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Improving Service Quality using DEMO

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To my parents, who have supported and guided me throughout life

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Resumo

Hoje em dia, o sector dos serviços é responsável pela maioria da actividade económica mundial e lidera a criação de valor nas organizações actuais. No entanto, todos os serviços apresentam lacunas na sua qualidade que reduzem a satisfação dos clientes e as receitas das empresas. Das cinco lacunas da qualidade de serviço, a quarta diz-nos que existe uma diferença entre a entrega de um serviço e a comunicação dessa mesma entrega. Esta foi a lacuna que atacámos nesta investigação.

Nesta investigação propômos uma abordagem baseada na teoria Enterprise Ontology para mitigar a quarta lacuna. A nossa proposta inclui também o desenvolvimento de um sistema, baseado no Design & Engineering Methodology for Organizations e em Acordos de Nível de Serviço, que promove o marketing interactivo entre prestadores de serviços e clientes, o DEMO Engine.

A metodologia de pesquisa usada para conduzir esta dissertação foi o Design Science Research Methodology. A demonstração da nossa proposta foi realizada usando uma instituição de administração pública portuguesa e também um caso fictício de uma agência de viagens.

Para avaliarmos o artefacto recorremos a comentários de académicos e profissionais da área de Tecnologias de Informação recolhidos em seminários e entrevistas. Utilizámos também os princípios de Österle. Para validarmos os resultados da dissertação, submetemos dois artigos científicos a conferências internacionais, para dar a conhecer à comunidade académica a nossa investigação.

Concluímos que o nosso artefacto, DEMO Engine, pode ajudar a reduzir as dificuldades de comunicação na execução de serviços e contribuir para um aumento da qualidade desses mesmos serviços.

Palavras-chave: Enterprise Ontology, DEMO, Qualidade de Serviço, Acordo de Nível de Serviço, Lacuna de Comunicação

Abstract

Nowadays, services account for the biggest part of the world economy, and is a sector that is leading the value creation in organizations. Nevertheless, services have quality gaps that reduce the customers' satisfaction and therefore revenues. Of all five service quality gaps the number four states that there is a difference between the service delivery and the communication that involves that delivery. This was the research problem we tackled.

In this research we propose an approach based on Enterprise Ontology theory to mitigate this gap. Our proposal also includes the development of a system, based on Design & Engineering Methodology for Organizations and Service Level Agreements that promotes an interactive marketing between service provider and customer. We have called this system the DEMO Engine.

The research methodology used to conduct this dissertation was the Design Science Research Methodology and the demonstration of our proposal was performed in a Portuguese Public Administration Institute and using a fictional example of a Travel Agency.

To evaluate the artifact developed, we used feedback from academic and practitioners of the Information Technology area collected in workshops and personal interviews. We also evaluated our proposal with the Österle principles. To better validate this dissertation we have submitted two scientific papers to international conferences, in order to have the scientific community know the research, evaluate, and accept it.

We concluded that our proposal, the DEMO Engine, can help reduce the difficulties of communication of service execution and contribute to an increase of the service quality.

Keywords: Enterprise Ontology, DEMO, Service Quality, Service Level Agreement, Communications Gap

Contents

List of Tables

List of Figures

Chapter 1

Introduction

The services industry has grown exponentially in the last decades. In these years the service sector has become the number one driver to obtain value in the economy (Central Intelligence Agency, 2011). These services comprises many daily activities that include telecommunication, mass media, financial, franchising, health care or even tourism. The importance of this industry can be seen by analyzing **Table 1.1**.

Country	% GDP	% Workforce
US	76,7	79,1
China	43,1	34,6
Japan	74,6	69,8
Germany	71	73,8

Table 1.1: Service industry in world's top 4 economies (Central Intelligence Agency, 2011; International Monetary Fund, 2012).

Table 1.1 shows two important factors of world's top four leading economies, the percentage of a country's workforce and also the fraction of the gross domestic product (GDP). All related to the service sector. We can see that (apart from China) all countries have over (or nearly) 70% in both GDP and Workforce percentage in the service sector. Looking at the world as a whole, the estimates point to 63,4% of the world GDP being from the service sector and 42,4% of the world's workforce also from this sector.

If we look at companies and not countries we reach the same conclusion of the importance of the service sector. From the 20 most successful companies in the world eight are from banking (service sector), two from conglomerates (in the service sector), eight from oil and gas (industry and service sector), one from retailing (service sector) and one from automotive (industry sector). While not all are directly related to the service sector, they are indirectly related to it with after-sale services, warranties and other types of

services provided (Wilson et al., 2012; Forbes, 2012).

With so much impact on the economies worldwide it is imperative to ensure that the service sector acts accordingly, namely, that services are provided with quality. This quality will be what differentiates the service providers and ultimately give them competitive advantages (Porter, 1980). The Information Technology (IT) boom in recent past gave service providers new ways to deliver their services and to innovate, which led to a large proliferation of IT services (Wilson et al., 2012).

With this big profusion of new services, providers faced the lack of principles to ensure the quality needed to satisfy customers. Frameworks to implement IT service management (ITSM) were created, being Information Technology Infrastructure Library (ITIL) the mostly adopted (Hochstein et al., 2005). Nevertheless, these frameworks are mostly best-practices and they lack a strong theoretical background to cement their implementation options. This absence leads to the increase of the gaps in the service quality (Parasuraman et al., 1985). Currently, the organizations that lead the service industry, provide better jobs and have the largest growth, but lack this conceptual foundation. This contributes to creating gaps as they do not have a solution to specify the services quality, becoming difficult to align the service expectations from both the providers and customers (Chesbrough & Sphorer, 2006).

The service quality is affected by five major gaps, which influence the expectations and the perceptions of customers (Parasuraman et al., 1985). They may arise from different situations, but they all state that the service delivered is different from the one initially requested. As stated above, this presents a major challenge and the closure of the five gaps will indubitably increase costumer satisfaction (Parasuraman et al., 1985) and be a positive factor on a company growth (Chesbrough & Sphorer, 2006).

In this research we will use Design Science Research Methodology (DSRM). We started by making a thorough analysis of the problem introduced in this section, explaining why it is relevant and what is the research question that guides this research. Next we did an overview of the literature focused on the service area and the theoretical background that could be applied to our research. Based on this analysis we then developed a proposal to decrease the gap number four of service quality. This proposal was later implemented in an instantiation artifact and demonstrated and evaluated.

1.1 Research Approach

In this section we present DSRM, the research methodology we used in our research and the strategies that can be used to evaluate the artifacts that result from the research methodology.

1.1.1 Research Methodology

As stated earlier, this research followed the Design Science Research Methodology (DSRM). This research methodology has been chosen because DSRM is appropriate for research that seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts. DSRM is also active with respect to technology, engaging in the creation of technological artifacts that impact people and organizations (Hevner et al., 2004).

This methodology is a sum of system of principles, practices and procedures with the primary goal of informing the community of IS researchers and practitioners of how to conduct, evaluate, and present design science research (Hevner et al., 2004).

We can apply these to IT (in this research's case) in order to solve problems in organizations. DSRM differentiates from other research paradigms because DSRM tries to develop and reach artifacts that can be proven effective in real world scenarios (Peffers et al., 2008). These artifacts can be categorized in:

- **Constructs**: provide the language in which problems and solutions are defined and communicated (vocabulary and symbols);
- **Models**: use constructs to represent a real-world situation - the design problem and its solution space (abstractions and representations);
- **Methods**: provide guidance on how to solve problems (algorithms and practices);
- **Instantiations**: show that constructs, models or methods can be implemented in a working system (implemented and prototype systems).

These types of artifacts are the tools that IT researchers have to develop and maintain information systems.

Apart from artifacts, DSRM is based on a process. This process is highly iterative and includes precise methods needed to be done in order to produce and evaluate the artifacts. There are six steps in the DSRM process, which can be seen in **Fig. 1.1** and are next described:

1. **Problem identification and motivation**: define the specific research problem and justify the value of a solution. It may be useful to atomize the problem conceptually so that the solution can capture its complexity (Chapters 1, 2 and 3);
2. **Definition of the objectives for a solution:** infer the objectives of a solution from the problem definition and knowledge of what is possible and feasible. Can be either quantitative or qualitative. The objectives should be inferred rationally from the problem specification (Chapters 2, 3 and 4);
3. **Design and Development:** The creation of the artifact that supports the defined objectives. This

activity includes determining the artifact's desired functionality and its architecture and then creating the actual artifact (Chapters 5 and 6);

4. **Demonstration:** The actual proof that the artifact developed solves the problem purposed. To do so the artifact is used to solve one or more instances of the problem. This can be achieved by experimentation, simulation, case study, proof or other appropriate activity (Chapter 6);

5. **Evaluation:** Measurement of how can the artifact produced be an effective solution to the problem. The initial objectives of the solution are compared to the actual results obtained from the demonstration using knowledge of relevant metrics and analysis techniques. After evaluation, the process can be iterated back to activity 3 (to improve the effectiveness of the artifact) or continue on to communication (Chapter 7);

6. **Communication:** The communication step is fundamental because only with support from the experts in the field it is possible to assure the problem and the artifact are important, useful, novel, rigorous and effective. Usually this step is accomplished with the submission of scientific papers (Chapter 8).

