Cloud Maturity Model

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We would rather die on our feet, than live on our knees

Franklin D. Roosevelt

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Resumo

Actualmente o mundo encontra-se em constante evolução e muitas organizações acreditam que a *Cloud* irá ser a próxima grande tendência no que diz respeito ao provisionamento de serviços. As organizaçã estão a fazer esforços para mover e gerir os seus serviços tecnológicos e/ou de base tecnolólogica na *Cloud*, esperando tirar partido das vantagens e promessas oferecidas pela *Cloud*. Apesar disso, a migração para a *Cloud* está longe de ser algo fácil devido aos problemas e desafios presentes, fazendo com que as organizações tenham receio e levando a uma adopção mais lenta de serviços na *Cloud*.

De modo a ajudar as organizações a adoptar serviços na *Cloud* e a desmitificar medos e preocupações propomos um método que irá juntar um ciclo de vida com o *Capability Maturity Model Integrated Model (CMMI-model)*, resultando num conjunto de passos para adopção e gestão de serviços na *Cloud* denominado *Cloud Maturity Model*.

O método proposto foi demonstrado em três organizações e posteriormente avaliado com entrevistas, *Moody and Shanks Quality Management Framework*, os quatro princípios de Österle e através da submissão de publicações científicas.

Finalmente, concluímos que a nossa proposta pode ajudar as organizações a migrar e gerir serviços na Cloud e, ao mesmo tempo, permite fazer a gestão e melhorar os processos utilizados.

Palavras-chave: Cloud Computing, Modelos de Maturidade, Outsource, Ciclo de Vida, Serviços de Base Tecnológica, Serviços de IT

Abstract

In today's ever-evolving world many organizations believe that Cloud computing will be the next big thing when speaking about services' delivery. Organizations are struggling to move and manage their IT Services and/or IT-enabled Services into Cloud, hoping to take advantage of all of the Cloud's promises. Despite that, the move to Cloud is far from being a nice walk in the park since many challenges and issues are presented, fearing organizations and slowing the adoption of Cloud services.

In order to help organizations adopting Cloud services and demystify fears and concerns we propose a method that will use a Lifecycle approach together with the Capability Maturity Model Integrated model (CMMI-model), resulting in a roadmap to Cloud adoption and management, defined as a Cloud Maturity Model.

We demonstrate the method in three organizations and then evaluate it with interviews, Moody and Shanks Quality Management Framework, Österle four principles and the feedback from the scientific community.

Finally, we conclude that our proposal can help organizations migrate and manage services in the Cloud and, at the same time, allows organizations to manage and improve the used processes.

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

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Chapter 1

Introduction

In the past few years, organizations had 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. Those hopes can be shaken when clients and providers start to found challenges associated with the service's migration to Cloud. 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 (M. C. Lacity & Willcocks, 2012, Weeden & Valiente, 2012, Willcocks & Lacity, 2012).

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, thus Cloud computing share identical advantages and challenges with Information Technology Outsourcing (ITO) and Business Process Outsourcing (BPO) (M. C. Lacity & Willcocks, 2012, Willcocks & Lacity, 2012).

This relation allows researchers to reutilize knowledge from outsourcing studies in the Cloud environment, e.g., the case of the Cloud lifecycle proposed by Lindner et al. (Lindner et al., 2011), which is an adaptation of the outsourcing lifecycle proposed by Cullen et al. (Cullen et al., 2005) in order to solve the problems associated with the migration and management of services into ITO and BPO.

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** (Conway & Curry, 2012). To solve this problem it is proposed the use of a lifecycle approach, in order to decompose the migration and management into discreet and manageable steps (Conway & Curry, 2012, Lindner et al., 2011), 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.

The proposed solution is a method based on a **Cloud Maturity Model** that will allow the migration and management of IT services, i.e., IT applications and engineering services, and IT-enabled services, i.e., services that are delivered over electronic networks (Sudan et al., 2010), into the Cloud (examples of IT services and IT-enables services are presented in Appendix A).

In order to demonstrate the proposed solution we have performed three demonstrations in three organization from different sectors.

To evaluate the solution we have carry out a set of twelve interviews with Cloud clients and suppliers to validate the proposed activities; used the results from the demonstrations and compare them to the objectives of the solution; the appraisal from the scientific community, by submitting papers; the Moody and Shanks Quality Management Framework, to evaluate the proposed method (Moody & Shanks, 2003); and the four principles proposed by Österle et al. were used to evaluate the research (Österle et al., 2011).

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 (Hevner et al., 2004).

Finally, in Chapter 8, we draw some conclusions, present the lessons learned, the limitations, and the future work of our research.

1.1 Research Methodology

Design Science Research Methodology (DSRM) has been used as the research methodology for this research. In order to better understand the DSRM it is important to comprehend the concept of methodology, according with Hevner et al. a methodology is *a system of principles, practices and procedures applied to a given branch of knowledge* (Hevner et al., 2004). The applied methodology, in the context of Information Systems, requires the creation and evaluation of an innovative and purposeful artifact that solves a specific problem in a specific domain (Hevner et al., 2004). These artifact can be defined as constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices), and instantiations (implemented and prototype systems) (Hevner et al., 2004).

In this research **the proposed artifact is a method**, i.e., the artifact will give guidance and explain how to solve the problem.

DSRM consists on an iterative process composed by six steps, **Fig. 1.1**, and include rigorous methods for the creation and evaluation of the artifacts. Bellow we will explain each one of the DSRM steps.

The steps of the above process are:

1. **Problem identification and motivation**: Define the specific research problem and justify the

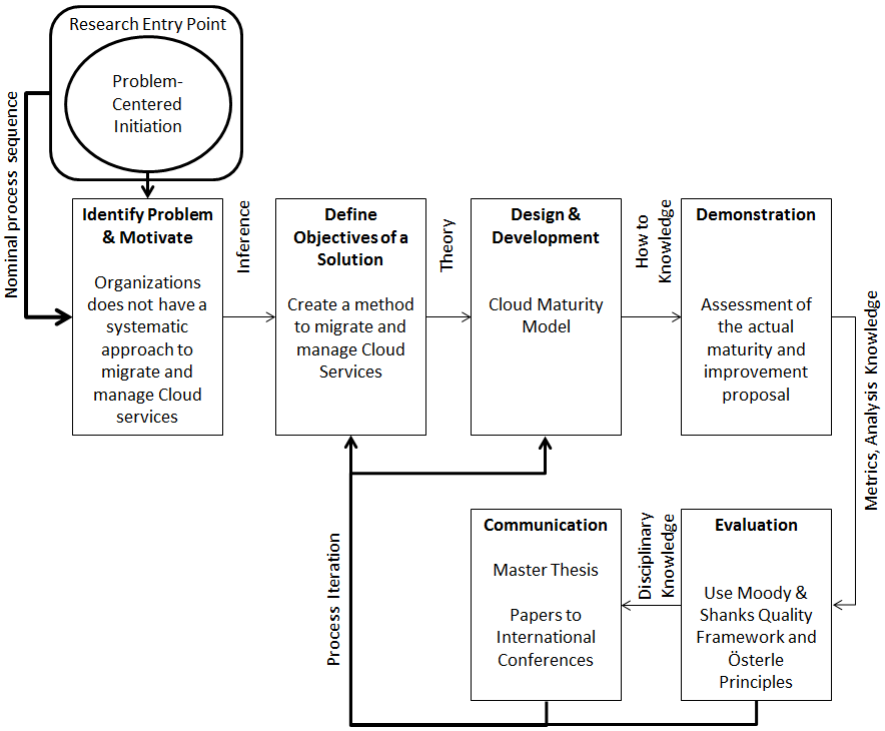

Figure 1.1: Design Science Research Methodology (adapted from (Peffers et al., 2008))

value of the solution. In this step it is required to know the state of the problem and to clearly justify the importance of the solution;

2. **Definition of the objectives of a solution**: Infer the objectives of a solution through the problem definition, the related work, and the knowledge taking into account what is possible and feasible. The objectives can be quantitative, such as terms in which a desirable solution would be better than current ones, or qualitative, such as a description of how a new artifact is expected to solve problems;

3. **Design and development**: Create the artifact, determining the artifact's desired functionality and its architecture and finally create the actual artifact. The artifact can be any designed object in which a research contribution is embedded in the design;

4. **Demonstration**: Demonstrate the use of the artifact to solve one or more instances of the problem. This can be done by using experimentation, simulation, case study, proof, or other appropriate activity;

5. **Evaluation**: This step compares the objectives of a solution to actual observed results from the artifact in the demonstration. Well executed evaluation methods are used to demonstrate the utility, quality and efficacy of the designed artifact, such methods may include simulations, surveys, interviews with practitioners, and others. After this step researchers can decide if it is necessary to iterate back in order to improve the artifact;

6. **Communication**: It consists on the communication of the research as a whole (problem, ob-

jectives, artifact, demonstration and evaluation) to a relevant audiences. The submission and presentation of papers can accomplish this step.

Finally it is important to refer that although DSRM is a sequential process researchers do not have to go from step 1 to 6 in that order or to start at step 1. Although it is not show in **Fig. 1.1** there are several entry point in which researchers can start (Problem identification and motivation, Definition of the objectives of a solution, Design and development, or Demonstration).

1.2 Structure

This research was conducted using the DSRM and is structured accordingly with the steps proposed by the methodology. The relation among the chapters and the DSRM steps are presented in **Tab. 1.1**.

DSRM step	Chapter
Identify Problem and Motivate	3 - Problem 4 - Related Work
Definition of the Objectives of a Solution	4- Related Work
Design and Development	5 - Theoretical Background 6 - Proposal
Demonstration	7 - Demonstration
Evaluation	8 - Evaluation
Communication	9 - Conclusion

Table 1.1: Relation among DSRM steps and Thesis Structure

Chapter 2

Problem

In this chapter 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 a fast adoption and a significant market growth and this trend is expected to continue (Weeden & Valiente, 2012), **Fig. 2.1**.

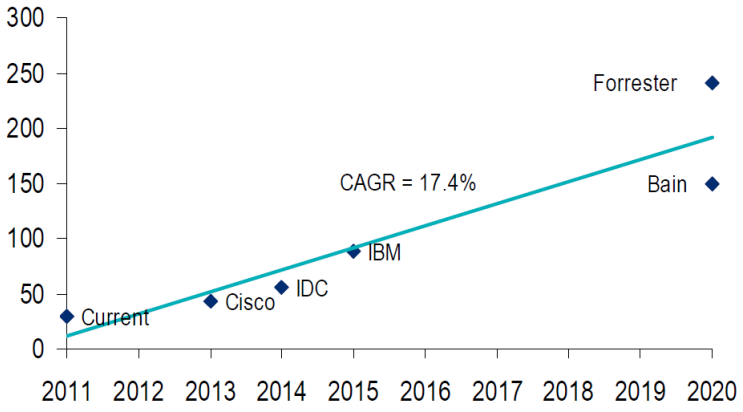

Figure 2.1: Cloud Computing Market Forecasts ($bn) (Weeden & Valiente, 2012)

Cloud adopters are moving to Cloud searching for costs benefits, such as a pay-per-use model in which organizations only pay what they use; an increased flexibility and scalability, that allows organizations to promptly increase or decrease the used resources; and, most important, the swift from a Capital Expense (CapEx) to a Operational Expense (OpEx) model. Along with that, they are also searching for functional benefits, e.g., increased response times and instant software updates, and resources benefits, e.g., employees can access the Cloud everywhere and focus on priority areas instead of routine maintenance tasks (Conway & Curry, 2012, Lindner et al., 2011).

On the other hand, the move to Cloud is not a clear path. Clients are struggling to understand and overtake several issues and challenges. **Fig. 2.2** show the most significant risks perceived by clients when moving their non-Cloud services to Cloud. (Willcocks & Lacity, 2012) raise an important question

about this subject, since Cloud computing is far from mature are this risks reasonable in the long term or they represent another example of the Fear Uncertainty and Doubt instilled by those with a stake in the non-Cloud model against the new and innovative entrant?

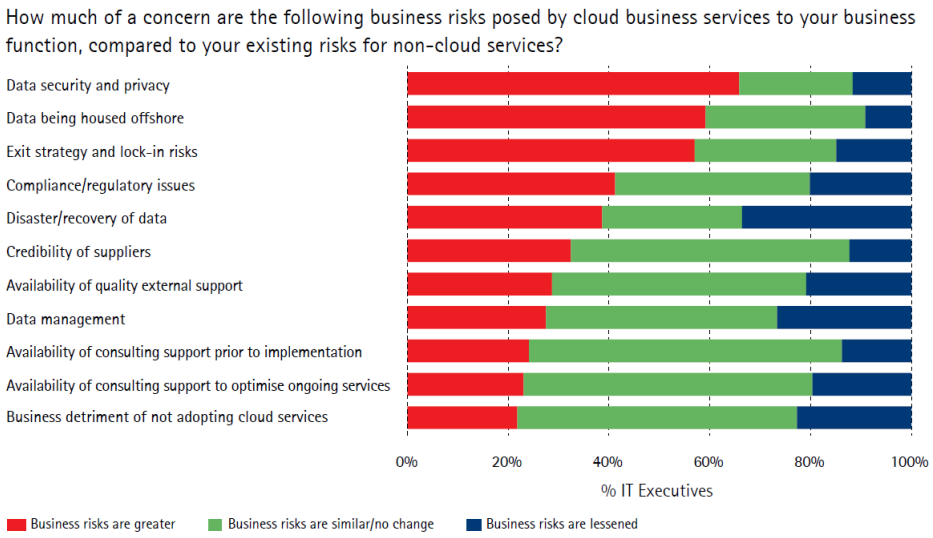

Figure 2.2: Comparative risks of business Cloud services (Willcocks & Lacity, 2012)

Those challenges and issues lead to uncertainty among the organizations when they think about moving to Cloud. (Conway & Curry, 2012) argue that in order to overcome the challenges and issues, organizations need a systematic means for review their business needs and weighing the potential gains and opportunities bring by the Cloud against the challenges and risks, in this way organizations will to a transition to Cloud based on a well planned and understood strategy.

(Conway & Curry, 2012) also argue that there is a need for a management framework for how a Cloud migration should be done and managed but due to its novelty and fast evolution Cloud computing has no guidelines and best practices available.

After analyzing the above challenges we define this research problem as **organizations do not have a systematic approach, e.g., maturity models, that allows them to migrate and manage their services into Cloud**.

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

Chapter 3

Related Work

In this chapter 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 (Section 3.1), Cloud Computing (Section 3.2) and Maturity Models (Section 3.3). In Section 3.4 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 (Section 3.5).

3.1 Outsourcing

Information Technology Outsourcing (ITO) and Business Process Outsourcing (BPO) markets were estimated to be worth, respectively, $290 billion and $170 billion in 2011. Being a more mature and a larger market ITO expenditure is expected to grow at a rate of 10% a year, in the other hand, BPO expenditure is expected to grow at a rate of 25% a year (M. C. Lacity & Willcocks, 2012).

Outsourcing can be seen as a disaggregation of the enterprise itself and as a new way for organizations to create and distribute optimal value from and around the existent fundamentals of business. This definition has been driven by the idea that organizations, in order to be successful, need to be focused in their core competencies and outsource functions which they cannot deliver at the highest level (M. C. Lacity & Willcocks, 2012).

When outsourcing, organizations can choose what to outsource and where to outsource. Within the current literature organizations can outsource their services, or part of it, to an external organization or/and their business processes, or part of it. Regarding the location options there are described below (M. C. Lacity & Willcocks, 2012, Willcocks & Lacity, 2012):

- **Offshore outsourcing**: It implies that the ITO and/or BPO are performed in a country that is not the one where the service will be developed and delivered. Although this option can deliver lower

contract prices, since organizations usually outsource for locations that take advantage of the local economy to offer lower prices, it will increase the communication costs among the client and the supplier. This happens mainly because of the different time zones and the cultural differences;

- **Nearshoring outsourcing**: It is the outsourcing of IT and/or BP to a bordering or near country. When compared with offshore outsourcing this practice ensures lower communication costs among the client and the supplier;

- **Onshoring outsourcing**: Implies that the outsourcing is performed in a country that is the one where the service will be developed and delivered;

- **Rural outsourcing**: According with Lacity and Willcocks (M. C. Lacity & Willcocks, 2012) we define rural outsourcing suppliers as *suppliers who position their value proposition to customers as lower in price than urban-based suppliers but higher in value than offshore-based suppliers*. Rural outsourcing may be refereed also as *remote domestic location* (RDL), (M. Lacity et al., 2011). This option major benefit are the reduction of communication costs among the client and the supplier when compared with offshore outsourcing and the lower costs because it is performed on areas with lower life costs and better life quality;

- **Insourcing**: Also known as in-house labor, it is appropriate when an organization has the skills and resources to do the work in-house.

