess and propose improvements in organizations from different sectors and that are using different Cloud services.

Along with that, the performed assessments allow us to verify that the organizations' maturity are very low when speaking about Cloud computing. This may occur due to the novelty of Cloud, or due to the lack of knowledge and best practices that organizations have to their disposal nowadays.

We found that, although all of the three organizations are very concerned about the Cloud, none of them are concerned about the management of the processes used to migrate and manage services in the Cloud. This lead us to conclude that organizations are still migrating and managing services to the Cloud in ad-hoc basis, and since they are only starting to migrate a few services (that are not part of the core-business) they do not consider the management of the processes critical to the organization.

6 Evaluation

This section corresponds to the *evaluation* step of DSRM in which we will analyze the results of the demonstration (Section 5).

6.1 Moody & Shanks Quality Management Framework

In this section we present the results obtained for the Moody & Shanks Quality Management Framework (MSQMF). This framework has used to evaluate the quality of the proposed method.

The results were obtained after the demonstrations. The interviewees were asked to evaluate our proposal using the MSQMF criteria, this was done without our intervention, allowing the interviewees to use only the definitions of the MSQMF criteria free of our interpretation.

The analysis of the results and the provided feedback allows us to infer the following results for the MSQMF:

– **Completeness**: The proposed method is complete since all the activities used in the interviewed organizations were provided in the method;
– **Simplicity**: Accordingly with the interviewees the method does not have redundant activities and the proposed activities are the essential ones;
– **Flexibility**: The use of the method in organizations from different sectors allows us to conclude that the method is flexible to support business and/or regulatory change without the need for change itself. Along with that, the interviewees provided positive feedback on this criteria;
– **Integration**: The method is consistent within the organizations since it can be implemented and used accordingly with the organizations needs and adapted to use the organizations' processes and practices;

– **Understandability**: Since the proposed method uses as basis known and proved methods (the outsourcing lifecycle and the CMMI-model) organizations found it easy to understand;
– **Implementability**: Although the interviewees found the method easy to understand and implement some of them found it to large to apply in smaller organizations;
– **Integrity**: The use of the first stage interviews allowed us to known the users requirements in order to define business rules and/or constraints in the final method. Furthermore, the results from the demonstrations had showed that the integrity criteria were accomplish;
– **Correctness**: The results gathered from the demonstrations shown that the interviewees have considered the method correct and valid within the requirements of their organization.

Finally, the results and analysis allow us to conclude that the proposed method achieves acceptable results and meets the MSQMF criteria.

6.2 Österle et al. principles

In this section we present the results obtained for the Österle four principles. The principles has used to evaluate the research itself.

The results inferred from the demonstrations are the following:

– **Abstraction**: the method was applied in different organizations that operate in different sectors. Along with that, all of the interviewees refereed that the method can be applied in their organization;
– **Originality**: during the interviews and the demonstration stages none of the interviewees shown knowledge about any similar method. Although one similar method were found in the related work it does not solves entirely the stated problem;
– **Justification**: the method is justified since it uses as basis the outsourcing lifecycle and the CMMI-model, that are well known and validated methods. Furthermore, the method was developed using the results from the interviews;
– **Benefit**: accordingly with the interviewees the proposed method wold bring valuable benefits since it provides a set of steps and best practices that allows them to perform a systematic approach when migrating and managing services to Cloud.

After the analysis of the results we can conclude that all of the principles were met.

7 Conclusion

Cloud computing growing market and promises are leading more and more organizations to migrate their services to a Cloud environment. Nevertheless, those promises have hidden challenges and problems that are not properly addressed and few solutions are presented. Given these facts the problem was defined as **organizations do not have a systematic approach, e.g., frameworks, that allows them to migrate and manage their services into Cloud**.

Following this, our proposal was a method based on a **Cloud Maturity Model**. With this we pretend to give guidance to organizations that wish to migrate their services into the Cloud.

The proposed method has been demonstrated by performing three assessments in three organizations from different sectors. After that we have proposed a target state for those organizations considering their strategies. The results of the demonstration were used to evaluate the proposed method through the Moody and Shanks Quality Management Framework, and the Österle four principles were used to evaluate the research itself.

The limitations associated with our proposal are mainly related to the performed demonstrations, the sectors in which they were performed, the size of the organization, and the services that organizations have migrated.

Regarding the sector, we used a different one for each demonstration. Nevertheless, the use of three sectors are not enough to prove that our proposal can be applied in all the existing sectors. Furthermore, the size of the organizations in which the demonstrations were performed does not allow us to state that every organization will be able to use the proposal.