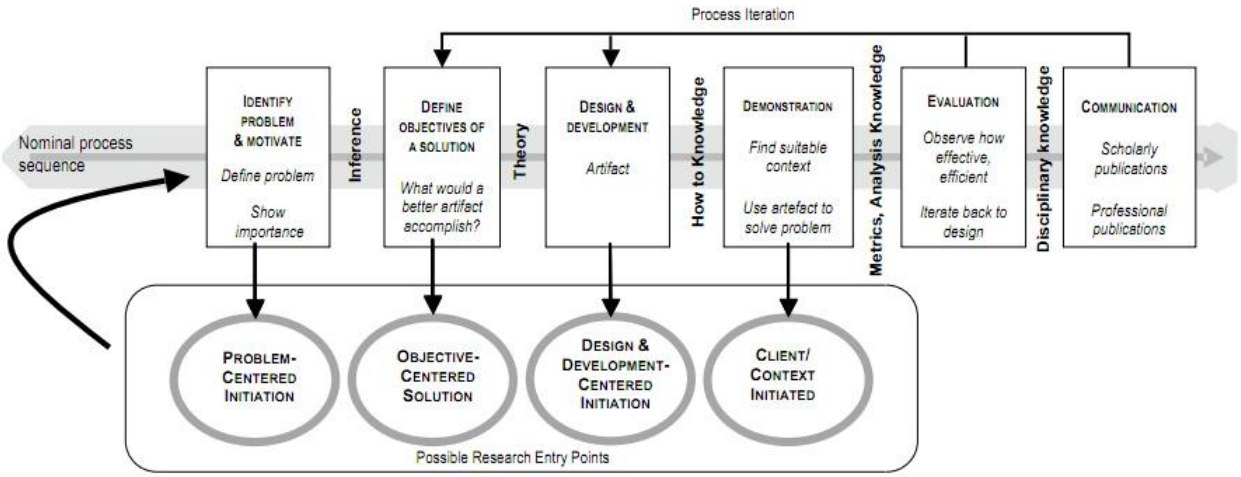

Figure 1.1: Research Design Science Process (Peffers et al., 2008).

It is important to guarantee that each of these steps should be done sequentially to achieve the expected results. Nevertheless, there are several starting points and much iterations can occur before the final result is reached. In a problem-centered approach the research starts of with the definition of the problem. A objective-centered solution is triggered when there is pre-defined set of objectives. Design & development-centered approaches result from the existence of an artifact not yet formally analysed in the problem domain. Lastly, client/context initiated approaches are based on evaluating practical working solutions.

In this research the DSRM processes started with a problem-centered approach and the artifact evalu-

ated is an instantiation.

1.1.2 Thesis Structure

In order to better express the contents of this dissertation in DSRM terms, we opted to structure the whole document with a direct relation to the DSRM steps. This relationship between DSRM steps and dissertation chapters can be seen in **Table 1.2**.

Chapter	DSRM Step
Introduction	Problem Identification and Motivation Definition of the Objectives for a Solution
Problem Statement	Problem Identification and Motivation Definition of the Objectives for a Solution
Related Work	Problem Identification and Motivation
Theoretical Background	Design and Development
Proposal	Design and Development
Demonstration	Demonstration
Evaluation	Evaluation
Conclusion	Evaluation Communication

Table 1.2: Thesis Structure.

This first Chapter presents a brief introduction of the general context related to this thesis, clearly indicating the main contributions of this research and the work methodology we adopted in our (DSRM). Chapter 2 introduces the problem of this dissertation and the research question derived and which we address in the document. Later, in Chapter 3 we make a deep and thorough analysis of work done in the fields of service science and quality and we present some of the solutions used to solve the problem proposed. Next, in Chapter 4, we introduce the theoretical background of this research, EO, the Generic Service Specification Framework (GSSF) and DEMO-based SLAs. In Chapter 5 we present our proposal to address the gap 4 problem and how to deal with the challenges it presents. In Chapter 6 we present experiments where we applied our proposal, followed in Chapter 7 by an evaluation of these results. To conclude, Chapter 8 describes the lessons learned from these experiences and a summary of the main conclusions we can take from our research.

Chapter 2

Problem Statement

Service quality is closely related to increased market share and return of investment (Parasuraman et al., 1985), but quality is difficult to be measured and to be assured. Nevertheless, in order to be successful organizations need to obtain this quality to get a competitive advantage (Chesbrough & Sphorer, 2006). On the other hand, if organizations cannot measure quality, they cannot know if they already provide services with quality or what is needed to be done to improve.

The Service Marketing research field provides us with a model of service quality gaps that can be used to assess where are the customers' perceptions and expectations of quality being corrupted. These gaps serve has a guideline for organizations to know what, where and how to tackle the lack of service quality. This model, designed by Parasuraman et al. (1985), is composed of five gaps:

- **Gap 1**: There is a difference between the service expectation of the customer and the provider perception of that expectation. This gap can be caused by bad communication between customers and service providers or lack of requirement engineering. For example, the service organization aims to satisfy certain availability constraints (e.g. 99% availability), while the actual customer concern is related with maximum downtime (e.g. no longer than one hour per failure);

- **Gap 2**: There is a difference between the provider service specification and the expectations that specification creates on the customer. This gap can be caused by inadequate management (lack of standards) or market and resource constraints. For example, the customer expects a quick restart of the system, while the standard procedure of the maintenance organization is focused on analyzing the reason for the crash;

- **Gap 3**: There is a difference between the specified service and the delivery of that service. This gap can be caused by insufficient front-office employees or by the customer playing his role wrong. For example, customers bypass the helpdesk by contacting the maintainer of their system directly, and thus circumventing a well-designed incident management process;

- **Gap 4**: There is a gap between the service delivery and the communication that involves it. This gap can be caused by sales overpromising, ineffective management of customers' expectations or inadequate horizontal communication. For example, a customer is not informed about the reparation of a bug he or she reported;

- **Gap 5**: There is a difference between the customers' expected service and the perceived service he receives. This gap is a function of the magnitude of all other four gaps:

$$Gap5 = f(Gap1, Gap2, Gap3, Gap4)$$

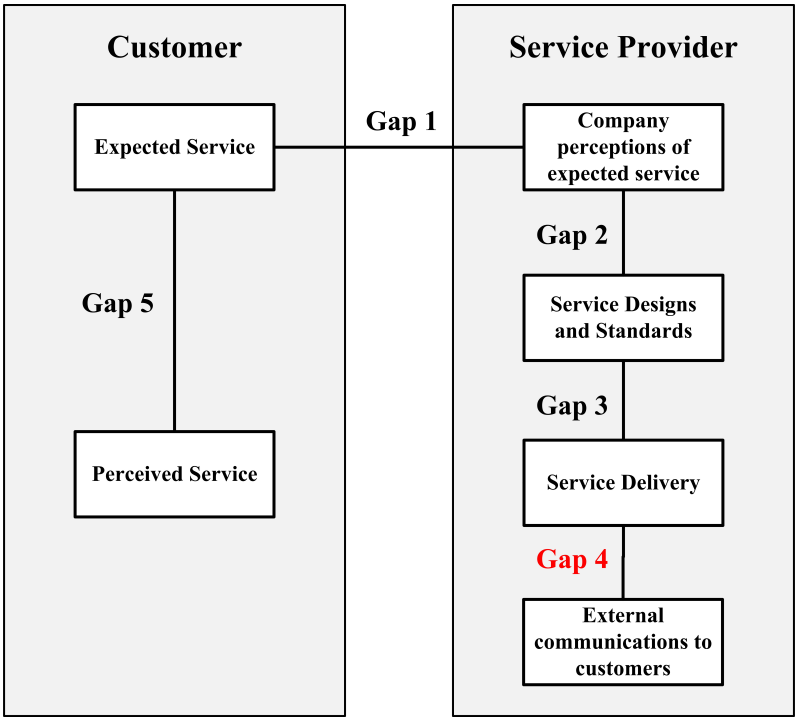

Figure 2.1: Model of Service Quality Gaps (based on (Parasuraman et al., 1985)).