Organizations need to have in account that outsourcing is neither good or bad in itself (Cullen et al., 2005). The results from an outsourcing contract will depend of how the organization minimize the risks and manage the contract.

When talking about outsourcing drivers the most referred one is the use of an outsourcing supplier in order to reduce costs, followed by the desire or need of clients' organizations to outsource non-core capabilities, in order to focus on their core ones. The access to providers' skills and expertise and the improvement of business/process performance through the use of providers help are also important drivers when outsourcing capabilities (M. C. Lacity & Willcocks, 2012, Willcocks & Lacity, 2012). As said above, these drivers are not advantages by themselves, they only become advantages if the organizations can minimize risks and manage the contract.

In the other hand, some of the risks and problems associated to ITO and BPO are escalation, which is defined by the continued commitment in *the face of negative information about prior resource allocations coupled with uncertainty surrounding the likelihood of goal attainment* (Willcocks & Lacity, 2012); the winner's course, that happens when the supplier is unable to deliver what specified on the contract and makes no profit, this lead to a negative impact on the service provided to the client. This situation is usually created when, in order to win the deal, the supplier might enter in a contract which favors the client; the hidden costs of manage multiple suppliers; loss of control when outsourcing functions and/or activities, especially if those functions and/or activities are part of the core business; communica-

tion problems, that can be the result of misunderstood contracts and can lead to an unexpected result; cultural differences, especially in offshore. For instance, an employee in China have a different mentality and work methods when compared with an European worker; and rigid contracts, in most cases contracts are rigid, leading to a lack of space to innovate from both parts and usually to legal issues.

3.1.1 Outsourcing Lifecycle

In order to solve the above problems (Cullen et al., 2005) have proposed an approach based on a lifecycle. This approach, as show in **Fig. 3.1**, consists in four phases and nine building blocks. Each phase has one or more building blocks and each building block have several key activities.

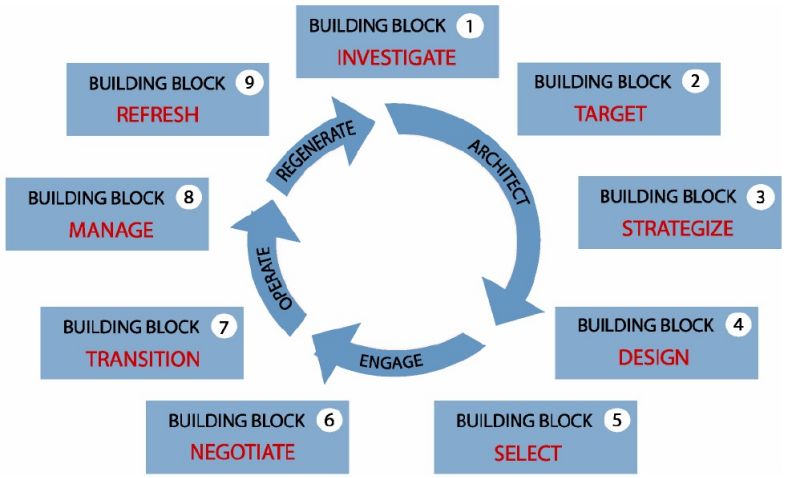

Figure 3.1: The Outsourcing Lifecycle Model: Phases and Building Blocks (Cullen et al., 2005)

The main objective of the Outsourcing Lifecycle proposed is to provide a standard way to organizations manage their outsourcing process in order to achieve better results from outsourcing (Cullen et al., 2005). Furthermore, this approach allows organizations to break down the process of outsourcing into discrete and manageable steps, thus allowing the organization to gather correct information in order to make a decision before move to the next step, minimizing the risk, and commit resources to only one step at a time (Conway & Curry, 2012, Lindner et al., 2011).

It is also important to refer that this model was tested in several organizations, both for ITO and BPO (Cullen et al., 2005).

Finally, although the benefits offered by this solution it does not solve this research problem because of factors such as the lack of Cloud knowledge and that, regardless of the fact that the lifecycle offers space for improvement, by be cyclic, it does not refer how improvements should be done.

3.2 Cloud Computing

With an estimated global revenue by 2013-2014 between $45 billion and $50 billion per year and an expected 20% of Compound Annual Growth Rate (CAGR) until 2020 (Weeden & Valiente, 2012) Cloud computing is one of the major technological challenges for organizations nowadays (M. C. Lacity & Willcocks, 2012, Willcocks & Lacity, 2012).

(M. C. Lacity & Willcocks, 2012, Willcocks & Lacity, 2012) 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 a kind of outsourcing with some specificities that will be explained along this section.

Cloud computing is defined by the National Institute of Standards and Technology (NIST) as

> *a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction* (Mell & Grance, 2009).

The above definition also includes five essential elements of Cloud computing (Dillon et al., 2010, Mell & Grance, 2009):

- **On-demand self-service**: A client can unilaterally and automatically set up computing resources (e.g., software usage and network storage) without the need of any human interaction with the service's provider.
- **Broad network access**: Computer resources are supplied over the network and used by the client's applications in heterogeneous platforms, e.g., laptops and smart phones.
- **Resource pooling**: The supplier's resources are pooled in order to serve multiple clients. The resources, e.g., storage, network bandwidth and virtual machines, use a multi-tenant model, this enables the dynamic allocation and reallocation of physical and virtual resources according with the client's demand. Besides that, the clients usually have no control, or knowledge, over the location of the provided resources, although they can specify the location at a higher level of abstraction (e.g., country or datacenter).
- **Rapid elasticity**: Resources can be rapidly and elastically provisioned, automatically or by human interaction, allowing the clients to quickly scale in and quickly scale out. In the clients' perspective the resources are unlimited and can be acquired in any quantity at any time.
- **Measured service**: The use of a multi-tenant model does not affect the capability of the supplier to measure and control the resources usage (e.g., active user accounts and bandwidth) for each indi-

vidual client using measuring capabilities. Those measuring provide transparency for the supplier and the clients.

Along with the five essential characteristics the NIST also defines three Cloud services models (Mell & Grance, 2009):

- **Software as a Service (SaaS)**: The supplier's applications run in a Cloud infrastructure and are provided to clients. Those applications are accessible to clients' devices through a thin client interface (e.g., web browser) and the clients have no control of the Cloud infrastructure (e.g., network, servers and operating systems);

- **Platform as a Service (PaaS)**: Provides to clients a Cloud environment in which they can deploy their own applications or acquired applications. The limitation of this model is the fact that clients have no control over the underlying infrastructure (e.g., servers and operating system), this implies that all the clients' applications need to compatible with the platform offered by the supplier;

- **Infrastructure as a Service (IaaS)**: The clients have access to processing, storage, network components (e.g., firewalls), and other fundamental computing resources. This allows clients to deploy and run arbitrary software (e.g., operative system and applications) in the provided environment. The clients do not control the underlying infrastructure.

The above service models are offered in five deployment models (Conway & Curry, 2012, Dillon et al., 2010, Mell & Grance, 2009):

- **Private Cloud**: The Cloud infrastructure is operated exclusively for an organization and can be managed by the organization itself or by a third party organization;

- **Community Cloud**: The Cloud infrastructure is shared by organizations that have concerns in common (e.g., security requirements, policy, and mission). It can be managed by the community itself or by a third party organization.

- **Public Cloud**: The Cloud infrastructure is owned by an organization that sells Cloud services and it is available to the general public or a large industry;

- **Hybrid Cloud**: The Cloud infrastructure is composed by two or more deployment models that remain unique entities but are bounded together by standardized or proprietary technology, allowing data and application portability;

- **Virtual Private Cloud (VPC)**: This model was proposed by Amazon Web Services and consists on a mixture of Public and Private Cloud. It is public because it uses resources pooled by Amazon for the general public, and it is virtually private firstly because the connection between IT legacy and the Cloud is ensured by a Virtual Private Network (VPN) and secondly because Amazon dedicate a set of isolated resources to each VPC.

(M. C. Lacity & Willcocks, 2012, Willcocks & Lacity, 2012) have presented a ”desires framework” for Cloud computing, i.e., things that IT executives would be looking for when adopting Cloud computing services. Those desires are equivalence, access services that are at least equivalent in quality to the performance of a locally running service; abstraction, hide unnecessary complexity of the lower-level application stack; automation, the running service is managed automatically; and tailoring, tailor the provided service for specific organization's needs.

In the other hand, when moving to the Cloud, managers need to look into the challenges they will face. (M. C. Lacity & Willcocks, 2012, Willcocks & Lacity, 2012) have defined four major challenges. The first one is weighing up the security and legal risks, this is a major issue when dealing with clients' private data and offshore data housing since there are several security risks and legislative barriers associated with this practice.

The second one is the definition of the contract, according to the authors nowadays' service level agreements (SLAs) are not robust enough for the Cloud business model. Nevertheless, the authors believe that in a near future, through competition and the development of Cloud standards, more adequate SLAs will be available.

The third challenge associated with Cloud is the lock-in dilemma that occurs in two forms, technology lock-in and institutional lock-in. The first one is associated with the costs of change services from one Cloud platform to another one and the second one occurs when users become attached to the technologies embedded in organizational routines.

Finally, the fourth challenge is managing the Cloud. This challenge covers several topics such as monitoring usage, SLAs and robustness and are focused on the premise that *outsourcing cannot be contracted and then not managed* (Cullen et al., 2005).

3.2.1 Cloud Lifecycle

As in the case of outsourcing, a lifecycle approach was also suggested to mitigate the migration and management issues of the Cloud, **Fig. 3.2**.

This approach was proposed by (Lindner et al., 2011) and it is based on the outsourcing lifecycle mentioned in Section 4.1. The model is focused in 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 provide 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 (Lindner et al., 2011).

Although the advantages offered by this model and its evolution from the outsourcing lifecycle towards the Cloud it continues to present limitations. Those limitations are the fact that there is a lack of the

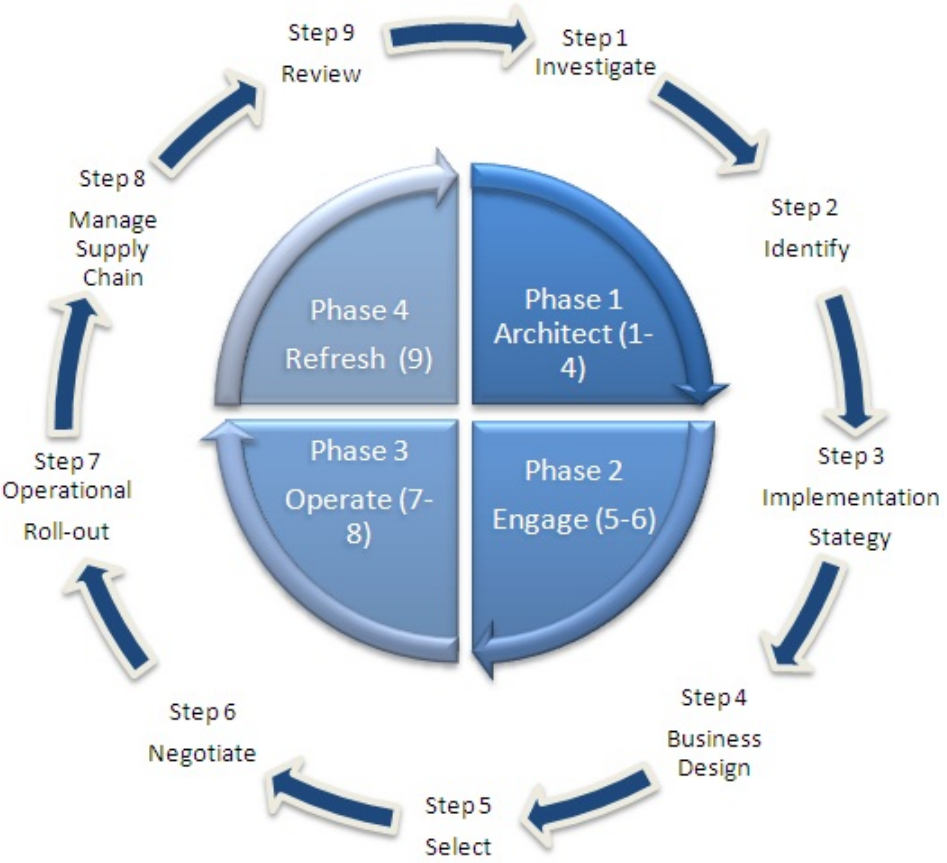

Figure 3.2: Cloud Lifecycle (Lindner et al., 2011)

concept of IT-enabled services, it only focus IT services, and that, regardless of the fact that the lifecycle offers space for improvement, by be cyclic, it does not refer how the improvements should be done.

3.3 Maturity Models

Maturity approaches came from the field of quality management (Fraser et al., 2002) and were extended to the IT field in order to manage software development (CMMI Product Team, 2010). Later on, those approaches were applied to organizations' processes.

Maturity is described as *the state of being complete, perfect or ready* (Simpson & Weiner, 1989). Therefore, in order to be 'mature', an organization needs to follow an evolutionary path to reach the desired state starting from the initial state (Lahrmann et al., 2011, Mettler & Rohner, 2009). Maturity Models (MM) provide that path since they are composed by multiple maturity levels of a domain and can be used to assess an organization maturity level or for organizational development (Lahrmann et al., 2011).

The inherent advantages when using maturity models comes from the best practices and evolutionary paths that they offer and due 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 (CMMI

Product Team, 2010, Curley, 2004).

An interesting distinction between *Models* and *Methods* is presented by Mettler and Rohner and we found it useful to better understand the concept of maturity model (Mettler & Rohner, 2009):

- **Models**: represent a formal description of the environment, or part of it, in order to understand and communicate it. The models' representation tries to answer to 'what' is happening;
- **Methods**: are structured ways to systematically develop activities or processes based on a group of rules, directions and ways of thinking. The methods focus on try to answer to 'how' do we reach a desired state or solution.

After the above distinction and the maturity model definition it is possible to conclude, in accordance with the authors (Mettler & Rohner, 2009), that a maturity model is between the model and method definition, as show in **Fig. 3.3**.

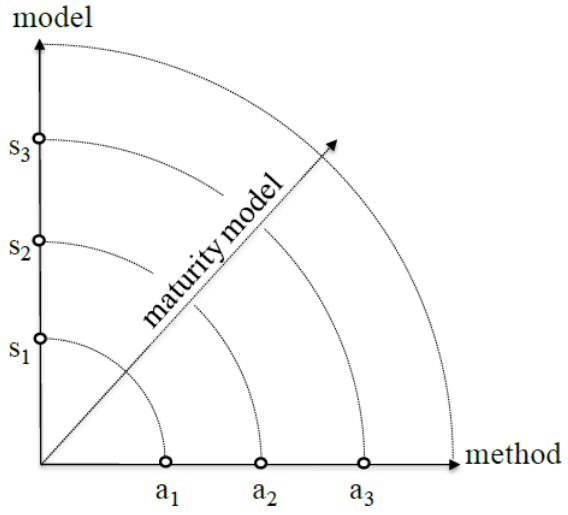

Figure 3.3: Maturity models in-between of models and methods (Mettler & Rohner, 2009)

In the current literature we found four groups of maturity models:

- **Maturity Grids**: Consists of a text description for each maturity level of an activity. These models are of moderate complexity and usually are described in a few pages (Fraser et al., 2002);
- **Situational Maturity Models**: These models take into account the situativity of organizations' design, i.e., instead of apply all the maturity models' requirements organizations can discard the ones that does not apply to their design. These models are focused in ensure that an organization does not get stuck in a maturity level because of one or more requirements that does not make sense in that specific organization (Mettler & Rohner, 2009);
- **Hybrids and Likert-like Questionnaires**: Likert-like questionnaires are composed by questions, in this case statements of good practices, and the answer is simply a score relative to the organizations' performance from 1 to n. Hybrid models are a combination of a questionnaire approach

with definitions of maturity, usually there is a description of the maturity levels but no description of the activities to be performed (Fraser et al., 2002);

- **CMM-like Models**: Capability Maturity Models (CMMs) have a more formal and complex architecture. These models organize the common features in process areas and each process area has a number of key practices in order to address its goals. CMMs are focused in processes' improvement, contain the essential parts of the processes and describe an evolutionary path from ad-hoc processes to mature processes (CMMI Product Team, 2010, Fraser et al., 2002).