As a final limitation, the fact that organizations are only moving a few services to Cloud does not allow a detailed study about the differences when applying the method for IaaS, PaaS or SaaS.

As future work we suggest a more detailed demonstration of the method, i.e., during a longer time period and be used to migrate and manage services in the Cloud and in different countries with different realities in order to show the flexibility of the method.

Another important aspect is to demonstrate that the method can be used regardless the differences among the Cloud models (IaaS, PaaS, and SaaS).

We also suggest as future work the development of an assessment process that ensures a systematic approach when assessing and proposing improvements of the organizations' processes related to the Cloud Maturity Model.

Finally, we can conclude that the proposed method was accepted by the interviewed organizations and that they found it useful for migrating and managing services in the Cloud. We support this conclusion in the results from the MSQMF and the Österle four principles analyzed in Section 6.

References

1. Lacity, M.C., Willcocks, L.P.: Advanced Outsourcing Practice: Rethinking ITO, BPO and Cloud Services. Palgrave Macmillan (2012)
2. Willcocks, L.P., Lacity, M.C.: The New Outsourcing Landscape: From Innovation to Cloud Services. Palgrave Macmillan (2012)
3. Weeden, S., Valiente, T.: Cloud Computing: Every Silver Lining Has a Cloud. Technical report (2012)
4. Conway, G., Curry, E.: Managing Cloud Computing: A Life Cycle Approach. In: 2nd International Conference on Cloud Computing and Services Science (CLOSER 2012), Porto, Portugal (2012) 198–207
5. Lindner, M.A., McDonald, F., Conway, G., Curry, E.: Understanding Cloud Requirements: A Supply Chain Lifecycle Approach. In: 2th International Conference on Cloud Computing, GRIDs, and Virtualization (Cloud Computing 2011), Rome, Italy (2011) 20–25
6. sterle, H., Becker, J., Frank, U., Hess, T., Karagiannis, D., Krcmar, H., Loos, P., Mertens, P., Oberweis, A., Sinz, E.J.: Memorandum on design-oriented information systems research. European Journal on Information Systems **20**(1) (2011) 7–10
7. Hevner, A.R., March, S.T., Park, J.: Design science in information systems research. MIS Quarterly **28**(1) (March 2004) 75–105
8. Cullen, S., Seddon, P., Willcocks, L.P.: Managing Outsourcing: The Lifecycle Imperative. MIS Quarterly Executive **4**(1) (March 2005) 229–256
9. Mell, P., Grance, T.: The NIST Definition of Cloud Computing. Technical report (2009)
10. Fraser, P., Moultrie, J., Gregory, M.: The use of maturity models/grids as a tool in assessing product development capability. In: IEEE International Engineering Management Conference (IEMC 2002): Managing Technology for the New Economy, Cambridge, UK (2002) 244–249
11. CMMI Product Team: CMMI for Services, Version 1.3 (CMU/SEI-2010-TR-034). Software Engineering Institute, Carnegie Mellon University (November 2010)
12. Simpson, J.A., Weiner, E.S.C.: The Oxford English Dictionary. Oxford University Press (1989)
13. Mettler, T., Rohner, P.: Situational maturity models as instrumental artifacts for organizational design. In: Proceedings of the 4th International Conference on Design Science Research in Information Systems and Technology. DESRIST '09, New York, NY, USA, ACM (2009) 22:1–22:9
14. Lahrmann, G., Marx, F., Winter, R., Wortmann, F.: Business Intelligence Maturity: Development and Evaluation of a Theoretical Model. In: 44th Hawaii International Conference on System Sciences, Hawaii, USA (2011)
15. Curley, M.: Managing Information Technology for Business Value: Practical Strategies for IT and Business Managers. Intel Press (2004)
16. Central Intelligence Agency: The World Factbook. Washington, DC: Central Intelligence Agency (2011)
17. Mattoon, S., Hensle, B., Baty, J.: Cloud Computing Maturity Model: Guiding Success with Cloud Capabilities. Technical report, Oracle Corp. (2011)
18. Jadhwani, P.: Cloud Computing: Building a Framework for Successful Transition. Technical report, GTSI Corp. (2009)
19. Iannucci, P., Gupta, M.: IBM SmartCloud: Building a Cloud Enabled Data Center. Technical report, IBM Corp. (2013)
20. Duarte, A., Mira da Silva, M. In: IEEE 6th International Conference on Cloud Computing (IEEE Cloud 2013), Santa Clara, USA
21. European Commission: The new SME definition: User guide and model declaration (January 2005)