A best view of the model is illustrated in **Fig. 2.1**. To achieve total and ultimate quality in services all these gaps should be addressed. This thesis is the follow up of previous research that addressed gaps 1, 2 and 3 (Mendes, 2013; Almeida, 2012; Ferreira, 2011).

There are several solutions that contributed to closing the gaps, but none solved the problem completely. Most of these solutions are function-oriented solutions and these are not sufficient because, they lack of an appropriate, deep understanding of enterprises and enterprises networks. Functional knowledge is appropriate and sufficient for the use and control of enterprises, but in order to change them, knowledge about their construction and operation is needed (Albani & Dietz, 2011).

To close the service quality gaps **this research will be focused on the gap number four**. Our problem is denoted in **Fig. 2.1** and can be defined as:

GAP 4: The difference between the service delivery and the communication that involves it.

Gap number four of service quality may be caused by several factors. Some examples are sales over-promising (advertising and personal selling), ineffective management of customer expectations (failure to educate the customer and to manage communication with him) or defective horizontal communication (between sales and operations, advertising and operations or different policies in different branches or units).

2.1 Research Question

Achieving an answer to this problem we selected, the service quality gap number four, can be summarized in one research question:

> ***Q1: Does a system that registers all the coordination acts involved in the service exchange diminishes the gap between the service delivery and the related communication?***

With this question we intend to assess qualitatively how can the creation of a system with strong notions of transparency and interaction between stakeholders have a positive impact on improving the external communications to customers.

2.2 Summary

Over the course of the last decades several studies have shown that there is a strong relationship between service quality and customer satisfaction, which can be used to increase the overall performance of companies (Parasuraman et al., 1985; Chesbrough & Sphorer, 2006). If we can increase the quality of services we can therefore have a positive impact on customer satisfaction. Nevertheless, quality presents itself with several challenges like service quality gaps. There are 5 gaps in service quality and each of them prevents customers from perceiving the expected quality. This research focus on gap number 4 and in the course of this dissertation we will discuss why and how we tried to mitigate the problem.

Chapter 3

Related Work

This Chapter is a detailed description of past works done on this area of investigation. We start by analyzing what is in fact a service, the implications of it, and reach a service definition to use over the course of the dissertation. Afterwards, we seek a definition of quality concordant with service and we look at how is quality currently measured and specified. Then we make an analysis of the service marketing field and the communication challenges that derive from the gap number four of service quality and what can be done to surpass them. Finally, we will talk about a recent DEMO engine that uses a modeling language based on DEMO to read, write, construct, destroy and execute DEMO models.

3.1 Service Definition

In order to use better define services we looked into what are the most accepted definitions of service. In this section we analyse the different definitions of service that have emerged in the past. Afterwards, we do a critical comparison of each one so we can reach the service definition we will use over the course of this dissertation.

3.1.1 ITIL's Service

The ITIL framework consists on best practices of IT Service Management that focus on aligning IT with business. Being focused on services, ITIL searched to find an agreement on the definition they would use. From ITIL point of view a service is *a means of delivering value to customers by facilitating outcomes customers want to achieve without the ownership of specific costs or risks* (Bon, 2007). We find that this definition proves as a good starting point to reach a good service definition, nonetheless, is too abstract and does not clearly identify all service features, characteristics, components and relationships with the organization assets. This definition has no close interaction with the our stated problem of

communication gaps between customers and providers.

3.1.2 CMMI's Service

Capability Maturity Model Integration (CMMI) is a process improvement framework that intends to create advancements in different departments of an organization. There are three types of CMMI, for development, for services and for acquisitions. In order to specify CMMI for services a concrete definition was needed, that had agreement in the community. They define service as *a product that is intangible and non-storable* (CMMI Product Team, 2010). This definition starts defining concrete characteristics that a service must have, but it lacks a focus on the client and the relations with organizational assets. In CMMI's definition there is no mention of the communication that exists in a service, and therefore, deviates that definition from our research.

3.1.3 Service Marketing's Service

Service Marketing is a area of research that, as the name says, focus immensely on services and its implications on the world (Wilson et al., 2012). According to Service Marketing, services are a special kind of product that differs from regular one mostly because they are a one-time product that is produced by the service provider and consumed by the customer at the same time (Wilson et al., 2012). Service Marketing also defines four key characteristics to help us define what is a service, they can be summarized in:

- **Intangibility**: Services are immaterial and cannot be touched, stored or returned if the customer is not happy with it. Healthcare is a good example of service intangibility. Despite body organs and examinations (the tangible components of the service) can be observed by the customer, the service itself is intangible. In healthcare there is usually a misalignment between what the provider communicates and what the customers perceive of it that can lead to an increase of gap four;

- **Perishability**: Services depend on the time they are delivered and they only exist in that specific time. For example, an airplane seat if not sold in one flight cannot be sold in another one, the service revenues that were expected are lost forever;

- **Inseparability**: The consumption time and production time of services are usually the same. Nevertheless, the technology change that is happening in the service sector is reducing this inseparability and there are technology driven services where the production can be separated from the consumption (Wilson et al., 2012). For example, a barber is a part of the haircut service that he delivers to his customer. A haircut is delivered to and consumed by a customer simultaneously;

- **Heterogeneity**: There are no two service requests alike, they are all different because they depend on human interaction from both the employees and the customers. For example, in the restaurant

business the service will depend on both the mood of the waiter and customer, and these moods vary constantly and depend on the weather, on the day of the week or even on the hour of the day.

Services are also different from other products because their delivery is mostly done by the front-office employees. They are the ones that have direct contact with the customers. This brings us to the fact that front-office employees must have integral and complete knowledge of the services they deliver. Most of the time, customers only have contact with front-office employees. When front-office employees behave differently than the customer expects they will damage the whole organization. Furthermore, whenever a customer is not happy with a service, he will always come to the front desk and file their claim with the front-office employees. They are the face of the company and their actions have a huge impact on customer satisfaction.

The definition of service that Service Marketing purposes is much more concrete than the other that we have seen, it comprises objective characteristics, the relationships between organizational assets, and emphasizes the importance of gap four. Nevertheless, the major downfall is the lack of theoretical background to support the definition.

3.1.4 Enterprise Ontology's Service

In order to achieve a strong theoretical background to strengthen our proposal we looked into Enterprise Ontology (EO). While not proposing a formal definition of service in (Dietz, 2006), another research complemented the work, and define service in EO terms.This definition, proposed in Albani et al. (2009), states that *a service is a universal pattern of coordination (c-acts) and production acts (p-acts), performed by the executor of a transaction for the benefit of its initiator, in the order as stated in the standard of a transaction. When implemented it has the ability to get to know the coordination facts produced by the initiator and to make available to the initiator the coordination facts produced by itself*.

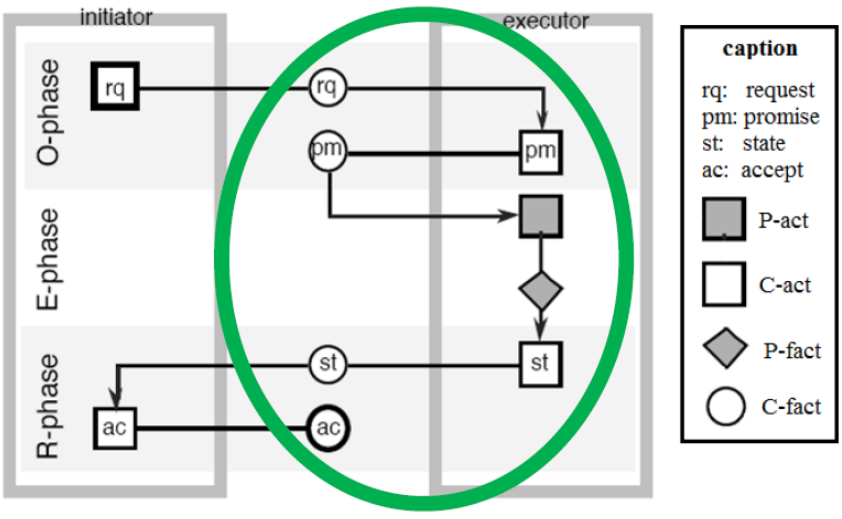

Figure 3.1: Service Definition based on EO (Service elements are inside the green line) (Albani et al., 2009).

This new concept focuses mainly on the transaction part related to the executor contrary to the initiator parts. Therefore, a service is defined as a part of the transaction and not the transaction as a whole. As part of the transaction, the communication is a very important factor of this definition and that goes in line with our research problem. We can see better this definition by looking at **Fig. 3.1**.