In this research we will study CMM-like models because maturity grids only focus on activities, and not on the activities' processes; situational maturity models does not apply due to the fact that the authors of the lifecycles approaches (Conway & Curry, 2012, Cullen et al., 2005) and ourselves believe that when adopting Cloud there is no way around of any of the proposed steps; and finally hybrids and Likert-like questionnaires lack a description of the activities to be performed (Fraser et al., 2002). For the previous motives, and the fact that CMM-like models are focused in processes' improvement and have a more formal description, they will be chosen for further analysis.

In terms of assessment and evolutionary paths, maturity models can provide a way to assess the organization as a whole, using a staged model, and/or a way to assess each of the organization's processes, using a continuous model (CMMI Product Team, 2010, Pereira & Mira da Silva, 2011).

Next we will do a brief description of the maturity models studied during this research. The reasons that lead us to chose the following models were historical reasons in the case of CMM, it was the base for CMM-like models; IT-CMF because there is a Cloud maturity models based on it; and CMMI for services because it is an evolution of CMM, it is a well known and tested model and it is focus on services (the services sector represents the majority of the global GDP (Central Intelligence Agency, 2011)).

3.3.1 CMM

The Capability Maturity Model (CMM) was proposed by the Software Engineering Institute (SEI). It specifies five maturity levels, from Initial (Level 1) to Optimizing (Level 5), and allows the assessment of the organization's processes capabilities. CMM consists of a cumulative set of key process areas (KPAs), i.e., goals and common features, per level and all these KPAs need to be performed in order to evolve to the next maturity level. The CMM only provides a staged representation (CMMI Product Team, 2010, Fraser et al., 2002, Pereira & Mira da Silva, 2011).

This model does not solve the research problem because it is only focused on software development projects.

3.3.2 CMMI for Services

The Capability Maturity Model Integration for Services (CMMI-SVC) was proposed by the Software Engineering Institute (SEI). This model has been developed to provide guidance in the application of CMMI best practices to activities required to establish, deliver and manage services (CMMI Product Team, 2010).

CMMI-SVC is based on concepts and practices from CMMI and other service oriented standards and models (CMMI Product Team, 2010):

- Information Technology Infrastructure Library (ITIL);
- ISO/IEC 20000: Information Technology-Service Management;
- Control Objectives for Information and related Technology (CobiT);
- Information Technology Services Capability Maturity Model (ITSCMM).

This model presents two improving paths, the first one allows organizations to improve processes corresponding to a specific process area, or a group of process areas. The second one allows organizations to improve a set of related processes by addressing sets of process areas. Those paths correspond to, respectively, the continuous model, from Incomplete (level 0) to Defined (Level 3), and the staged model, from Initial (Level 1) to Optimizing (Level 5) (CMMI Product Team, 2010).

CMMI for services does not solve this research problem. This happens mainly because that there is a lack of the Cloud concept and process areas to migrate and manage services in the Cloud.

3.3.3 IT-CMF

The IT-Capability Maturity Framework (IT-CMF) was develop by the Innovation Value Institute and have the propose of enabling CIOs/CEOs to assess and improve their organization's maturity and enabling organizations to retrieve optimal business value from IT investments through the use of a maturity framework that manages the IT function of an organization (Conway & Curry, 2012, Curley, 2004).

The IT-CMF has by four macro-capabilities, **Fig. 3.4**, each one composed by several critical IT processes with an associated maturity. There are thirty three critical IT processes, each one of those processes having an associated maturity and several building blocks (Innovation Value Institute, 2012).

IT-CMF uses a continuous approach and defines five maturity levels, from Initial (level 0) to Optimizing (level 5). Each one of the critical processes have its own maturity level and the maturity level of a macro-capabilities is defined by the average of the maturity levels of the critical processes that compose it (Innovation Value Institute, 2012).

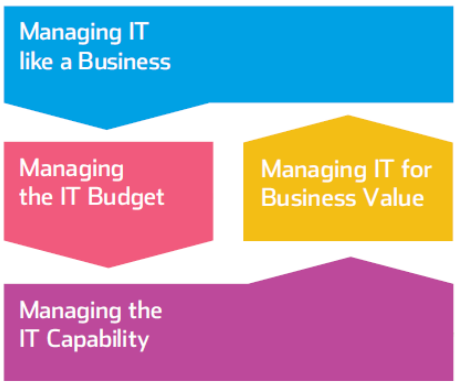

Figure 3.4: IT-CMF macro capabilities (Innovation Value Institute, 2012)

The model does not solve the problem of this research problem because it lacks critical processes that focus on Cloud adoption and management and because it is focused only on the IT department service delivery and in IT services.

3.3.4 Summary

According to the above descriptions and the read literature maturity models share common problems and properties. Starting with problems, we can see that although maturity models tries to close the gap between the current state and the pretended state the majority of them only focus on the 'what' and only a few give a clear explanation of 'how' to implement the activities needed to achieve a determined state (Fraser et al., 2002, Mettler & Rohner, 2009). Another criticism is that maturity models sometimes focus only the process perspective and disregard the people's capabilities (Mettler & Rohner, 2009).

Regarding the common properties, maturity models are composed by a number of levels (usually between three and six); a descriptor for each level (e.g. from Initial to Optimizing); a high level description of each the level characteristics; and a number of dimensions (e.g. process areas in the case of CMMI-SVC) composed by several elements (e.g. building blocks in the case of IT-CMF) that have a description of the way that they are supposed to be performed at each level (CMMI Product Team, 2010, Fraser et al., 2002, Innovation Value Institute, 2012, Mettler & Rohner, 2009, Pereira & Mira da Silva, 2011, Weeden & Valiente, 2012).

Finally, after the performed analysis we can conclude that maturity models do not solve this research problem. This happens mainly because of the lack of Cloud concepts and knowledge in the actual maturity models. Nevertheless, maturity models offer an excellent knowledge base about process's adoption and improvement, referring 'what' process need to be performed and 'how' it should be performed. Along with that, maturity models common properties made them a solid base for manage the migration and management of IT services and IT-enabled services in the Cloud. For those reason we opt for use maturity models in order to solve this research problem.

3.4 Cloud Maturity Models

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

Nevertheless, three maturity models published by Cloud vendors were surveyed (Iannucci & Gupta, 2013, Jadhwani, 2009, Mattoon et al., 2011) 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.

3.4.1 IT-CMF Cloud Master Deck

(Conway & Curry, 2012) 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 outsourcing lifecycle (Cullen et al., 2005) and the Cloud lifecycle (Lindner et al., 2011) and results in a Cloud lifecycle with an associated maturity model (Conway & Curry, 2012).

The model, **Fig. 3.5**, uses the IT-CMF in order to define the critical processes which costumers need to address before migrating their IT services to the Cloud (Conway & Curry, 2012).

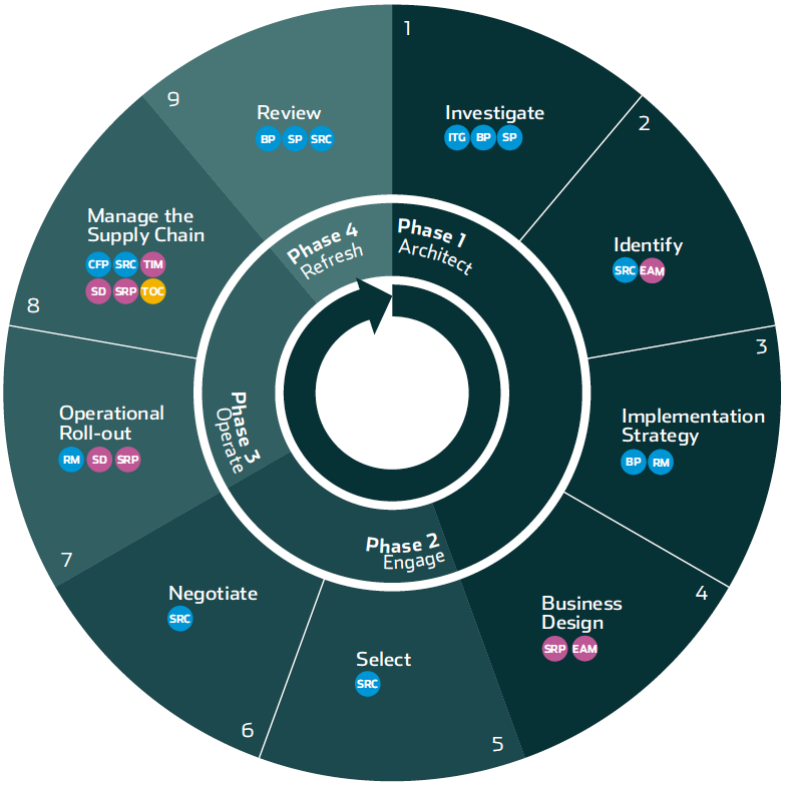

Figure 3.5: IT-CMF Cloud lifecycle (Conway & Curry, 2012)

Although this model solve the problem of migrating and managing IT services in the Cloud it lacks a

vision of IT-enabled services. Furthermore, since this model are based and uses IT-CMF capabilities it requires that organizations 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 lead us to conclude that this solution does not solve the problem stated in Chapter 3, mainly because it is only focused on IT services and it can only be applied if the organizations want to use a public Cloud supplier.

3.5 Objectives

To overcome the problem statement, Chapter 2, we have presented several approaches, such as the use of maturity models, lifecycles or both. Nevertheless, those approaches do not solve the research problem as we have explained in each one of them

A systematic approach to migrate and manage services, both IT services and IT-enabled services, into the Cloud is needed. In order to do it we seek to define a method using the knowledge gathered from lifecycles, maturity models and Cloud computing research.

We propose **a method based on a lifecycle and a maturity model for migrating and managing services in the Cloud**.

We also define as objectives the demonstration, evaluation and communication of the method, in order to show its efficiency and efficacy. Finally, we intend to use the Moody & Shanks Quality Management Framework to assess the quality of the proposed method and the Österle four principles to evaluate the research.

Chapter 4

Theoretical Background

This chapter briefly describes the fundamentals of CMMI for services (CMMI-SVC) and it based on (CMMI Product Team, 2010). These fundamentals will provide the basis for the development of the proposed method.

CMMI models are collections of best practices that help organizations to improve and assess their processes. CMMI-SVC uses those practices to provide a comprehensive integrated set of guidelines for providing superior services. In order to do it, this model offers guidance for applying CMMI best practices in a service oriented provider organization, focusing on activities for providing quality services to customers and end users.

This model covers the activities required to establish, deliver and manage services and contain practices that cover work management, process management, service establishment, service delivery and support, and supporting processes.

CMMI-SVC is composed by twenty four process areas (PAs), that are clusters of related practices in an area that, when implemented collectively, satisfies a set of important goals for making improvements in that area.

In order to satisfy a process area specific goals (SGs) are defined. Specific goals describe the unique characteristics that must be present to satisfy the process area and are composed by specific practices (SPs) that are the description of an activity that is considered important in achieving the associated specific goal.

In the other hand, generic goals (GGs) apply the same statement to multiple process areas. They describe the characteristics that must be present to institutionalize processes that implement a process area. The generic goals are composed by generic practices (GPs) that describe the activities that needed to be addressed in order to achieve the generic goal and institutionalize the processes associated with a process area. The generic goals and generic practices are common to all CMMI models.

CMMI-SVC uses levels to describe an evolutionary path recommended for an organization that want to improve their processes. Levels can also be the outcome of the rating activity in appraisals.

There are two improvement paths using levels: the first one enables organizations to incrementally improve processes corresponding to an individual process area (continuous approach) and is associated with capability levels; the second one enables organizations to improve a set of related processes by incrementally addressing successive sets of process areas (staged approach) and is associated with maturity levels.

Capability levels are means to incrementally improve the processes corresponding to a a specific process area. There are four capability levels, from Incomplete (Level 0) to Defined (Level 3). Maturity levels are means to improve the processes corresponding to a specific set of process areas. There are five maturity levels, from Initial (Level 1) to Optimizing (Level 5). A resume of these levels are presented in **Table 4.1**.

Level	Continuous Representation Capability Levels	Staged Representation Maturity Levels
Level 0	Incomplete	
Level 1	Performed	Initial
Level 2	Managed	Managed
Level 3	Defined	Defined
Level 4		Quantitatively Managed
Level 5		Optimizing

Table 4.1: Comparison of Capability and Maturity Levels (CMMI Product Team, 2010)

Process areas have an assigned maturity level and can be represented from both the continuous and staged perspective, **Fig. 4.1**. This representation allows organization helps organizations to opt by choose to focus in a specific process' improvement, by choosing a specific process area from the continuous representation; or to focus on a set of interrelated process areas, by choosing it from the staged representation.

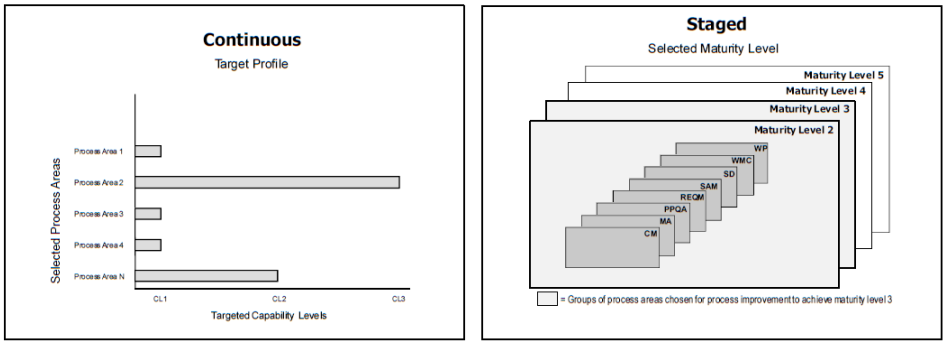

Figure 4.1: Process Area in the Continuous and Staged Representation (CMMI Product Team, 2010)

For the continuous representation process areas can be organized in four categories: Process Man-

agement, Project and Work Management, Service Establishment, and Support. These categories are based on some of the key relationships among the process areas.

The proposed solution will be focused on the continuous approach, for this reason we found important to specify the meaning of each one of the capability levels proposed in the CMMI-models:

- **Capability Level 0 - Incomplete Process**: The process is not performed or is partially performed, i.e., one or more of the specific goals of the process area are not satisfied;
- **Capability Level 1 - Performed Process**: The process accomplishes the needed work to produce work products, i.e., the specific goals of the process area are satisfied;
- **Capability Level 2 - Managed Process**: It is a performed process that is planned and executed in accordance with policy; employs skilled people; produce controlled outputs; involves relevant stakeholders; is monitored, controlled, and reviewed; and is evaluated. Nevertheless, the execution of the process can be quite different in each instance of the process depending, for instance, of the work group;
- **Capability Level 3 - Defined Process**: It is a managed process that is tailored from the organization's set of standard processes according with the organization's tailoring guidelines. This level ensures that the instances of the process are more consistent through a more rigorous description of the process than at capability level 2.

A summary of the target profiles that must be achieved when using the continuous approach to be equivalent to maturity levels are presented in **Fig. 4.2**. The rules of the equivalent staging are:

- **Maturity level 2**: All the process areas assigned to maturity level 2 must achieve capability level 2 or 3;
- **Maturity level 3**: All the process areas assigned to maturity level 2 and 3 must achieve capability level 3;
- **Maturity level 4**: All the process areas assigned to maturity level 2, 3, and 4 must achieve capability level 3;
- **Maturity level 5**: All process areas must achieve capability level 3.

Finally, it is important to refer that CMMI-SVC are a well tested and known model that has been proved to bring benefits to organizations that have adopt it.

Name	*Abbr.*	*ML*	*CL1*	*CL2*	*CL3*
Configuration Management	CM	2			
Measurement and Analysis	MA	2			
Process and Product Quality Assurance	PPQA	2			
Requirements Management	REQM	2			
Supplier Agreement Management	SAM	2			
Service Delivery	SD	2			
Work Monitoring and Control	WMC	2			
Work Planning	WP	2			
Capacity and Availability Management	CAM	3			
Decision Analysis and Resolution	DAR	3			
Incident Resolution and Prevention	IRP	3			
Integrated Work Management	IWM	3			
Organizational Process Definition	OPD	3			
Organizational Process Focus	OPF	3			
Organizational Training	OT	3			
Risk Management	RSKM	3			
Service Continuity	SCON	3			
Service System Development	SSD	3			
Service System Transition	SST	3			
Strategic Service Management	STSM	3			
Organizational Process Performance	OPP	4			
Quantitative Work Management	QWM	4			
Causal Analysis and Resolution	CAR	5			
Organizational Performance Management	OPM	5			

Figure 4.2: Target Profiles and Equivalent Staging (CMMI Product Team, 2010)

Chapter 5

Proposal

This chapter corresponds to the *design and development* step of DSRM, in which we will present a *new* method (Österle et al., 2011) to solve the problem presented in Chapter 2.

We propose a method based on a **Cloud Maturity Model**, **Fig. 5.1** . The Cloud Maturity Model was based on the outsourcing lifecycle (Cullen et al., 2005) and on the continuous approach for processes' improvement of CMMI-model (CMMI Product Team, 2010). 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.

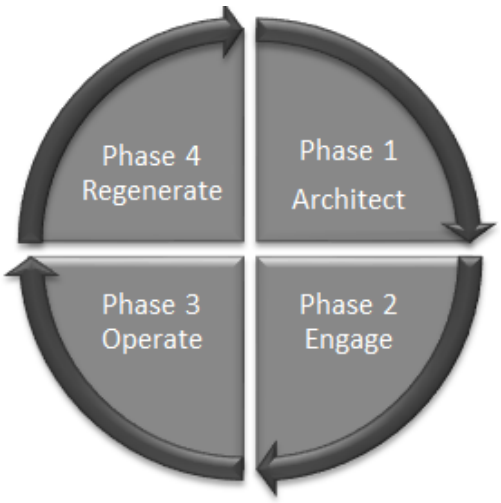

Figure 5.1: Cloud Maturity Model

We used the outsourcing lifecycle proposed by (Cullen et al., 2005) as a basis because, although it does not have the Cloud concept, it is recommended to manage ITO and BPO while the Cloud lifecycle proposed by (Lindner et al., 2011) is only focused on IT services migration and management.

The reasons that led us to choose the CMMI-SVC as the base for the solution are the fact that it is an

evolution of the CMM (CMMI Product Team, 2010), which means CMM is obsolete when compared to CMMI-SVC. In addition, the IT-CMF is focused on the IT department and, for that reason it does not fulfill the objectives of the solution. Furthermore, CMMI-SVC is a clearly outlined and well-known model that has been tested, showed good results when applied and also has a well-defined continuous approach (CMMI Product Team, 2010). Finally, CMMI-SVC is focused on services delivery and nowadays the services' sector represents most of the global GDP (Central Intelligence Agency, 2011).

The proposed model was developed in two steps: **first**, we adapted the outsourcing lifecycle to Cloud (defining what needs to be done) and **second**, we developed the maturity model itself (defining how to improve the processes).

The outsourcing lifecycle has used as a basis to know which activities need to be performed, and in which order, to migrate services to Cloud and manage them, thus defining the set of activities to perform. In order to adapt the outsourcing lifecycle, we analyzed the key activities of each building blocks and them selected the ones that apply to Cloud computing and/or add new ones if necessary and finally evaluate the result with interviews (see Section 7.3). The resulting key activities were used in the respective building blocks.

To know how to improve the processes of the lifecycle, gathered from the above point, we have used the continuous approach to processes' improvement of the CMMI-model. This was done as follows:

1. First, we created four new process areas, one for each phase of the lifecycle (Architect, Engage, Operate, and Regenerate), **Fig. 5.1**. Each one of those process areas have one specific goal composed by one or more specific practices. There are a specific practice for each of the building blocks of the outsourcing lifecycle, which include the key activities in their description. For instance, in **Fig. 5.2** we present the final result for the Architect phase, in this case, we created a corresponding process area (Cloud Architect) composed by a specific goal (Architect the Cloud contract) and the four building blocks of the outsourcing lifecycle (Investigate, Target, Strategize, and Design) were added to the specific goal as specific practices;

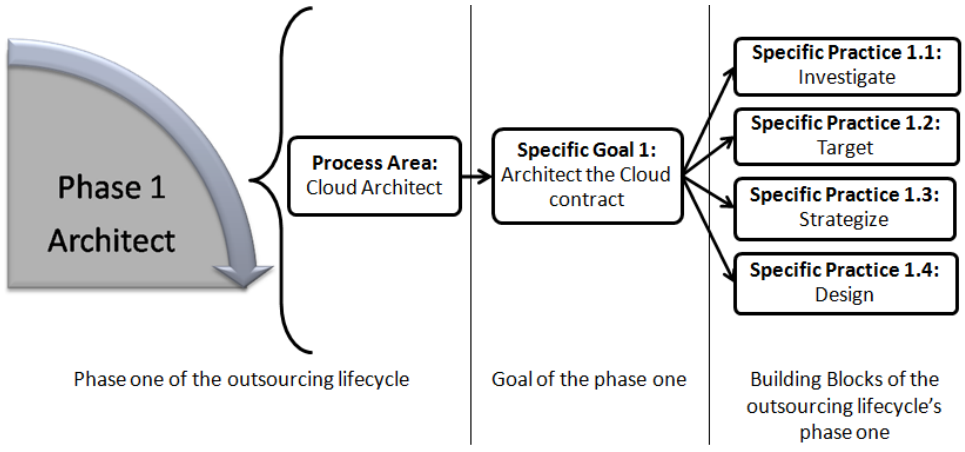

Figure 5.2: Process area associated with the phase one of the outsourcing lifecycle

2. Second, we created the elaborations for each of the new process areas, based on the existing generic goals and practices of the CMMI-model. This was done through the addition of four new elaborations (Cloud Architect, Cloud Engage, Cloud Operate, and Cloud Regenerate) in each one of the generic practices of the CMMI-model. This phase allows the assessment and improvement of the process areas capability levels, **Fig. 5.3**.

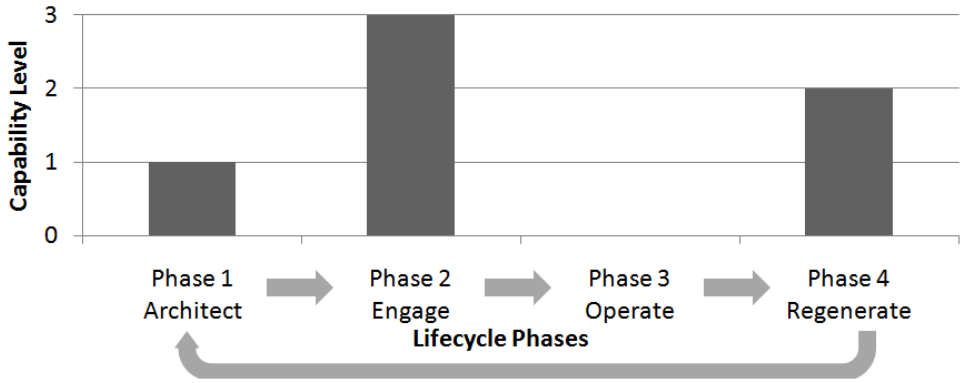

Figure 5.3: Example of an assessment result of the proposed lifecycle

In the next section we present the proposed Cloud Maturity Model.

5.1 Cloud Maturity Model

In this section we present the proposed Cloud Maturity Model and explain how it should be used in organizations.

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 see Section 7.3. The proposed key activities are presented in **Fig. 5.4** and are the result from the adaptation of the outsourcing lifecycle to Cloud.

The key activities, building blocks, and phases was 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. 5.5**.

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). The book with the process areas are presented in Appendix B, and the book with the generic goals are presented in Appendix C.

	Build Block	Key Activity
Architect	BB1: Investigate	1. Gather insight (e.g., via experts and experienced organizations) 2. Determine and test goals/expectations 3. Collect intelligence on market conditions and potential suppliers 4. Investigate similar decisions and peer organizations 5. Analyze the organization's competences and strategy
	BB2: Target	6. Match goals to appropriate Cloud model 7. Identify, with objective criteria, suitable services to migrate/acquire in the Cloud 8. Prepare the seven baseline and future state profiles: service, cost, asset, staff, stakeholder, current contracts, and governance
	BB3: Strategize	9. Decide the rollout approach (e.g., big bang, phased) 10. Determine key "rules" (e.g., governing docs, number of suppliers, asset ownership, risk/reward) 11. Design the detailed lifecycle of the project, identifying and sourcing the necessary skills and prepare the communication strategy 12. Prepare the business case rules and the base case 13. Design an exit strategy 14. Asses feasibility, risk and impact to the organization
	BB4: Design	15. Prepare the commercial and operating blueprint 16. Develop the four balanced score metrics - service, financial, relationship and strategic 17. Draft the service level agreement - scope, metrics/incentives, reporting, and governance 18. Draft the price framework (e.g., fixed, variable, cost plus items) 19. Draft the contract 20. Design the inter-party relationship (e.g., structure, roles, authorities) and the retained organization (kept functions) 21. Design the contract management function (governance)
Engage	BB5: Select	22. Plan and detail the tender stages 23. Identify the right evaluation team - breadth and depth 24. Determine the right evaluation criteria and strategy for each tender stage 25. Request right, clear and comprehensive bid data for each tender stage 26. Facilitate the best responses (e.g.,briefings, Q&A, and data room) 27. Use interactive evaluation techniques (e.g., interviews and site visits) 28. Select supplier based on value for money 29. Construct the five due diligences on supplier: company, price, solution, contract, and customer references
	BB6: Negotiate	30. Prepare negotiation strategy and prioritize negotiation items 31. Conduct and evaluate a pilot project 32. Conduct effective negotiations
Operate	BB7: Transition	33. Finalize and mobilize all plans (e.g., communications, risk, setup, and acceptance) 34. Resource the transition project (e.g., manage the impact on staff, the transfers, and knowledge retention and transfer) 35. Implement retained organization and contract management 36. Create or update workflows, communication channels, authorities, etc. 37. Conduct closeout and post-implementation review
	BB8: Managment	38. Invest in the relationship (plan, assess and improve) and keep communication among parts 39. Meaningful reporting and analyses 40. Diligent documentation and administration 41. Manage risks and plan contingencies 42. Manage issues, variations and disputes 43. Effect continuous improvement and streamlining 44. Evaluate and audit supplier (controls, performance, compliance) 45. Knowledge refreshment (e.g., market, technology, price, and metrics) 46. Evaluate organization both as a customer and contract manager
Regenerate	BB9: Refresh	47. Assess next generation options (backsource, retention, handover) 48. Assess contract outcomes and lessons 49. Reassess requirements - re-scope, re-bundle and re-design 50. Refine the strategy and business case for each option

Figure 5.4: Cloud Building Blocks and Key Activities

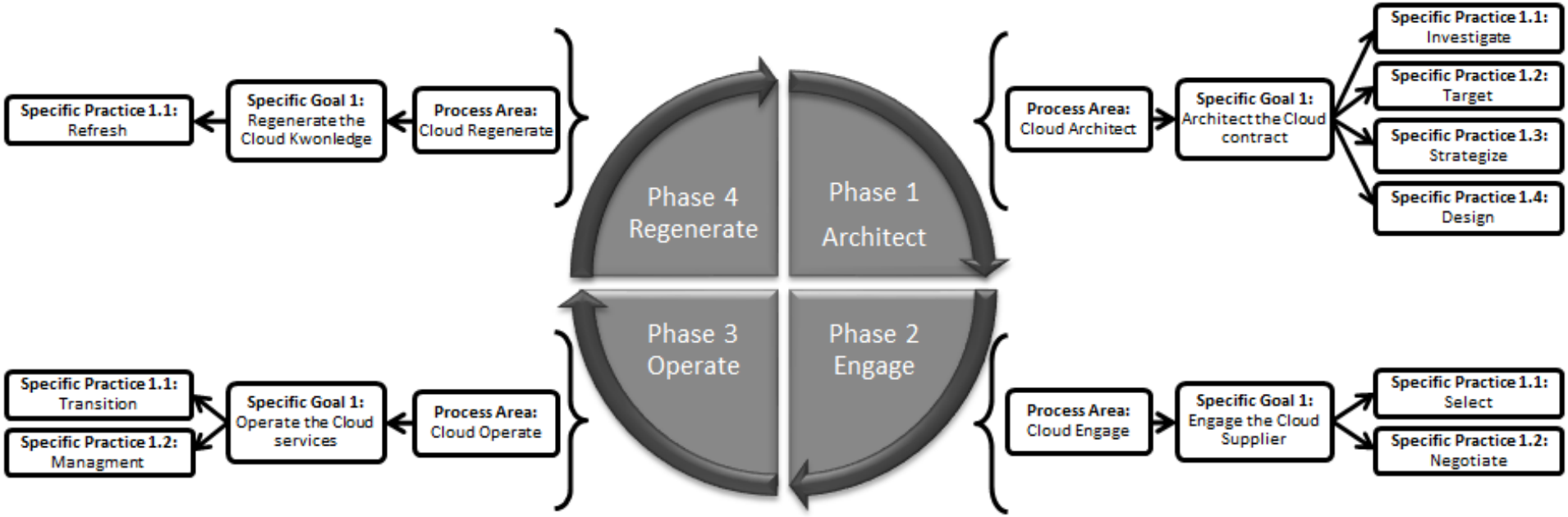

Figure 5.5: Final Cloud Lifecycle with Process Areas

Regarding the usage of the maturity model there are two assumptions to consider. First one, we consider that the decision to migrate services to Cloud has already been 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 one, 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 (M. C. Lacity & Willcocks, 2012, Willcocks & Lacity, 2012).

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 processes are 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 activities in order to implement the specific practices proposed, as long as them can justify that their activities 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 Chapter 6 and their respective evaluations in Chapter 7.

Chapter 6

Demonstration

This chapter corresponds to the *demonstration* step of DSRM in which we demonstrate that the proposal (Chapter 5) can be used to solve one or more instances of the problem stated on Chapter 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. An example of the current capability levels and the proposed improving path is present in **Fig. 6.1**. For instance, in the figure Phase 1 is at Level 1 and we propose to increase to Level 3.

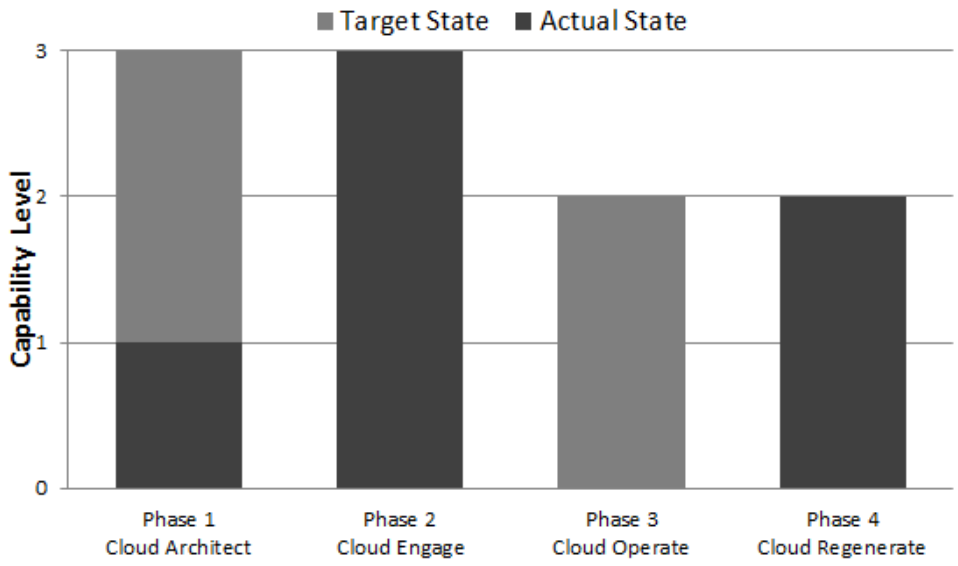

Figure 6.1: Example of the actual state and the target state

The assessment was done through interviews within the organization and we have proposed a target state with base on the organizations' strategy.