This definition of service is applied to all types of acts that are defined in EO either performed by human actors or technological components. The only difference between them is the way they are implemented. The two different types of acts possible in this definition are production acts and coordination acts. Enterprise Ontology defines three levels of services: datalogical, infological and ontological. Combining this with the definition of service being used in this research we reach to six types of services: datalogical, infological and ontological human services, and datalogical, infological and ontological IT services.

We will use this definition over the course of the dissertation, because this definition is the only service definition that, as our research, uses EO and DEMO as a conceptual foundation.

3.2 Service Quality

This section will be used to better define the notion of quality. First we make an assessment of several current quality definitions and then we compared them, justifying the selection of one in order to use that definition over the course of the thesis.

3.2.1 Quality Definition

Service quality is the mean that organizations have to ensure that their services are done accordingly and that their customers can be happy with them. Nevertheless, service quality is very hard to measure. That is mostly due to three factors (Parasuraman et al., 1985):

- Service quality is more difficult for the consumer to evaluate than goods quality;
- Service quality perceptions result from a comparison of consumer expectations with actual service performance;
- Quality evaluations are not made solely on the outcome of a service, they also involve evaluations of the process of service delivery.

As we try to reach a definition for service quality it is important so see what maturity models think of it. According to CMMI quality is *the degree to which a set of inherent characteristics fulfills requirements* (CMMI Product Team, 2010). This definition lacks focus of the customer and puts him aside from the quality pursuit.

In (Parasuraman et al., 1985) there is another definition of quality. According to it quality is *the difference between customer expectations regarding a service to be received and perceptions of the service being received*. In this research we will use this definition of quality, because this definition is highly focused on the customer and is the base of the service quality gaps, namely gap number four, which is the problem we intend to solve.

The service characteristics we presented before (intangibility, heterogeneity, inseparability and perishability) are a major contribution to influence the quality of a service. Namely:

- **Intangibility**: will make pricing difficult, and price will influence the service expectations of the customers, which can consequently reduce quality;
- **Heterogeneity**: makes assuring equal quality for all services provided hard, because of all the factors that can influence a service delivery;
- **Inseparability**: makes quality very dependent of the interactive marketing and real-time decisions, increasing the number of factor that can influence quality;
- **Perishability**: has a negative influence in quality, because with the lack of stocks services may not have the same quality every time.

All these problems in service quality have tried to be reduced. In order to reduce them, organizations are creating services in which the customer is also responsible for the quality of the service. This tries to make the customer feel also accountable to what happens during the service delivery and to lower insatisfaction when a service goes wrong (Wilson et al., 2012).

The IT development is one of the things that facilitated this responsibility sharing. For example, airplane tickets can now be bought with real-time input from the customer that makes reserving a seat faster and less expensive. But in order to convince customers to share this responsibility, customers need to know that they will get a better service, in this case cheaper tickets. This makes communication a critical success factor (Wilson et al., 2012).

There are even some new kind of services, self-service technologies (SSTs), that are *services produced entirely by the customers without any direct involvement or interaction with the firm's employees* (Wilson et al., 2012). Self-Service petrol pumps are a good example of a SST. In this case, for a faster service the customers do not mind having to get out of the car to tank it up.

3.2.2 Quality Measurement

Despite being difficult to achieve, quality also needs to be measured. In order to do so there were developed methods, namely ServQual (Parasuraman et al., 1988). This method was created by Parasuraman after he also proposed the the five model gap (Parasuraman et al., 1985).

ServQual intends to measure a service's quality by analysing ten dimensions, later refined to five. This measurement intends to make a connection between the service characteristics and customers' expectations. Those dimensions are:

- **Tangibles**: appearance of physical facilities, equipment, personnel and written materials;
- **Empathy**: caring, individualized attention given to customers;
- **Assurance**: employees' knowledge and courtesy and their ability to inspire trust and confidence;
- **Reliability**: ability to perform the promised service dependably and accurately;
- **Responsiveness**: willingness to help customers and provide prompt service.

More recently, and in order to response to the large IT service profusion, it was also suggested the e-SERVQUAL (Parasuraman et al., 2005) with four final refined dimensions. The four final dimensions are:

- **Efficiency**: the ability of customers to get to the website, find their desired product and information associated with it, and check out with minimal effort;
- **Fulfillment**: the accuracy of service promises, having products in stock, and delivering the products in the promised time;
- **Reliability**: the technical functioning of the site, particularly the extent to which it is available and functioning properly;
- **Privacy**: the assurance that shopping behavior data are not shared and that credit information is secure.

The present day mechanisms that exist to define and measure service quality provides us with frameworks to assess service quality. Nevertheless, service quality is a multidisciplinary and complex field that can be subjective. To help mitigate this subjectiveness new definitions based on a theoretical background can contribute to a larger adoption.

3.2.3 Quality Specification

Quality definition and measurement are very important when we talk about achieving quality, but we still need to know how to specify that quality in a comprehensible way, so that customers and providers understand and agree on the terms. In order to to so we present two current solutions that are used to specify and manage service quality: Service Level Management and Web Services based Solutions.

Service Level Management

Regarding Service Level Management (SLM), it acts as an interface between an organization and their customers. The objective of SLM is creating a cycle of agreeing, monitoring, reporting and improving the current levels of service quality (Lewis & Ray, 1999). SLM comprises three stages:

- Definition of Service Level Requirements (SLR);
- Definition of Service Level Targets (SLT);
- Definition of Service Level Agreements (SLA).

SLR are statements done by the service providers describing the service expectations. SLT are objectives negotiated by the service provider and the customer, based on SLR. SLT specify what should and should not be the characteristics of the service. SLT specification should always follow the SMART rule: **S**pecific, **M**easurable, **A**ttainable, **R**ealistic and **T**imely. SLA are the documents which state the SLT. They represent a contract that specifies what the provider and the customer agree on and their responsibilities in the service delivery. These contratcs ensure that the service quality expected from the customer does not differ from the provider. The correct resolution of a SLA ensures the quality of the service.

Despite all of this, SLM presents several flaws. As SLM is based on best practices it lacks a strong theoretical background to support the methods described. With the result of this flaw we reach the second one, the inconsistent between solutions. Another major downfall is that SLM leaves the customer behind when defining the SLR.

Web Service Based Solutions

Another approach to quality specification is by looking into web services. Web Service Based Solutions are based on using Web Service Description Language (WSDL) and Web Service Flow Language (WSFL) to specify and manage services and their quality. Nevertheless, these solutions suffer from a web tunnel vision as their major focus is on web services and not on business services. Because of the web tunnel vision, important attributes, such as penalty or price, are missing from both WSDL and WSFL.

However, another framework called Web Services Level Agreement (WSLA) was proposed (Keller & Ludwig, 2003). This other framework has four different types of parameters: business metrics, SLA parameters, composite metrics and resource metrics. These parameters ensure the ability to also focus on business services and try to involve the customer in the process. Despite these new additions to web service based solutions, they all lack a strong conceptual foundation to support their options, and as a result to that there is inconsistency between solutions.

3.3 Service Marketing

As we have seen before, Service Marketing proves to be a good contribution to the service science. Besides the services characteristics that we have seen previously, Service Marketing also contributes with an embracing view of services, the service triangle. In **Fig. 3.2** we can see that in a service interacts the employee, the customer and the company. Each of them contributes to the service provisioning and can negative or positive influence the outcome.

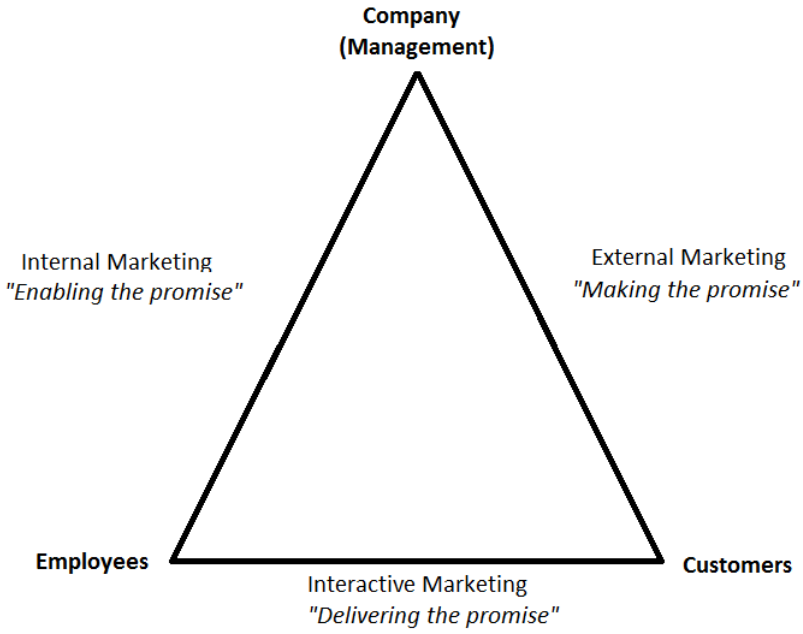

Figure 3.2: The Service Marketing Triangle (based on (Wilson et al., 2012)).