We have choose organizations from three different sectors in order to show that the model is abstract and not specific to a given sector. The summary of the organizations, and the interviewees, in which the

demonstrations were performed is presented in **Tab. 6.1**.

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 6.1: Summary of organizations used in the demonstration

For each demonstration we started by presenting the problem and the proposed solution, the Cloud Maturity Model. After that we performed an assessment of the processes used by the organizations to migrate and manage services in the Cloud.

The assessments were performed using the Cloud Maturity Model books in a face-to-face semi-structured interviews in which the interviewees were asked if they are using some of the generic practices, specific practices, or key activities proposed in the model. When we receive positive answers we asked the interviewees to justify why they consider that they are performing the practices or activities and how they are performing them. Finally, we used the generic goals to assess the capability level of the process areas in each they have achieved all the specific practices.

Using the results from the interviews we had also proposed a target state for organizations to achieve in order to improve their processes.

At the end of the interviews, interviewees were asked to classify the eight quality factors proposed in Moody and Shanks Quality Management Framework (Moody & Shanks, 2003) without intervention from the interviewers. The results are presented in Section 7.4.

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.

6.1 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 (European Commission, 2005), 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. 6.6**.

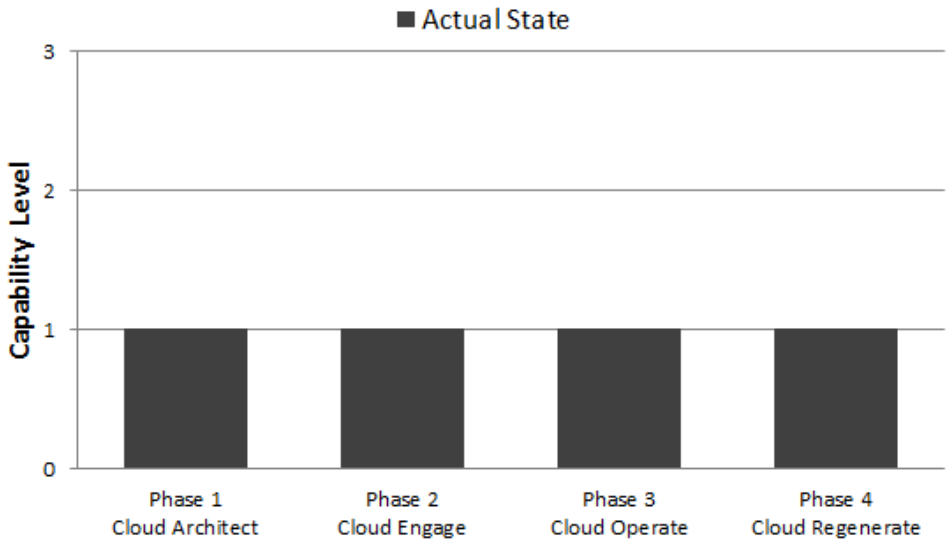

Figure 6.2: Actual state of Organization A

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. 6.7** represents the target state for Organization A.

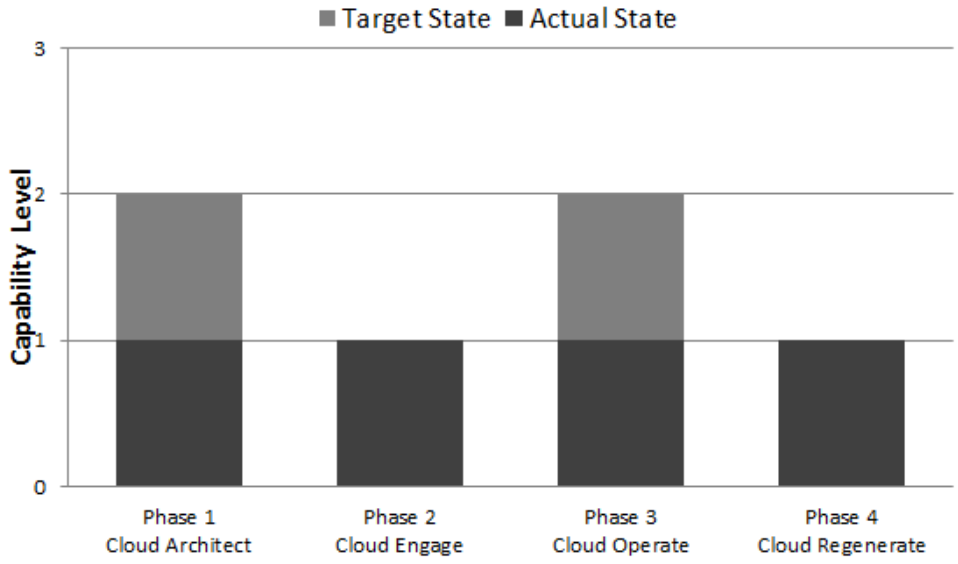

Figure 6.3: Target state of Organization A

Finally, the assessment results and the proposed target state were presented to Organization A. The outcomes of the demonstration are described in Chapter 7.

6.2 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 (European Commission, 2005), 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. 6.6**.

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 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.

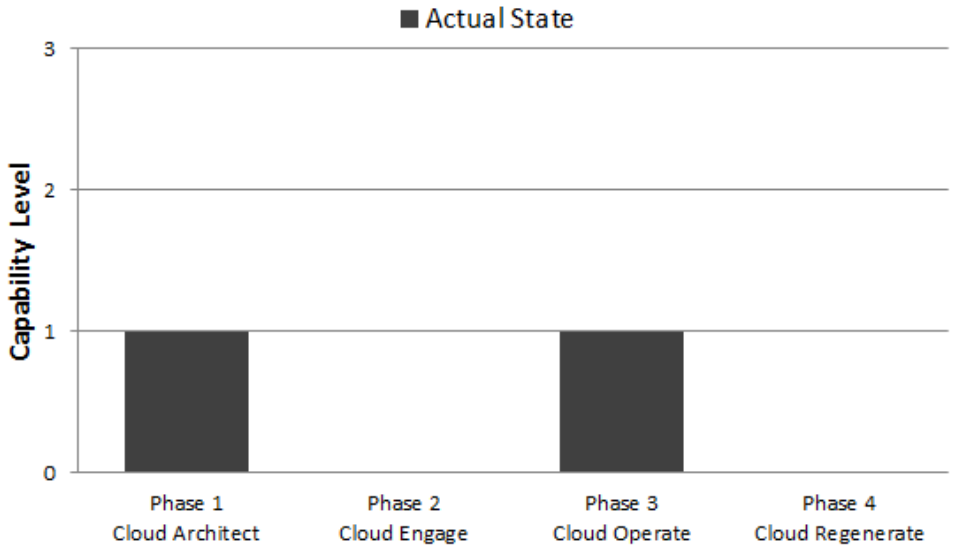

Figure 6.4: Actual state of Organization A

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. 6.7** represents the target state for Organization B.

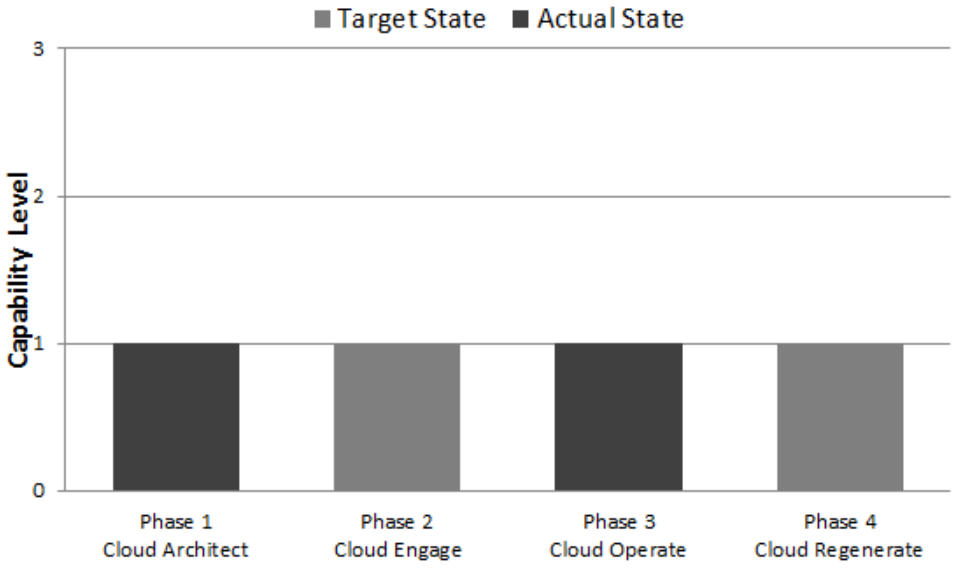

Figure 6.5: Target state of Organization A

Finally, the assessment results and the proposed target state were presented to Organization B. The outcomes of the demonstration are described in Chapter 7.

6.3 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 (European Commission, 2005), 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. 6.6**.

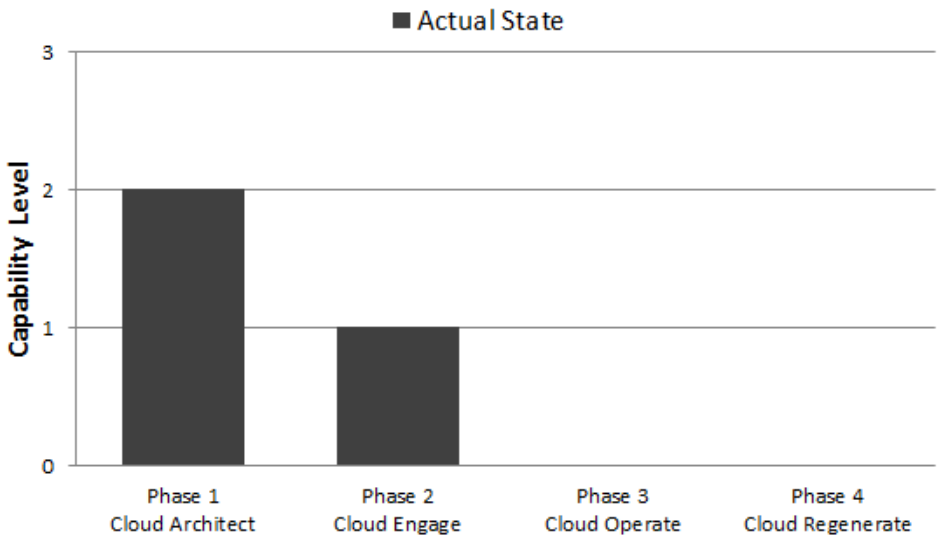

Figure 6.6: Actual state of Organization C

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.

Our final improvement proposal is shown in **Fig. 6.7**.

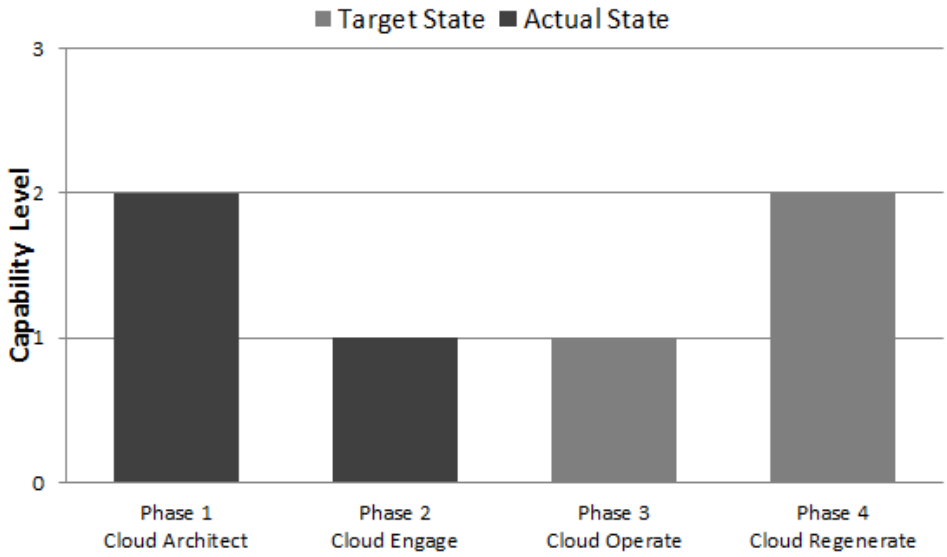

Figure 6.7: Target state of Organization C

Finally, the assessment results and the proposed target state was presented to Organization C. The outcomes of the demonstration are described in Chapter 7.

6.4 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.

Chapter 7

Evaluation

This chapter corresponds to the *evaluation* step of DSRM in which we will compare the results of the demonstration (Chapter 6) with the objectives of the solution (Section 3.5).

7.1 Evaluation Framework

The evaluation method will consist in the following steps:

- **Interviews**: gather feedback from the proposed key activities in order to adapt them to the Cloud, and gather information to the demonstrations;
- **Scientific community**: submit papers in order to get appraisal of the community;
- **Moody and Shanks Quality Management Framework**: assess the quality of the produced method;
- **Österle et al. principles**: to evaluate the research.

The DSRM outline five evaluation methods: Observational, Analytical, Experimental, Testing, and Descriptive (Hevner et al., 2004). In this research we will use the **Observational** method, when the artifact is studied in a business environment; the **Analytical**, to examine the structure and/or behavior of an artifact; and the **Descriptive**, to build a convincing argument for the artifact's utility through the use of relevant research and construct detailed scenarios around the artifact in order to demonstrate its utility (Hevner et al., 2004).

Interviews: this step consists on the following steps:

1. Try to address the validation of the research problem, the relevance of it, and the proposed method;

2. Evaluate the proposed key activities, adding or removing key activities from the outsourcing lifecycle, which is used to anticipate improvements on the method;

3. Gather information relative to the processes used by organizations to migrate and manage services in the Cloud in order to perform the assessments.

Moody and Shanks Quality Management Framework: the framework propose eight quality factors (Moody & Shanks, 2003):

- **Completeness**: the artifact contains all user requirements;
- **Simplicity**: the artifact contains the minimum possible entities and relationships;
- **Flexibility**: the ease with which the artifact can support business and/or regulatory change without the need for change itself;
- **Integration**: the consistency of the artifact within the organization;
- **Understandability**: the ease with which the concepts and structures in the artifact can be understood;
- **Implementability**: the ease with which the artifact can be implemented in the time, budget and technology available for the project;
- **Integrity**: business rules and/or constraints are defined from the user requirements in order to guarantee the artifact integrity;
- **Correctness**: is defined as whether the model is valid, i.e., conforms to the rules of the modeling technique.

Österle et al. principles: in order to evaluate the research Österle et al. propose four principles (Österle et al., 2011):

- **Abstraction**: the artifact must be applicable to a class of problems;
- **Originality**: the artifact must substantially contribute to the advancement of the body of knowledge;
- **Justification**: the artifact must be justified in a comprehensible manner and must allow validation;
- **Benefit**: the artifact must yield benefit, either immediately or in the future, for the respective stakeholder groups.

Finally, after the conclusion of the steps of this chapter it is expected to gather enough knowledge in order to decide if we need go back, and modify the previous objectives defined for the solution or perform modifications in the proposed method, skip forward and communicate the results of this research (Peffers et al., 2008).

7.2 Design Science Research Evaluation Framework

The DSRM consider the evaluation step as being one of the most important ones. This occurs because it is this step that verifies the contribution of the solution, its utility, quality and efficacy to the identified problem (Hevner et al., 2004). (March & Smith, 1995) argues that evaluation regards the development of evaluation criteria and the assessment of the method's results in comparison with those criteria.

Accordingly with (Hevner et al., 2004) there are five evaluation methods: Observational, Analytical, Experimental, Testing, and Descriptive. Nevertheless, the authors does not provide much guidance on how to use the methods.

In order to provide guidance in how to use the methods (Pries-Heje et al., 2008) have proposed a framework to help researchers to build strategies for evaluation and to improve the rigor in DSR.