In order to achieve a complete marketing triangle, organizations' communications and knowledge transfer must reach all departments. If not achieved, this may endanger the service delivery and ultimately can lead to misinformed and unsatisfied customers. The relation between customers and employees is one of the major concerns of service marketing and can be viewed as **interactive marketing, the delivery of the promise**.

To create employees that can deliver the promises, the organization itself must provide their employees with the power needed. This is called **internal marketing, the enabling of the promise**.

Lastly, there is the **external marketing** that the organizations do to customers. This marketing will greatly influence the customers' expectations of the services and can be seen has **the making of the promise**.

But the standard service triangle does not sufficiently highlights the importance of the customer, and the relationship with him. So now, service marketing is changing, customer is now the focus of business and an inversion occurred in the service triangle.

3.4 Service Communication

Service Communication is closely related with the fourth service quality gap. Nowadays, there are several means that organizations use to make external communications that include media advertising, word of mouth and social networks. Nevertheless, this external communications raise the customers' expectations and if the communication is exaggerated can lead to an increase in the fourth gap (Wilson et al., 2012).

The complexity of marketing communication increased over the last years and while twenty years ago, newspapers and television advertising were the mass-communication vehicles, nowadays there are additionally websites, direct mail, cinema advertising, Facebook, Youtube and others. If we look at the service marketing triangle introduced in the previous section, we can exemplify the three marketing types in a communications point of view.

- **Internal Marketing**: Vertical communications, horizontal communications;
- **Interactive Marketing**: Personal selling, customer service center, service encounters, servicescapes;
- **External Marketing**: Advertising, sales promotion, public relations, direct marketing, websites.

However, recently there is a trend of organizations merging all their external communications channels in an Integrated Marketing Communications (IMC) (Wilson et al., 2012). Using IMC helps organizations build a stronger brand identity. For example, IMC assures that if a customer receives an e-mail with a promotion, the sales person that the customer goes to has total knowledge about that promotion.

There are several challenges that we need to deal in order tackle the communications gap. One of them is closely related to the service characteristic of intangibility. Because services are not concrete products it makes communication more challenging for customer and provider, is difficult to understand what a customer is buying and to evaluate their experience of the service provisioning. We can divide the intangibility challenge in five properties that affect communication (Wilson et al., 2012):

- **Incorporeal existence**: Although the delivery mechanism can have a physical space (for example a dry cleaning shop) the service itself (dry cleaning) does not. This implicates that showing a service to a customer is difficult;
- **Abstractiveness**: The benefits of a service not always correspond directly to objects, which makes them difficult to understand. For example, explaining the benefits of financial security might be difficult with no concrete object being produced out of the service;
- **Generality**: Most services refer to a class of things and not a specific object, this difficult the process of achieving a competitive advantage. For example, it is difficult to differentiate two services that promise ”superior education” because they are described in a very generic point of view;

- **Non-searchability**: Service is a performance and not a product, so most of services cannot be previewed or inspected prior to the purchase. For example, in a supermarket we choose from a wide variety what kind of meat we desire, but if we are looking for a plumber searching in a telephone directory gives us few insight of the service;

- **Mental Impalpability**: Services are complex and multidimensional, so when a customer with no prior information tries to understand the service, he often fails to. For example, buying car insurance for the first time is a good example of such a service.

To address this **Service Intangibility** characteristic there are several communication strategies to adopt. Using narratives to demonstrate the service experience is one of them. These narratives are a uniquely effective approach to reach the customers and make them react more positively towards advertising. There are also many other techniques such as presenting vivid information, using interactive images, focusing on the tangible aspect of services (the physical support), feature employees and customers in advertising or encouraging word-of-mouth communication. Although there are many alternatives, all come from best practices. Due to this, they lack a theory to support them and a method to produce a successful and scalable implementation.

Another serious challenge to the service communication gap is the **Management of Service Promises** (Wilson et al., 2012). The Management of Service Promises is what ensures that vows employees take are correctly considered. The software industry is a good example of this because many of the software services are actually sold before being available and without a precise date on when will that happen. Dealing with Management of Service Promises can be done in two different ways, creating a strong service brand and coordinating external communications. With a service brand we can inspire loyalty in customers. If customers recognize a brand that fulfills their promises they will be more inclined to request them other services. To coordinate external communications we need to integrate sales promotion, public relations, direct marketing and personal selling in just one marketing strategy to ensure that all promises done to customers can actually be fulfilled.

The third challenge of Service Communications is the **Management of Customers Expectations** (Wilson et al., 2012). Without Management of Customers Expectations, customers have no clue about their duties and rights in the service. The usual compartmentalized structure of organizations acutes this problem, departments start acting like silos that cannot communicate with each another. There are several ways to consider when attacking the Management of Customer Expectation challenge. First of all, promises should be realistic and employees should not promise what they cannot keep. If not, the overpromising can backfire. We can also provide the customer with service guarantees and choices. These two offers (guarantees and choices) will create a sense of trust on the customer and increase their satisfaction.

Customer Education is crucial in the reduction of the gap four (Wilson et al., 2012). If customers are unclear on how the service will be provided, how their role must be performed, they will have erroneous

expectations and will be disappointed when the service comes to a close. To counterbalance this, the service provider should always prepare customers for the service process and teach them what they should do and when. Also, implicit expectations and standards must be covered by the service provider, i.e. the provider must reach to the customer and communicate to him implicit actions and decisions. For example, when a medical exam comes negative the medical doctor may forget to inform the patient.

Finally, **Internal Marketing Communications** is the fifth challenge to the communications gap (Wilson et al., 2012). The Internal Marketing is related to the horizontal communications inside an organization. Every marketing strategy should take input from all the organization departments. If this does not occur, the perceived service quality is at risk. For example, in franchising if the policies over all branches are not respected it will affect the service quality across those branches. To reduce the communication gaps in Internal Marketing the organization should have an effective vertical communication. This can be achieved by implementing downward and upward communication, so that the information flows through the organization clearly. Also, selling the brand internally can be a critical factor to success as it motivates the employees and inspires company values in employees and, consequentially, customers.

The challenges of service communication and its proposed solutions have a flaw as they cannot be applied to each and every service the same way, neither they following a procedure. They are best-practices (lacking a theoretical background) that depend of the real situation at hand.

3.5 DEMO Processor

In a recent research (van Kervel et al., 2012) was designed a modeling language for DEMO that uses extensible markup language (XML) representations to capture DEMO models, called DEMO modeling language (DMOL). The purpose of the DEMO processor is to be able to offer a full decomposition of transactions, disagreements patterns inclusion, concatenated and parallel transactions identification, further detail required in the action rules specification and negative policy enforcement.

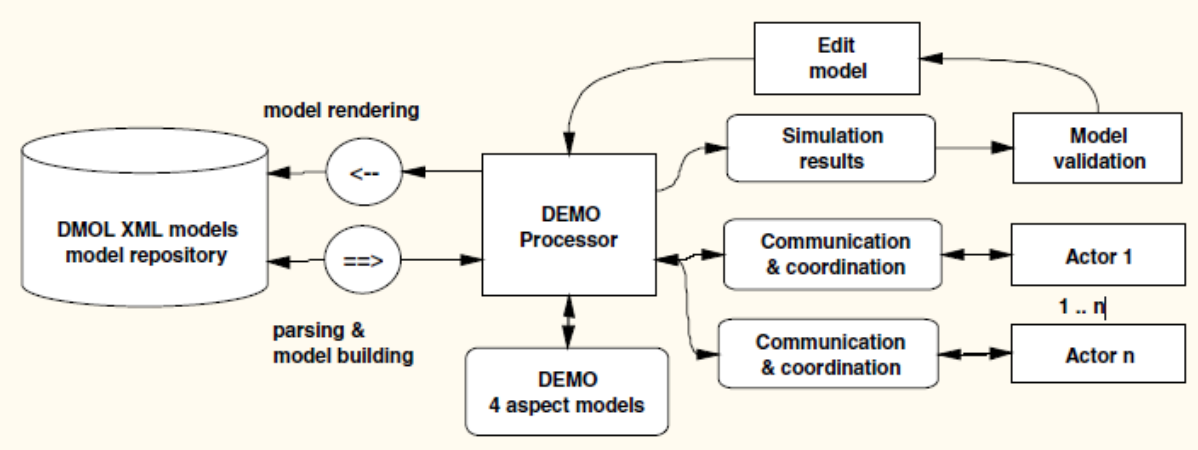

Figure 3.3: DEMO Processor rendering phase (van Kervel et al., 2012).