The proposed frameworks splits the evaluation in two dimensions:

- The first one is related with the evaluation's form. The form can be artificial, i.e., evaluates the solution in a artificial and non-realistic way (e.g., laboratory experiments and mathematical proofs), or it can be naturalist, i.e., evaluates the solution within its real environments using real users, real problems and taking into account the human behavior.
- The second one is related with the moment in time of the evaluation. The evaluation can be performed ex-ante, i.e., before the artifact is developed, or ex-post, i.e., the evaluation is performed with the artifact already developed.

Finally, the framework also defines that the artifact can be a process or a product and that a process and criteria must be defined. **Fig. 7.1** represents the two dimensions and the possible combinations.

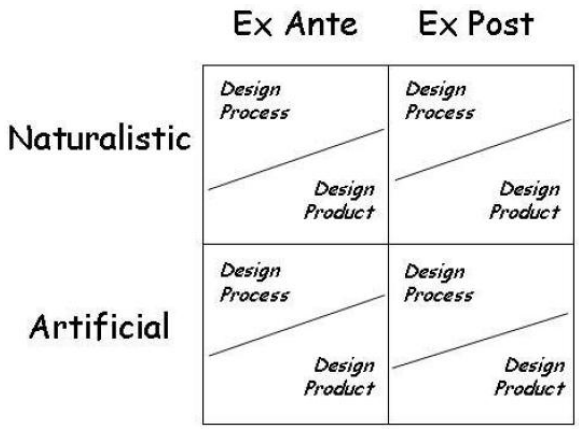

Figure 7.1: DSR Evaluation Strategies (Pries-Heje et al., 2008)

In order to evaluate the artifact the framework proposes a strategy based in three questions:

- When does evaluation take place?

- What is actually evaluated?
- How is it evaluated?

In our research the evaluation is inserted on the quadrant present in **Fig. 7.2**, since it was done after the development of the artifact in a naturalistic way (we use demonstrations in real organizations) and we have evaluated the proposed method.

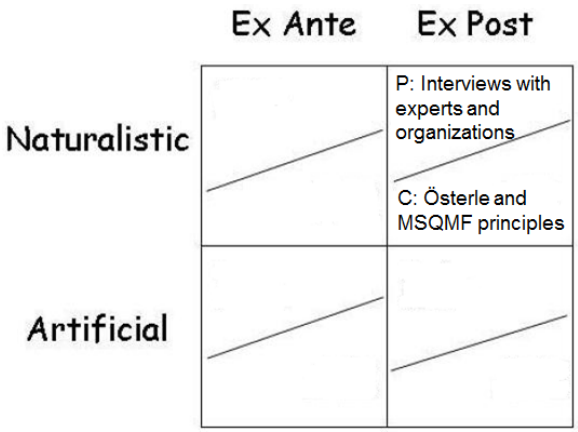

Figure 7.2: DSR Evaluation Strategy Instantiation (adapted from (Pries-Heje et al., 2008))

Finally, the used process was interviews and we used as criteria the four principles of Österle and the MSQMF.

7.3 Interviews

In this section we will explain how the interviews where conducted and present the results gathered during the process.

To evaluate the proposed key activities we have performed a set of twelve semi-structured interviews with seven Cloud clients and five Cloud suppliers. The opinion of the suppliers was useful since they interact with a high range of clients, thus having knowledge about what the clients need to do to migrate and manage their services in the Cloud.

The set of clients include public and private organizations, from small to large ones (European Commission, 2005), and the suppliers set include private organizations, from a large and well-established organization to a small start-up. **Tab. 7.1** presents the summary of the organizations interviewed.

The interviews consisted of a face-to-face or online meeting (e.g. Skype) questionnaire. At the beginning of the meeting we performed a brief explanation of the outsourcing lifecycle and the objectives of the questionnaire. After that, the interviewees were asked to evaluate the set of fifty-four key activities proposed by Cullen et al. (Cullen et al., 2005) in the outsourcing lifecycle, using the scale presented in **Tab. 7.2**.

Type	Sector	Role	Years of experience	Number of employees
Client	Banking	CIO	14	170
Client	Public Administration	CIO	20	130
Client	Public Administration	CIO	8	450
Client	Services	IT Manager	5	68
Client	Services	Financial Manager	5	68
Client	Education	IT Coordinator	2	403
Client	Services	IT Manager	8	6 400
Supplier	IT Services	Customer Services Director	16	56
Supplier	IT Services	Solution Specialist	24	90 000
Supplier	IT Services	ISV Partner Manager	18	90 000
Supplier	IT Services	Manager Partner	5	15
Supplier	Services	CEO	3	6

Table 7.1: Summary of the interviewees

Value	Description
1	Key practice is not applicable/necessary in Cloud
2	Key practice is not important in Cloud
3	Key practice is important in Cloud
4	Key practice is very important in Cloud

Table 7.2: Scale used in the interviews

The interviewees were also asked to explain their classification and propose changes or additions to the existing set of key practices in order to adapt them to the Cloud.

In the following sections we will present the results gathered from the interviews (Section 7.3.1), the analysis of those results (Section 7.3.2), and finally a brief summary of the interviews (Section 7.3.3).

Finally, we also used interviews to gather information about the processes used by organizations to migrate and manage services in the Cloud, as referred in Chapter 6.

7.3.1 Results

In this section we present the results gathered during the *design and development* step of DSRM.

The main goal of this step was to validate the key practices used in the outsourcing lifecycle and to adapt it to the Cloud through the removal, addition or rewriting of key practices.

The interviews' results are illustrated in **Fig. 7.3**. The leftmost point of the lines represent the lowest value assigned, the rightmost point of the lines represents the highest value assigned and the circle represents the average result of the specific key practice.

	Building Block	Key Activity	Importance
Arquitect	BB1: Investigate	1) Gather insight via experts and experienced organizations	
		2) Determine and test goals/expectations	
		3) Collect intelligence on market conditions and potential suppliers	
		4) Investigate similar decisions and peer organizations	
	BB2: Target	5) Match goals to appropriate Cloud model	
		6) Identify, with objective criteria, suitable services to migrate to the Cloud	
		7) Prepare the seven baseline and future state profiles: service, cost, asset, staff, stakeholder, contracts, and governance	
	BB3: Strategize	8) Decide the rollout approach (e.g., big bang, phased)	
		9) Determine key "rules" (e.g., governing docs, number of suppliers, risk/reward)	
		10) Design the detailed end-to-end lifecycle program/project	
		11) Identify and source the lifecycle skills	
		12) Prepare the lifecycle communications strategy	
		13) Prepare the business case rules and the base case	
		14) Asses feasibility, risk and impact to the organization	
	BB4: Design	15) Prepare the commercial and operating blueprint	
		16) Develop the four balanced score metrics - service, financial, relationship and strategic	
		17) Draft the service level agreement - scope, metrics/incentives, reporting, and governance	
		18) Draft the price framework (e.g., fixed, variable, cost plus items)	
		19) Draft the contract	
		20) Design the inter-party relationship (e.g., structure, roles, authorities)	
		21) Design the retained organization (kept functions)	
		22) Design the contract management function (governance)	
Engage	BB5: Select	23) Plan and detail the tender stages	
		24) Identify the right evaluation team - breadth and depth	
		25) Determine the right evaluation criteria and strategy for each tender stage	
		26) Request right, clear and comprehensive bid data for each tender stage	
		27) Facilitate the best responses (e.g., briefings, Q&A, and data room)	
		28) Use interactive evaluation techniques (e.g., interviews and site visits)	
		29) Select supplier based on value for money	
		30) Construct the five due diligences on supplier: company, price, solution, contract, and costumer references	
	BB6: Negotiate	31) Prepare negotiation strategy and prioritize negotiation items	
		32) Conduct effective negotiations	
Operate	BB7: Transition	33) Finalize and mobilize all plans (e.g., communications, risk, setup, and acceptance)	
		34) Resource the transition project	
		35) Manage the impact on staff (retained, transferring, departing)	
		36) Manage the transfers (e.g., staff, asset and work-in-progress)	
		37) Manage knowledge retention and transfer	
		38) Implement retained organization and contract management	
		39) Engineer workflows, communication channels, authorities, etc.	
		40) Conduct acceptance, closeout and post-implementation review	
	BB8: Manage	41) Invest in the relationship (plan, assess and improve)	
		42) Meaningful reporting and analyses	
		43) Regular communication and meetings	
		44) Diligent documentation and administration	
		45) Manage risks and plan contingencies	
		46) Manage issues, variations and disputes	
		47) Effect continuous improvement and streamlining	
		48) Evaluate and audit supplier (controls, performance, compliance)	
		49) Evaluate organization both as a customer and contract manager	
Regenerate	BB9: Refresh	50) Assess next generation options (backsource, retain, handover)	
		51) Assess contract outcomes and lessons	
		52) Knowledge refreshment (e.g., market, technology, price, and metrics)	
		53) Reassess requirements - re-scope, re-bundle and re-design	
		54) Determine the strategy and business case for each option	

Figure 7.3: Building blocks and key activities (adapted from (Cullen et al., 2005)) and results from the interviews

By analyzing the graphic we can conclude that the key activities number 6 (*identify, with objective cri-*

teria, suitable services to migrate to cloud) and number 14 (*assesses feasibility, risk and impact to the organization*) are the most important in the Cloud environment. After those activities, there are activities number 3 (*collect intelligence on market conditions and potential suppliers*), number 21 (*design the retained organization (kept function)*), number 29 (*select supplier based on value for money*), and number 45 (*manage risk and plan contingencies*).

On the contrary, the lowest importance was attributed to the key activities numbers 10, 11 and 12, all of them related to the design and communication of the project's lifecycle; and activity number 43, *regular communication and meetings*.

Through the analysis of the results, we can observe that 6 out of 54 of the key activities evaluations were very distinct, going from one, not necessary or applicable in the Cloud, to four, very important in the Cloud. 24 out of 54 were classified between two, not important in the Cloud, to four. Finally, 24 out of 54 of the activities were classified between three, important in the Cloud, and four.

In spite of the variation in the classifications, the results were positive for 93% of the key activities.

7.3.2 Analysis

In this section we use the results and performed analysis to retrieve knowledge for the construction of the Cloud Maturity Model.

The results were negative for key activities number 10, 11 and 12. All of these activities are related to the design and communication of the project's lifecycle. Nevertheless, these key activities are related to the reduction of change resistance, and, despite the Cloud usually presents faster lifecycles than the normal outsourcing, the Cloud projects still have a transition phase, an operation phase, and a discontinuing phase (M. C. Lacity & Willcocks, 2012, Willcocks & Lacity, 2012). For the previous reason, we opted to merge all the activities into one, *design the detailed lifecycle of the project, identifying and sourcing the necessary skills, and preparing the communication strategy*, instead of removing the activities.

The key practice number 43 also showed negative results. This key activity consists on *regular communication and meetings* which the majority of the interviewees stated to be not necessary in the Cloud environment. However, they also acknowledged that communication among both parts is important from time to time. Using the suggestion of the interviewees, we opted to include activity 43 in activity 41, *invest in the relationship (plan, assess and improve)*, resulting in *invest in the relationship (plan, assess and improve) and keep communication among parts*.

The interviewees also suggested the merge and addition of some of the key activities. Starting with the merge of activities, the suggestions are to merge activities 20 and 21 into a single activity; and activities 34, 35, 36 and 37 also into a single activity since all of them are related to the transition project.

The proposed add-ons were the addition of the activity *analyze the organization's competences and*

strategy to the Investigate building block; the activity *conduct and evaluate a pilot project* to the Negotiate building block; and *design an exit strategy* to the Strategize building block.

Regarding the proposed changes, the interviewees suggested changes in the following activities: activity 1, changed to *gather insight (e.g., via experts or experienced organizations)*; activity 6, changed to *identify, with objective criteria, suitable services to migrate into/acquire in the Cloud*; activity 39, changed to *create or update workflows, communication channels, authorities, etc*; activity 40, changed to *conduct closeout and post-implementation review*; and activity 54, changed to *refine the strategy and business case for each option*.

Interviewees were of the opinion that activity 52, *knowledge refreshment (e.g., market, technology, price, metrics)*, should be performed regularly instead of only being performed at the end of the cycle. Thus, we opted to remove the activity from the ”Refresh build block” and added it to the ”Manage build block”. The last one is performed during the contract and will avoid deviations from the original strategy during the execution of the other building blocks.

Finally, the resulting lifecycle has 50 key activities to migrate and manage Cloud services that were evaluated, proposed and validated by the interviewees. These key activities, together with their building blocks and phases, were used in the definition of the Cloud Maturity Model (Section 6.3).

7.3.3 Summary

After the analysis of the results gathered from the interviews we conclude that the key activities proposed in the outsourcing lifecycle are close to the final results, being only needed minor changes in the set of key activities. This results confirms the close relation among outsourcing and Cloud computing and that it is possible to adapt the outsourcing lifecycle to the Cloud.

During the interviews we have also collected informal information that allows us to validate the importance of the research problem and its relevance. We have also receive positive feedback regarding the proposed model, organizations had show interest in the model and in the proposed key activities. Interviewees also refer the lack of knowledge that exists in the migration and management of services in the Cloud.

Finally, the information presented in this section was published in (Duarte & Mira da Silva, 2013).

7.4 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 results are presented in **Fig. 7.4**.

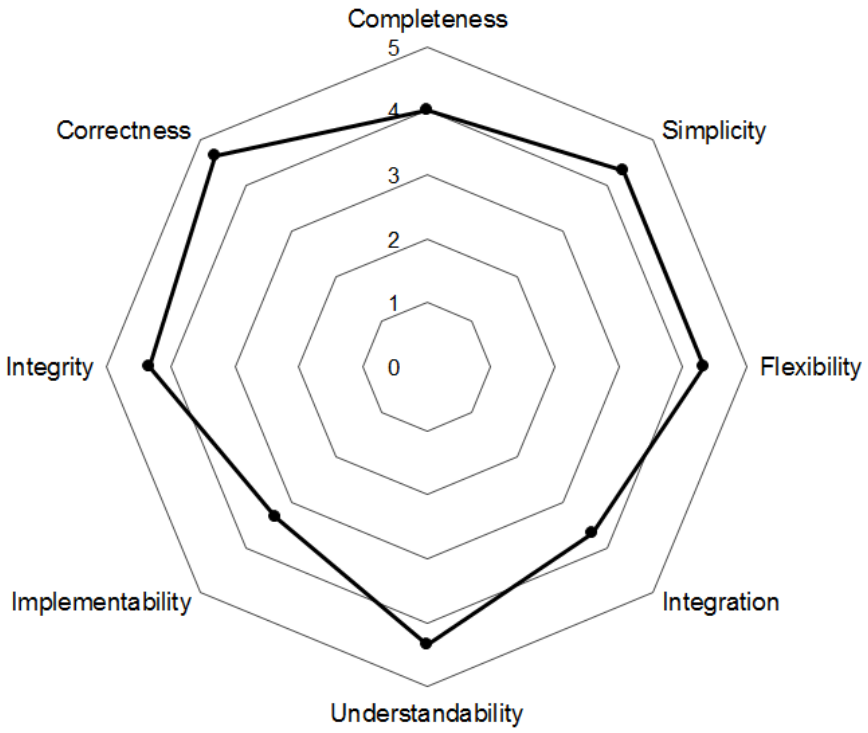

Figure 7.4: Results of the MSQMF

The analysis of **Fig. 7.4** 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.

7.5 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 key activities 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.

7.6 Summary

In this section we will compare the objectives of the solution (Section 3.5) with the gathered results. After that, we will state the conclusions achieved in this chapter.

The first objective was to propose a method based on a lifecycle and a maturity model approach to create a systematic approach for organizations migrate and manage their services in the Cloud. This objective has been successfully achieved as shown in the evaluation results of the MSQMF and the Österle principles.

We also defined as objectives the evaluation and communication of the method, in order to show its efficiency and efficacy. The evaluation were performed using the MSQMF and the Österle principles and, as shown in the previous sections, it was positive, thus proving the efficiency and efficacy of the method. Regarding the communication, in section 8.1 we show that it was achieved through the submission of scientific publications and the writing of the research itself.

The evaluation allow us to draw some conclusions and to propose some aspects to take into account when implementing the method. The first one is to use a change management project when implementing the method. This will mitigate the risk associated with the change in the processes used by the organizations to migrate and manage services in the Cloud, or even if it is the first time that the organization is moving services to the Cloud.

Other useful conclusion is that for smaller organizations with few resources in the IT department found the method to large for them. To solve this problem we advice smaller organizations to only implement the process areas and use the best practices that they are capable of support and that will bring them value when migrating and managing services in the Cloud.

Finally, we conclude that the method was accepted and have provided the needed systematic approach that allows organization migrate and manage their services in the Cloud.

Chapter 8

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**.

In the current literature only one solution tries to address this problem from the client's perspective, but it only solve it partially since it is focused on IT services and does not take into account IT-enabled services. Some approaches could be used to solve the problem, such as existing maturity models or lifecycles approaches, but, due to its novelty, the concept of Cloud computing is not present in any of those approaches.

Following this, our objective is to create a method based on a lifecycle and on a maturity model approach that will allow organizations migrate and manage their services in the Cloud. We chose to use the ITO & BPO lifecycle since it is a well defined and tested model in outsourcing (Cullen et al., 2005) and adapt it to Cloud, if necessary. The main reasons to chose CMMI for services were the fact that it is a wide known and tested maturity model oriented to services, and that it provides a well defined continuous approach for processes' improvement and assessment (CMMI Product Team, 2010).

Our proposal is then 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 appraisal of the scientific community; the Moody and Shanks Quality Management Framework; and, in order to evaluate the research, Österle et al. four principles were used.

8.1 Communication

This section corresponds to the *communication* step of DSRM that consists in communicating to the proper audience the method and its contributions.

In order to communicate our method we chose to use two channels: demonstrations to practitioners and potential users and by submission of scientific publications.

The first one was performed during the interviews and demonstrations in which we present the method in organizations operating in several sectors and to persons that are performing different roles within the organizations.

The second one was achieved through the submission of two scientific publications to international conferences:

- A. Duarte and M. Mira da Silva. (2013) Cloud Maturity Model, IEEE 6th International Conference on Cloud Computing (IEEE Cloud 2013), Santa Clara Marriott, California, USA **(Accepted)** **(ERA Ranking: B)**
- A. Duarte and M. Mira da Silva. (2013) Demonstrating the Cloud Maturity Model, 11th International Conference on Service Oriented Computing (ICSOC 2013), Berlin, Germany **(Submitted)** **(ERA Ranking: A)**

The fist paper is related with the validation of the first step of this research, in which we adapted the outsourcing lifecycle to the Cloud and conclude which activities should be used in the Cloud Maturity Model.

The second paper presents the demonstrations and the corresponding evaluation of the Cloud Maturity Model in three real world organizations.

8.2 Lessons Learned

During our research we found several aspects that are important to mention. Some of them arose from the related work, others from the design phase, and others from the interviews and demonstrations.

During the related work we found that, although the Cloud is one of the IT buzzwords of the moment for the organizations, only a few are seeing it from a business perspective and there are not much research directed to Cloud clients. During our research we found several lifecycles and maturity models regarding the implementation of an in-house Cloud, the implementation of Cloud from the suppliers side, but only a lifecycle and a maturity model for the client side. This gap leads to a lack of knowledge from the clients when it comes to adopt services in the Cloud since they do not have enough best practices, or

frameworks, to guide them.

The main lessons arose from the design phase was that the only existing maturity model for Cloud clients are attached to an existing maturity model (IT-CMF), thus it can only be used by organizations that that using that model or that are willing to use it. This perception lead us to use an existing maturity model as a basis but construct a method that is independent of the maturity model. In this way, organizations can use our proposal without the need to implement anything else.

The interviews and demonstration phases had improve our knowledge about the real world. Although everyone is aware of the Cloud only a few really know what to take advantage for it. All the organizations recognize the importance of the proposal and the key activities proposed, but only a few are willing to really use the proposal. Although, we have explained that it is not mandatory to implement the entire proposal, and that organizations should only use what brings value to them, the main comment is that there are too many practices for them to implement and maintain due to their small size.. We believe this occurs because the majority of organizations are only migrating small services (e.g., email services), thus not seeing advantages of performing a good management of those services.

Finally, a more personal lesson, Cloud computing is a new trend and, although organizations are not comfortable with it already, they are expecting that Cloud will bring them opportunities to reduce costs and to improve their resources usage. We also learned that the adoption of a new technology is not easy for organizations, it requires the acceptance of the top management, the effort of the IT department, and an excellent propaganda to ensure and overall acceptance within the organization.

8.3 Limitations

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. Two of the organizations are considered large organizations and one a Small and Medium Enterprise (but it is almost a large organization) accordingly with (European Commission, 2005), thus we can not prove that the same results are expected in smaller organizations or even in very large organization.

Finally, 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, for instance, none of the organizations used in the demonstrations are using IaaS. Nevertheless, organizations have not found

significant differences among those service delivery models.

8.4 Main Contributions

The main contributions expected from this research are the proposed method itself, its demonstration and evaluation.

With the method we intend to improve the existing knowledge in the area of how to use a lifecycle approach together with a maturity model in order to migrate and manage services in the Cloud. The method also provides a solid set of steps and key activities that should be used by organizations that wish to migrate their services to Cloud or to improve the processes that they are already using.

The demonstration contributes to prove that the method can be used in real organizations that are operating in different sectors and have different dimensions.

The evaluation proves that the method has been accepted and that interviewees found it useful and a good knowledge base for their organizations.

To finalize, we also expect to increase the knowledge base related to Cloud computing, through a best understanding of its basis, and the knowledge base related to lifecycle's approaches and maturity models usage to solve identical problems.

8.5 Future Work

In this section we present a brief description of the proposed future work. We also address the limitations of the research presented in Section 8.3.

We believe that the proposed method need to be demonstrated in more detail, i.e., during a longer time period and be used to migrate and manage services in the Cloud. During our research, and due to time limitations, we only used the method do assess the maturity and to propose a target state.

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

The scope of this research only includes the activities to be performed and does not give any explanation about how to perform then. Those activities can be study in more detail and a detailed description of each one of then can be created.

We also suggest the development of an assessment process that ensures a systematic approach to assess and propose improvements of the organizations' processes related to the Cloud Maturity Model.

Finally, our research demonstrations and evaluations were only performed in Portugal, thus further usage of the method in countries with different realities (e.g., a big organization in Portugal is not a big organization in the United States of America) should be performed in order to show the flexibility of the method.

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Appendix A

A Tipology of IT Services and IT-enabled Services

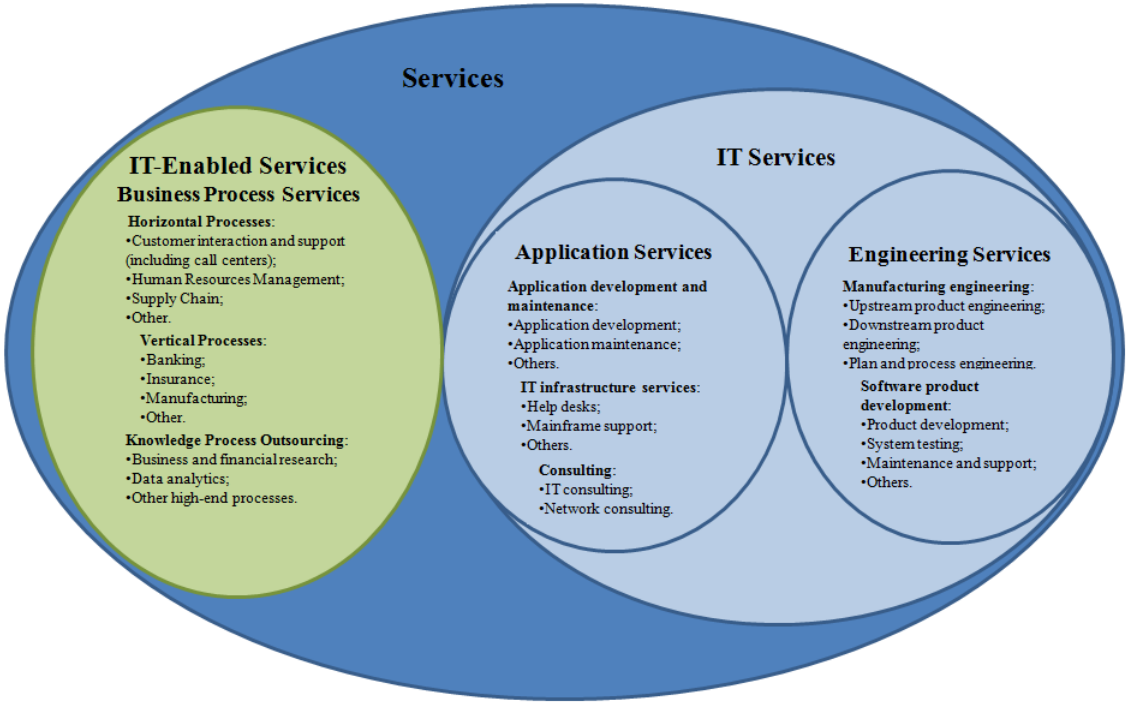

Figure A.1: IT services and IT-enabled services example (adapted from (Sudan et al., 2010))

Appendix B

Cloud Maturity Model: Process Areas

Cloud Maturity Model

Process Areas

André Duarte

July 10, 2013

1

Cloud Architect (CloudA)

Cloud Architect

Purpose

The purpose of Cloud Architect (CloudA) is to ensure effective investigation and planning of the Cloud project. At the end of this phase the organization should have effective knowledge of itself, in order to confidently publicize its needs.

Specific Goal and Practice Summary

SG 1 – Architect Cloud Contract

- SP 1.1 - Investigate
- SP 1.2 - Target
- SP 1.3 - Strategize
- SP 1.4 - Design

Specific Practices by Goal

SG 1 – Architect Cloud Contract

Gather knowledge about the organization itself in order to confidently publicize its needs.

SP 1.1 – Investigate

Investigate market to ensure veracity instead of ideology.

Example Work Products

1. Strategy for Cloud Computing
2. Strategic intent of moving to the Cloud and how it progresses the business objectives
3. Document on service offerings and providers
4. Comparison among the strategic requirements and the available services and providers

Sub practices

1. Gather insight (e.g., via experts and experienced organizations).
2. Determine and test goals/expectations.

3. Collect intelligence on market conditions and potential suppliers.
4. Investigate similar decisions and peer organizations.
5. Analyze the organization's competences and strategy.

SP 1.2 – Target

Define and target the scope.

Example Work Products

1. Services to be outsourced to the Cloud
2. Services' delivery model
3. Baseline and future state profiles

Sub practices

1. Match goals to appropriate Cloud model.
2. Identify, with objective criteria, suitable services to migrate to the Cloud.
3. Prepare the seven baselines and future state profiles: service, cost, asset, staff, stakeholder, current contracts, and governance.

SP 1.3 – Strategize

Create informed and holistic strategies.

Example Work Products

1. Roll-out strategy
2. Project lifecycle and its communication strategy
3. Exit strategy
4. Risk assessment

Sub practices

1. Decide the rollout approach (e.g., big bang, phased).
2. Determine key "rules" (e.g., governing docs, number of suppliers, asset ownership, and risk/reward).
3. Design the detailed lifecycle of the project, identifying and sourcing the necessary skills and prepare the communication strategy.
4. Prepare the business case rules and the base case.
5. Design an exit strategy.
6. Assess feasibility, risk and impact to the organization.

SP 1.4 – Design

Design the future state.

Example Work Products

1. Service Level Agreement
2. Price framework
3. Commercial and operational blueprint
4. Draft of the contract
5. Inter-party relationship and retained organization

Sub practices

1. Prepare the commercial and operating blueprint.
2. Develop the four balanced score metrics - service, financial, relationship and strategic.
3. Draft the service level agreement - scope, metrics/incentives, reporting, and governance.
4. Draft the price framework (e.g., fixed, variable, cost plus items).
5. Draft the contract.
6. Design the inter-party relationship (e.g., structure, roles, authorities) and the retained organization (kept functions)
7. Design the contract management function (governance).

2

Cloud Engage (CloudE)

Cloud Engage

Purpose

The purpose of Cloud Engage (CloudE) is to analyze and select a service provider, or several, that can deliver the required Cloud service and negotiate the contract.

Specific Goal and Practice Summary

SG 1 – Engage Cloud Supplier

SP 1.1 – Select

SP 1.2 – Negotiate

Specific Practices by Goal

SG 1 – Engage Cloud Supplier

Engage and select one or more Cloud supplier and negotiate the deal.

SP 1.1 – Select

Select sustainable solution and supplier, based on the value for money.

Example Work Products

1. Tender process
2. Evaluation team, criteria and strategy
3. List of suitable suppliers
4. Due diligence report

Sub practices

1. Plan and detail the tender stages.
2. Identify the right evaluation team - breadth and depth.
3. Determine the right evaluation criteria and strategy for each tender stage.
4. Request right, clear and comprehensive bid data for each tender stage.
5. Facilitate the best responses (e.g., briefings, Q&A, and data room).

6. Use interactive evaluation techniques (e.g., interviews and site visits).
7. Select supplier based on value for money.
8. Construct the five due diligences on supplier: company, price, solution, contract, and customer references.

SP 1.2 – Negotiate

Negotiate and complete the contract.

Example Work Products

1. Negotiation strategy
2. Evaluation of the pilot project
3. Signed final documents

Sub practices

1. Prepare negotiation strategy and prioritize negotiation items.
2. Conduct and evaluate a pilot project.
3. Conduct effective negotiations.

3

Cloud Operate (CloudO)

Cloud Operate

Purpose

The purpose of the Cloud Operate (CloudO) is to implement and manage the Cloud service.

Specific Goal and Practice Summary

SG 1 – Operate the Contract

SP 1.1 – Transition

SP 1.2 – Manage

Specific Practices by Goal

SG 1 – Operate the Contract

Put the deal in place, operationalized, and managed through its term.

SP 1.1 – Transition

Support efficient and complete mobilization.

Example Work Products

1. Roll-out plan
2. Workflows, communication channels, and authorities updates
3. Closeout and post-implementation review

Sub practices

1. Finalize and mobilize all plans (e.g., communications, risk, setup, and acceptance).
2. Resource the transition project (e.g., manage the impact on staff, the transfers, and knowledge retention and transfer)
3. Implement retained organization and contract management.
4. Create or update workflows, communication channels, authorities, etc.
5. Conduct closeout and post-implementation review.

SP 1.2 – Manage

Manage the contract and ongoing results.

Example Work Products

1. Performance metrics
2. Status on issues, problems, variations and disputes
3. Risk and contingency plan
4. Audit reports
5. Knowledge refreshment report

Sub practices

1. Invest in the relationship (plan, assess and improve) and keep communication among parts.
2. Meaningful reporting and analyses.
3. Diligent documentation and administration.
4. Manage risks and plan contingencies.
5. Manage issues, variations and disputes.
6. Effect continuous improvement and streamlining.
7. Evaluate and audit supplier (controls, performance, and compliance).
8. Knowledge refreshment (e.g., market, technology, price, and metrics).
9. Evaluate organization both as a customer and contract manager.

4

Cloud Regenerate (CloudR)

Cloud Regenerate

Purpose

The purpose of Cloud Regenerate (CloudR) is to assess the next generation options and evaluate the outcomes of the previous contracts.

Specific Goal and Practice Summary

SG 1 – Regenerate Knowledge

SP 1.1 – Refresh

Specific Practices by Goal

SG 1 – Regenerate Knowledge

Regenerate knowledge about the Cloud in order to assess the next-generation options.

SP 1.1 – Refresh

Refresh the strategy and options.

Example Work Products

1. Report for next generation options and requirements
2. Assessment of the previous contracts
3. Strategy and business case for each proposed changes

Sub practices

1. Assess next generation options (backsource, retain, handover).
2. Assess contract outcomes and lessons.
3. Reassess requirements - re-scope, re-bundle and re-design.
4. Refine the strategy and business case for each option.

Contents

Appendix C

Cloud Maturity Model: Generic Goals

Cloud Maturity Model
Generic Goals

André Duarte

Note: Only the elaborations are original,
the descritpitions of the Generic and Specific Goals
are original from the CMMI-model

July 10, 2013

1

Generic Goals 1

GG 1 - Achieve Specific Goals

The specific goals of the process area are supported by the process by transforming identifiable input work products into identifiable output work products.