The processor takes use of definitions such as business transaction model (BST) and enterprise dynamic systems control (EDSC). BST are specifications on how all actors co-operate and communicate to an optimal production in an enterprise. EDSC consists in *a set of concepts designed to enforce control of the enterprise in the run-time business transactions* (van Kervel et al., 2012).

With this is mind we can see that the DEMO processor can be a great contribution to the creation of an enterprise information system (EIS), an information system driven by DEMO models.

Models used in this processor can later be read, written, destroyed, constructed or executed using a DEMO processor (also introduced in (van Kervel et al., 2012)). To create a DMOL model the users starts by entering the desired DEMO models one by one in the DEMO processor. After this the DEMO processor tries to validate the models in a cyclic process, every failure in validation is communicated to the relevant stakeholders and they can edit the model. A successful validation translates into a renderization and storage of the model in DMOL. It is important to refer that in every step the original model can be parsed and rebuild. This process is illustrated in **Fig. 3.3**.

This DEMO processor contributes to assess the quality of DEMO models and re-engineering them, if needed, before implementing them in real world organizations. All the models that go through the DEMO processor are assured with a formal rigor, the absence of anomalies and guaranteed ontological completeness.

In section 5.3 we will compare this DEMO Processor with the proposal we present in this research. The greatest fault of this processor is that it focus primarily on modelling instead of execution and has no quality component, essential to tackle our research problem.

3.6 Summary

In this Chapter we have compared several service definitions and reached to the one we will be using in this dissertation, the one presented by (Albani et al., 2009). Afterwards, we also looked for a quality definition concordant with our problem and service definition. We opted for the one purposed by (Parasuraman et al., 1985). Then we analysed how can quality be measured (e. g. ServQual) or defined (e. g. SLM) and noticed how current solutions fail to mitigate gap number four. Because our research problem is related to communication we then made a review of the service marketing field and service communication, to better understand the problem and how can we address it. Lastly, we looked onto a recent research that also proposes a system based on EO and DEMO to correctly model organizations services.

Chapter 4

Theoretical Background

In this Chapter we start by presenting the Enterprise Ontology that is the theory supporting our proposal, later we will talk about a recent framework that brings closer together services and Enterprise Ontology. After it, we introduce a work done in joining that framework with service level agreements.

4.1 Enterprise Ontology

Enterprise Ontology (Dietz, 2006) is based on four axioms – operation, transaction, composition and distinction – and the organization theorem. The operation axiom (**Fig. 4.1**) states that the operation of an enterprise is constituted by the activities of actor roles that are elementary chunks of authority and responsibility, fulfilled by subjects. In doing so, these subjects perform two kinds of acts: production acts and coordination acts. These acts have definite results: production facts and coordination facts, respectively. By performing production acts (P-acts) the subjects contribute to bringing about the goods and/or services that are delivered to the environment of the enterprise. By performing coordination acts (C-acts) subjects enter into, and comply with, commitments towards each other regarding the performance of production acts.

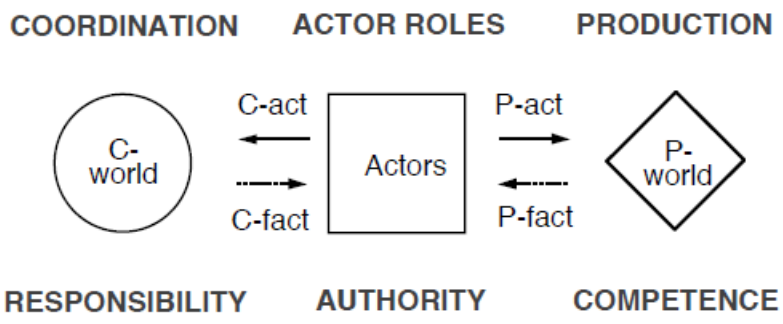

Figure 4.1: Operation Axiom(Dietz, 2006).

The transaction axiom states that coordination acts are performed as steps in universal patterns. These patterns, also called transactions, always involve two actor roles (initiator and executer) and are aimed at achieving a particular result. A transaction develops in three phases: the order phase (O-phase), the execution phase (E-phase), and the result phase (R-phase). In the O-phase the two actors agree on the expected result of the transaction; in the E-phase the executer executes the production act needed to create the expected result; and in the R-phase the two actors dis-cuss if the transaction result is equal to the expected result. **Fig. 4.2** ilustrates the basic transaction pattern, an example of the transaction axiom.

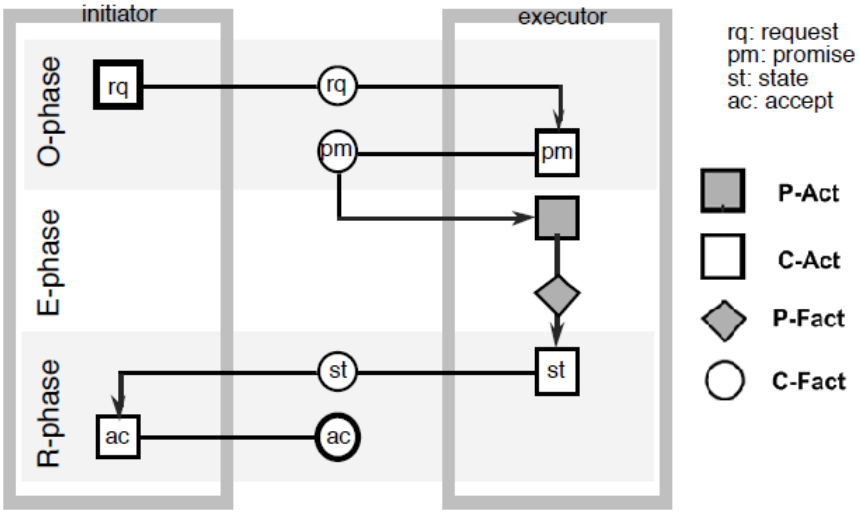

Figure 4.2: Basic Transaction Pattern (Dietz, 2006).

The composition axiom establishes the relationships between transactions. This axiom states that every transaction is either a) enclosed in another transaction, b) is a customer transaction of another transaction, or c) is a self-activation transaction. The latter case refers to transactions that give rise to further transactions of the same type.

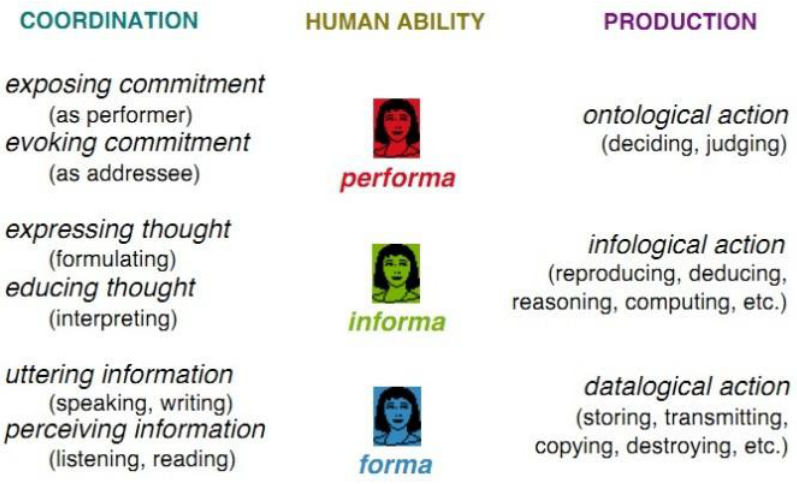

Figure 4.3: Distinction Axiom(Dietz, 2006).

The distinction axiom states there are three distinct human abilities playing a role in the operation of actors, called performa, informa, and forma. An ontological act (performa) is an act in which new original things are brought about. Deciding and judging are typical ontological production acts. Regarding the coordination between people, typical ontological acts are requesting and promising. An infological production act is an act in which one is not concerned about the form but, instead, about the content of the information. Typical infological acts are inquiring, calculating, and reasoning. Regarding the coordination between people, formulating thoughts (in written or spoken sentences) and interpreting perceived (through listening or reading) sentences are typical infological coordination acts. Acts like copying, storing, and transmitting data are typical datalogical acts, while speaking, listening, writing, and reading are typical datalogical coordination acts. This axiom is represented in **Fig. 4.3**.

The Organization Theorem combining the four axioms, obtaining a notion of enterprise concise, comprehensive, coherent and consistent. This notion is states that the organization of an enterprise is a heterogeneous system that is constituted of the layered integration of three different systems: the B-organization, the I-organization and the D-organization.

4.2 Generic Service Specification Framework

After the definition of service according to EO there were some other developments in the field leading to the creation of the Generic Service Specification Framework (GSSF) (Terlouw & Albani, 2011). This framework is used to specify both IT and human services to create an understandable notation for the providers and customers. It facilitates the search of services that meets their needs and lets them know how to deal with a certain service. The framework can be seen in **Fig. 4.4**.

The GSSF divides each service in four main concern areas: Service Executor, Service Production, Service Coordination and Contract Options.

Service Executor contains information about the provider of the service such as the role he implements and his contact information. The information needed to fulfill this area can be retrieved by the Actor Transaction Diagram and the Process Model.

Service Production focus on the p-act performed by the service executor. It encompasses seven aspects:

- Prooduction Act: obtained from the Actor Transaction Diagram or the Process Model;
- Production Info Used: specifies which information is needed in order to produce the service. This information can be obtained in the Information Use Table;
- Production Fact: the result of executing the p-act. Is obtained using the Transaction Result Table;

- Production Kind: is the type of the service specified (ontological, infological or datalogical). Obtainable from the Transaction Result Table;
- Production World Semantics: the common knowledge and understandings about the semantics of the service. Present in the State Model;
- Pre & Postconditions: the production facts that always hold before and after the service execution. We can obtain this using the Action Model.

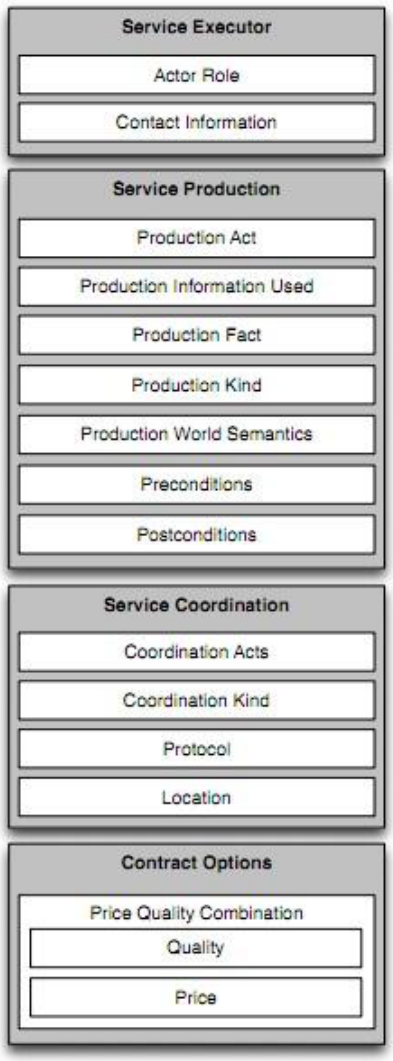

Figure 4.4: Generic Service Specification Framework (Terlouw & Albani, 2011).

Service Coordination represents four aspects related to the communication between the consumer and the provider. Only the Coordination Acts can be directly obtained using the Transaction Pattern. The other aspects are related to if the service is human or IT (Coordination Kind), the rules and syntax of the communication (Protocol) and provisioning of input and output parameters (location).

Lastly, the **Contract Options** specify the relationship between price and quality of the service.

Despite being a very important research on the service specification this work does not provide much

information on how to represent quality aspects. This absence leads to a misalignment between provider and customer expectations and contributes to the service quality gaps.

4.3 DEMO-Based SLA

In order to use SLA with DEMO methodology we need to make an adaptation from standard SLA to DEMO-Based SLA. This will be useful to guarantee that SLA that service providers currently used and are not modeled in DEMO can be used in our research without any loss of information (Mendes & Mira da Silva, 2012). In **Fig. 4.5** we can see the correlation that exists between the service quality gaps and EO's basic transaction pattern.

We can see that the gap number four is caused by a difference between the p-fact execute, the c-fact state (both performed by the service provider) and the c-fact accept (performed by the customer). This corresponds to the E-phase and the R-phase.

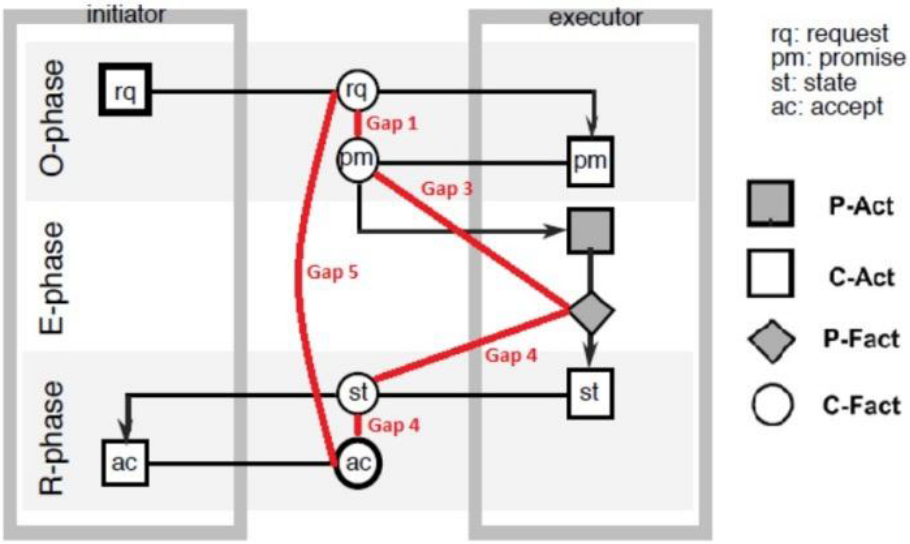

Figure 4.5: Service quality gaps represented using the basic transaction pattern (Mendes & Mira da Silva, 2012).

In order to complement the model we need to add SLA knowledge. Mendes & Mira da Silva (2012) defined a SLA using EO terms. Mendes & Mira da Silva (2012) state that *a service level agreement is the proposition that two actors (initiator and executor) build together in the O-phase of any ontological transaction. This proposition is clarified by informative acts.*

Also these SLAs have five elements, entity responsible for achieving the SLA, service, target, price and penalty. These elements can be all retrieved by using the correct DEMO models. **Fig. 4.6** illustrates the connection between SLA elements and DEMO models.

This methodology has been proven correct with different types of services and SLA (Mendes, Almeida,

et al., 2012; Mendes, Ferreira, & Mira da Silva, 2012).

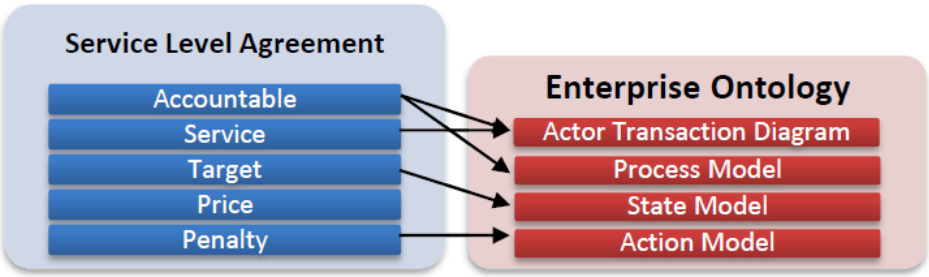

Figure 4.6: Service Level Agreement proposal and relation to Enterprise Ontology (Mendes & Mira da Silva, 2012).

The correlation is possible because, in one hand the EO theory describes, very formally, the interactions that happen between customer and provider and in the other hand Service Level Management acts as the interface between customer and provider. And by using the solid basis of EO we can formalize the SLA definition and achieve better representations of the SLA.

4.4 Summary

This theoretical background Chapter was created to introduce a brief and concise presentation of all the theoretical background of our proposal. We started by introducing EO, which by using it we intend to remove the lack of strong foundations of the solutions we analysed in the previous Chapter. Secondly, we analysed the Generic Service Specification Framework (GSSF) (Terlouw & Albani, 2011) that will help us specify services that are concordant with EO. To mitigate the lack of quality attributes in this framework we introduced DEMO-based SLA (Mendes & Mira da Silva, 2012). With the use of this research we can better specify quality using EO terms. All these researches bring essential knowledge to tackle our problem and address the communication challenges it presents.