GP 1.1 Perform Specific Practices

Perform the specific practices of the process area to develop work products and provide services to achieve the specific goals of the process area.

The purpose of this generic practice is to produce the work products and deliver the services that are expected by performing (i.e., executing) the process. These practices can be done informally without following a documented process description or plan. The rigor with which these practices are performed depends on the individuals managing and performing the work and can vary considerably.

2

Generic Goals 2

GG 2 - Institutionalize a Managed Process

The process is institutionalized as a managed process.

GP 2.1 Establish an Organizational Policy

Establish and maintain an organizational policy for planning and performing the process.

The purpose of this generic practice is to define the organizational expectations for the process and make these expectations visible to those members of the organization who are affected. In general, senior management is responsible for establishing and communicating guiding principles, direction, and expectations for the organization.

Not all direction from senior management will bear the label "policy." The existence of appropriate organizational direction is the expectation of this generic practice, regardless of what it is called or how it is imparted.

CloudA Elaboration

This policy establish organizational expectations for identifying the needs and expectations of the service's migration and management.

CloudE Elaboration

This policy establish organizational expectations for selecting the supplier and negotiating the contract.

CloudO Elaboration

This policy establish organizational expectations for transitioning and managing the services contracted.

CloudR Elaboration

This policy establish organizational expectations for refreshing the knowledge acquired during the contracts.

GP 2.2 Plan the Process

Establish and maintain the plan for performing the process.

The purpose of this generic practice is to determine what is needed to perform the process and to achieve the established objectives, to prepare a plan for performing the process, to prepare a process description, and to get agreement on the plan from relevant stakeholders.

The practical implications of applying a generic practice vary for each process area.

Establishing a plan includes documenting the plan and a process description. Maintaining the plan includes updating it to reflect corrective actions or changes in requirements or objectives.

The plan for performing the process typically includes the following:

- Process description
- Standards and requirements for the work products and services of the process
- Specific objectives for the execution of the process and its results (e.g., quality, time scale, cycle time, use of resources)
- Dependencies among the activities, work products, and services of the process
- Resources (e.g., funding, people, tools) needed to perform the process
- Assignment of responsibility and authority
- Training needed for performing and supporting the process
- Work products to be controlled and the level of control to be applied
- Measurement requirements to provide insight into the execution of the process, its work products, and its services
- Involvement of relevant stakeholders
- Activities for monitoring and controlling the process
- Objective evaluation activities of the process
- Management review activities for the process and the work products

Sub practices:

1. Define and document the plan for performing the process.

This plan can be a stand-alone document, embedded in a more comprehensive document, or distributed among multiple documents. In the case of the plan being distributed among multiple documents, ensure that a coherent picture of who does what is preserved. Docu-

ments can be hardcopy or softcopy.

2. Define and document the process description.

The process description, which includes relevant standards and procedures, can be included as part of the plan for performing the process or can be included in the plan by reference.

3. Review the plan with relevant stakeholders and get their agreement.

This review of the plan includes reviewing that the planned process satisfies the applicable policies, plans, requirements, and standards to provide assurance to relevant stakeholders.

4. Revise the plan as necessary.

CloudA Elaboration

Establish and maintain the plan of what is needed in order to architect the Cloud contract.

CloudE Elaboration

Establish and maintain the plan of what is needed in order to select the supplier and negotiate the contract.

CloudO Elaboration

Establish and maintain the plan of what is needed in order to perform the transition and management of the services.

CloudR Elaboration

Establish and maintain the plan of what is needed in order to refresh the knowledge acquired during the contracts.

GP 2.3 Provide Resources

Provide adequate resources for performing the process, developing the work products, and providing the services of the process.

The purpose of this generic practice is to ensure that the resources necessary to perform the process as defined by the plan are available when they are needed. Resources include adequate funding, appropriate physical facilities, skilled people, and appropriate tools.

The interpretation of the term "adequate" depends on many factors and can change over time. Inadequate resources may be addressed by increasing resources or by removing requirements, constraints, and commitments.

CloudA Elaboration

Provide the needed resources, defined in the plan, to architect the Cloud contract.

CloudE Elaboration

Provide the needed resources, defined in the plan, to select the supplier and negotiate the contract.

CloudO Elaboration

Provide the needed resources, defined in the plan, to perform the transition and management of the services.

CloudR Elaboration

Provide the needed resources, defined in the plan, to refresh the knowledge acquired during the contracts.

GP 2.4 Assign Responsibility

Assign responsibility and authority for performing the process, developing the work products, and providing the services of the process.

The purpose of this generic practice is to ensure that there is accountability for performing the process and achieving the specified results throughout the life of the process. The people assigned must have the appropriate authority to perform the assigned responsibilities.

Responsibility can be assigned using detailed job descriptions or in living documents, such as the plan for performing the process. Dynamic assignment of responsibility is another legitimate way to implement this generic practice, as long as the assignment and acceptance of responsibility are ensured throughout the life of the process.

Sub practices:

1. Assign overall responsibility and authority for performing the process.
2. Assign responsibility and authority for performing the specific tasks of the process.
3. Confirm that the people assigned to the responsibilities and authorities understand and accept them.

CloudA Elaboration

Responsibility is assigned for define and elaborate the Cloud contract.

CloudE Elaboration

Responsibility is assigned to those who can select the supplier and negotiate the contract with sufficient independence and objectivity.

CloudO Elaboration

Responsibility is assigned for the transition and management steps.

CloudR Elaboration

Responsibility is assigned for perform the knowledge refreshment.

GP 2.5 Train People

Train the people performing or supporting the process as needed.

The purpose of this generic practice is to ensure that people have the necessary skills and expertise to perform or support the process.

Appropriate training is provided to those who will be performing the work. Overview training is provided to orient people who interact with those who perform the work.

Examples of methods for providing training include self study; self-directed training; selfpaced, programmed instruction; formalized on-the-job training; mentoring; and formal and classroom training.

Training supports the successful execution of the process by establishing a common understanding of the process and by imparting the skills and knowledge needed to perform the process.

CloudA Elaboration

Examples of training activities include the following:

- Market analysis
- Contract design
- Risk management concepts and activities

CloudE Elaboration

Examples of training activities include the following:

- Cost benefits analysis
- Negotiation techniques

CloudO Elaboration

Examples of training activities include the following:

- Project management
- Auditing techniques

CloudR Elaboration

Examples of training activities include the following:

- Results analysis

GP 2.6 Control Work Products

Place selected work products of the process under appropriate levels of control.

The purpose of this generic practice is to establish and maintain the integrity of the selected work products of the process (or their descriptions) throughout their useful life.

The selected work products are specifically identified in the plan for performing the process,

along with a specification of the appropriate level of control.

Different levels of control are appropriate for different work products and for different points in time. For some work products, it may be sufficient to maintain version control so that the version of the work product in use at a given time, past or present, is known and changes are incorporated in a controlled manner. Version control is usually under the sole control of the work product owner (which can be an individual, group, or team).

Sometimes, it can be critical that work products be placed under formal or baseline configuration management. This type of control includes defining and establishing baselines at predetermined points. These baselines are formally reviewed and approved, and serve as the basis for further development of the designated work products.

Additional levels of control between version control and formal configuration management are possible. An identified work product can be under various levels of control at different points in time.

CloudA Elaboration

Examples of work products placed under control include the following:

- Strategy for Cloud computing
- Services' delivery model
- Exit strategy
- Service Level Agreement

CloudE Elaboration

Examples of work products placed under control include the following:

- Tender process
- Evaluation of the pilot project

CloudO Elaboration

Examples of work products placed under control include the following:

- Roll-out plan
- Status on issues, problems, variations, and disputes

CloudR Elaboration

Examples of work products placed under control include the following:

- Report for next generation options and requirements
- Assessment of the previous contracts

GP 2.7 Identify and Involve Relevant Stakeholders

Identify and involve the relevant stakeholders of the process as planned.

The purpose of this generic practice is to establish and maintain the expected involvement of relevant stakeholders during the execution of the process.

Involve relevant stakeholders as described in an appropriate plan for stakeholder involvement. Involve stakeholders appropriately in activities such as the following:

- Planning
- Decisions
- Commitments
- Communications
- Coordination
- Reviews
- Appraisals
- Requirements definitions
- Resolution of problems and issues

The objective of planning stakeholder involvement is to ensure that interactions necessary to the process are accomplished, while not allowing excessive numbers of affected groups and individuals to impede process execution.

Examples of stakeholders that might serve as relevant stakeholders for specific tasks, depending on context, include individuals, teams, management, customers, suppliers, end users, operations and support staff, other work groups, and government regulators.

Sub practices:

1. Identify stakeholders relevant to this process and their appropriate involvement.

Relevant stakeholders are identified among the suppliers of inputs to, the users of outputs from, and the performers of the activities in the process. Once the relevant stakeholders are identified, the appropriate level of their involvement in process activities is planned.

2. Share these identifications with work planners or other planners as appropriate.
3. Involve relevant stakeholders as planned.

CloudA Elaboration

Examples of activities for stakeholder involvement include the following:

- Analyze the organization's competences and strategy
- Prepare the business case and the base case
- Prepare the commercial and operating blueprint
- Design the contract management function

CloudE Elaboration

Examples of activities for stakeholder involvement include the following:

- Select supplier based on value for money
- Conduct effective negotiations

CloudO Elaboration

Examples of activities for stakeholder involvement include the following:

- Resource the transition project
- Invest in the relationship
- Evaluate the organization both as customer and contract manager

CloudR Elaboration

Examples of activities for stakeholder involvement include the following:

- Assess the contract outcomes and lessons
- Refine the strategy and business case for each option

GP 2.8 Monitor and Control the Process

Monitor and control the process against the plan for performing the process and take appropriate corrective action.

The purpose of this generic practice is to perform the direct day-to-day monitoring and controlling of the process. Appropriate visibility into the process is maintained so that appropriate corrective action can be taken when necessary. Monitoring and controlling the process can involve measuring appropriate attributes of the process or work products produced by the process.

Sub practices:

1. Evaluate actual progress and performance against the plan for performing the process.

The evaluations are of the process, its work products, and its services.

2. Review accomplishments and results of the process against the plan for performing the process.
3. Review activities, status, and results of the process with the immediate level of man-

agement responsible for the process and identify issues.

These reviews are intended to provide the immediate level of management with appropriate visibility into the process based on the day-to-day monitoring and controlling of the process, and are supplemented by periodic and event-driven reviews with higher level management as described in GP 2.10.

4. Identify and evaluate the effects of significant deviations from the plan for performing the process.

5. Identify problems in the plan for performing the process and in the execution of the process.

6. Take corrective action when requirements and objectives are not being satisfied, when issues are identified, or when progress differs significantly from the plan for performing the process.

Inherent risks should be considered before any corrective action is taken.

Corrective action can include the following:

- Taking remedial action to repair defective work products or services
- Changing the plan for performing the process
- Adjusting resources, including people, tools, and other resources
- Negotiating changes to the established commitments
- Securing change to the requirements and objectives that must be satisfied
- Terminating the effort

7. Track corrective action to closure.

CloudA Elaboration

Examples of measures and work products used in monitoring and controlling include the following:

- Number of options analyzed
- Number of hours spend
- Contract draft

CloudE Elaboration

Examples of measures and work products used in monitoring and controlling include the following:

- Detail level of the tender stages
- Criteria and strategy used in the tender stage
- Adherence to the pilot project

CloudO Elaboration

Examples of measures and work products used in monitoring and controlling include the following:

- Time used in the transition phase
- Adherence of the staff
- Quality of the reports
- Results of the meetings with the suppliers

CloudR Elaboration

Examples of measures and work products used in monitoring and controlling include the following:

- Outcomes and lessons
- Report for the next generation options

GP 2.9 Objectively Evaluate Adherence

Objectively evaluate adherence of the process and selected work products against the process description, standards, and procedures, and address noncompliance.

The purpose of this generic practice is to provide credible assurance that the process and selected work products are implemented as planned and adhere to the process description, standards, and procedures.

People not directly responsible for managing or performing the activities of the process typically evaluate adherence. In many cases, adherence is evaluated by people in the organization, but external to the process or work group, or by people external to the organization. As a result, credible assurance of adherence can be provided even during times when the process is under stress (e.g., when the effort is behind schedule, when the effort is over budget).

CloudA Elaboration

All the work products and activities are liable to be reviewed.

CloudE Elaboration

All the work products and activities are liable to be reviewed.

CloudO Elaboration

All the work products and activities are liable to be reviewed.

CloudR Elaboration

All the work products and activities are liable to be reviewed.

GP 2.10 Review Status with Higher Level Management

Review the activities, status, and results of the process with higher level management and resolve issues.

The purpose of this generic practice is to provide higher level management with the appropriate visibility into the process.

Higher level management includes those levels of management in the organization above the immediate level of management responsible for the process. In particular, higher level management can include senior management. These reviews are for managers who provide the policy and overall guidance for the process and not for those who perform the direct day-to-day monitoring and controlling of the process.

Different managers have different needs for information about the process. These reviews help ensure that informed decisions on the planning and performing of the process can be made. Therefore, these reviews are expected to be both periodic and event driven.

CloudA Elaboration

These reviews are typically in the form of a briefing presented to the management steering committee by those responsible for the Cloud contract elaboration.

Presentation topics should include all the work products defined for this Process Area.

CloudE Elaboration

These reviews are typically in the form of a briefing presented to the management steering committee by those responsible for selecting the supplier and negotiating the contract.

Presentation topics should include all the work products defined for this Process Area.

CloudO Elaboration

Higher level management is kept informed of the status of significant events.

CloudR Elaboration

These reviews are typically in the form of a briefing presented to the management steering committee by those responsible for the knowledge refreshment and the assessment of the previous contracts.

Presentation topics should include all the work products defined for this Process Area.

3

Generic Goals 3

GG 3 - Institutionalize a Defined Process

The process is institutionalized as a defined process.

GP 3.1 Establish a Defined Process

Establish and maintain the description of a defined process.

The purpose of this generic practice is to establish and maintain a description of the process that is tailored from the organization's set of standard processes to address the needs of a specific instantiation. The organization should have standard processes that cover the process area, as well as have guidelines for tailoring these standard processes to meet the needs of a work group or organizational function. With a defined process, variability in how the processes are performed across the organization is reduced and process assets, data, and learning can be effectively shared.

The descriptions of the defined processes provide the basis for planning, performing, and managing the activities, work products, and services associated with the process.

Sub practices:

1. Select from the organization's set of standard processes those processes that cover the process area and best meet the needs of the work group or organizational function.

2. Establish the defined process by tailoring the selected processes according to the organization's tailoring guidelines.

3. Ensure that the organization's process objectives are appropriately addressed in the defined process.

4. Document the defined process and the records of the tailoring. 5. Revise the description of the defined process as necessary.

GP 3.2 Collect Process Related Experiences

Collect process related experiences derived from planning and performing the process to support the future use and improvement of the organization's processes and process assets.

The purpose of this generic practice is to collect process related experiences, including information and artifacts derived from planning and performing the process. Examples of process related experiences include work products, measures, measurement results, lessons learned, and process improvement suggestions. The information and artifacts are collected so that they can be included in the organizational process assets and made available to those who are (or who will be) planning and performing the same or similar processes. The information and artifacts are stored in the organization's measurement repository and the organization's process asset library.

Examples of relevant information include the effort expended for the various activities, defects injected or removed in a particular activity, and lessons learned.

Sub practices:

1. Store process and product measures in the organization's measurement repository.

2. The process and product measures are primarily those measures that are defined in the common set of measures for the organization's set of standard processes.

3. Submit documentation for inclusion in the organization's process asset library.

4. Document lessons learned from the process for inclusion in the organization's process asset library.

5. Propose improvements to the organizational process assets.

CloudA

Examples of process related experiences include the following:

- List of potential suppliers
- Exit strategy
- Risk analysis
- Contract management functions

CloudE

Examples of process related experiences include the following:

- Tender stages planning and results
- Results of pilot project
- Negotiation strategies

CloudO

Examples of process related experiences include the following:

- Created workflows, communication channels and authorities
- Close-out and post implementation review
- Risk management reports
- Reports and analysis of the contracted services
- Results of audits to the supplier

CloudR

Examples of process related experiences include the following:

- Contracts outcomes and lessons
- Results of the assessment of the next generation options

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