Chapter 5

Proposal

This Chapter corresponds to the design and development step of Design Science Research Methodology (DSRM). In order to tackle the problem that was described in Chapter 2, we intended to create a system that registers all the coordination acts involved in the service exchange. We have called this system the DEMO Engine. This DEMO Engine will need to bring together combined knowledge from EO, DEMO, GSSF and DEMO-based SLA (**Fig. 5.1**).

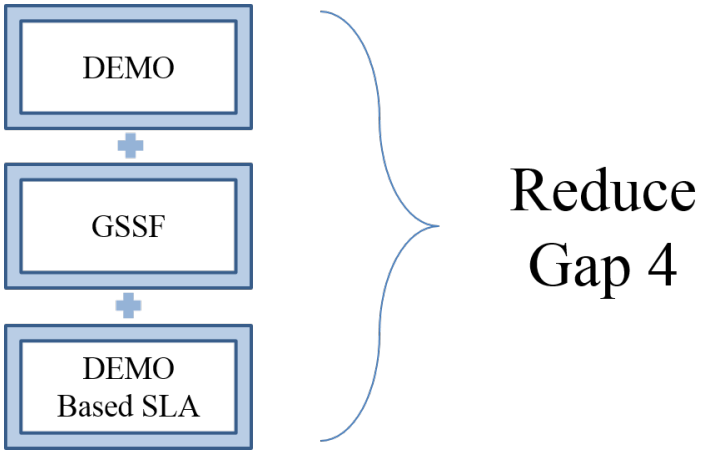

Figure 5.1: DEMO Engine Overview.

But not only we purpose to register all coordination acts and production facts involved in a service exchange, we also learned from Service Marketing and Service Communication that we must make them visible at any time. The c-facts and p-facts should be available to any actor that participates in the service delivery and at any given moment. This way providers and customers have more sense of control and responsibility, since they get all the information they need, whenever they need.

By using EO and DEMO, someone might think that only the B-organization and ontological services are aimed at in this DEMO Engine. Nevertheless, our proposal can be used to the other two layers of any organization and intends to support any kind of service, might they be ontological, infological or

datalogical. Furthermore, we will use past work done in the service quality gaps field, that tackled the gaps 1,2,3 and 5 (Mendes & Mira da Silva, 2012; Almeida, 2012; Ferreira, 2011) to support our proposal.

5.1 Proposed Features

In this section we will discuss how have several researches contributed to the DEMO Engine features and the objective behind that contribution.

Enterprise Ontology & DEMO

Starting with EO & its proposed methodology DEMO, their strong conceptual foundations can provide us with **coherency, comprehensiveness, consistency, conciseness**. We do not focus on the **essential** characteristic because, as we have said before, we opted for supporting ontological, infological and datalogical services.

Also, we will make extensive use of the transaction axiom, and the transaction patterns EO proposes, namely the standard and the cancellation pattern. This patterns ensure that all services follow a strict, but grounded, flow with known steps and end points. We will use the EO acts request, decline, quit, promise, state, reject, stop, accept, cancel, allow and refuse in order to give us a more realistic view of all the iterations that occur during a service.

We try to model the whole transaction because, despite gap four being located in the E-phase and R-phase of the EO patterns, it is crucial to model the other phase of the transaction pattern (O-phase). It is easy to see that all acts done on the O-phase have a direct influence on this gap. If the service provider overpromises the c-act promise, it will directly influence how the p-fact execute is done, therefore increasing gap four.

Furthermore, the notion of actor role is a great contribution of EO, and in the DEMO Engine we propose to create such roles, making them easily associated and editable.

Generic Service Specification Framework

As we have seen before the GSSF can helps us better define the domains of a service. we will use GSSF in order to improve the understandability of services for both the service providers and customers. This is very important because when we are trying to improve the quality of communication, knowing of what are we talking about is essential, in this case knowing exactly what a service aims to do is crucial for either the customer who requests it and the provider who handles its provisioning.

Besides, the areas of service concern give us key aspects that we will include in the DEMO Engine.

Things like the production acts (the service results), the executor information (the service provider), and the coordinations acts (the communication of the service) will be included in the DEMO Engine as inherent service characteristics, that need to be determined for each service execution.

DEMO-based SLA

DEMO-based SLA complements the GSSF and brings the quality specification into the DEMO Engine. This will further complement our proposal and add service level agreements to the service catalogue.

We will focus on the performance targets of DEMO-based SLA, namely, the response time (the time it takes from a request to the actual promise) and the resolution time (the time taken from the request to a state c-fact).

We pretend to use DEMO-based SLA dynamically, this is, it would be possible to propose a new SLA for a service and, using DEMO patterns, negotiate that SLA in order to reach a Service Level that both the customer and the provider agree on, in line with Mendes (2013).

5.2 The DEMO Engine

The system we propose will enable two different things: first, the service provider can use his catalogue to provide services to the customer, and second, the customer can propose new services or modifications to the provider's catalogue.

Any provider can specify their services and SLAs in the system and then use it to fulfill the service requests regarding their services, using GSSF and DEMO-based SLAs.

The system is also prepared to give the customers the chance of requesting generic services. In other words, customers will be able to request services that are not included in the providers' service catalogue. In this case, the providers may choose to provide for this services or not. We would like to stress the fact that in both situations, the service executions will follow the EO transaction patterns.

We also aimed to store all the c-acts that are performed over the course of a service and make it available to both the customer and the provider so that they know in any given time what acts were performed, who did each act and when were they made.

Ultimately, we also pretended to measure important metrics such as the percentage of fulfilled SLA (in total and per customer or provider) or the average time it takes to response to a request (customized or not). For example, these metrics provide the customers with information about which services are faster and which fulfill their promises.

To further reduce the communication's gap, we intend to address the following topics:

- **Service Intangibility**: To create a simple service catalogue that can be understood by the customer using both GSSF and DEMO-based SLA. Both the customer and the provider will be active in the creation of the catalogue;

- **Management of Service Promises**: DEMO roles ensure that employees have a promise jurisdiction. Also, customers will perceive the "DEMO brand" and know what to expect of the service. Customers will perceive DEMO and know that patterns are the same in every execution, making it harder for the providers to overpromisse without the customers noticing it;

- **Management of Customer Expectations**: The arguments of the DEMO SLA (such as bonus or price) ensure that customers know what they are paying for and what they can receive for a poor service performance. Also, the initiator/executor relationship clarifies which actors are participating in the service. Furthermore, all acts are recorded for later reference, which gives transparency to all the service delivery process. The customer knows at which step is the execution and has a constant feedback that allows him manage his expectations;

- **Customer Education**: Both the customer and the provider responsibilities are stated in the DEMO-based SLA. Customers can add custom services/SLA to the provider's catalogue to better match their needs. Additionally, the DEMO transaction patterns are always the same so the customer always knows about the existing choices, they perceive what they have to do, why and when. After some use of our proposal, it is intended that the customer becomes educated on how it works since the patterns are always the same and provide real-time feedback;

- **Internal Marketing Communications**: Related to the information seen from inside a company. All services, DEMO-based SLA and acts are visible to all employees to increase communication inside the organization. Even service executions are always visible so that we can know which state they are in.

In **Fig. 5.2** we illustrate the connection between the knowledge used from the related work and the the five communication challenges.

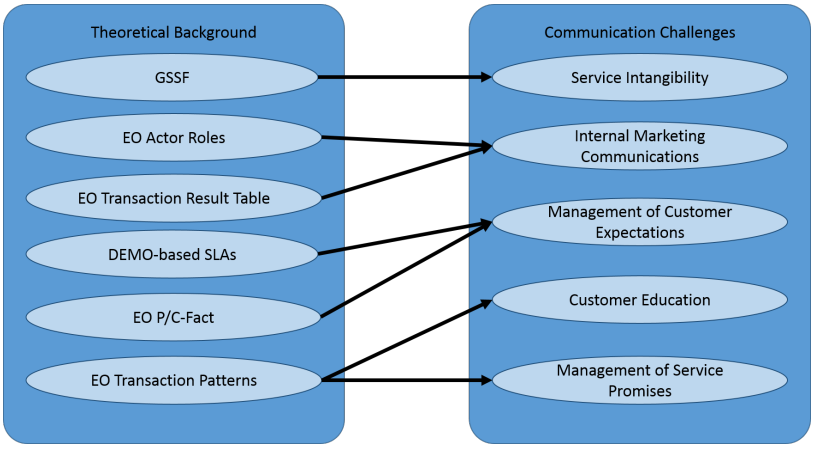

Figure 5.2: Communication Challenges Addressed.

With these solutions in our system, we expect that our proposal will be able to reduce the gap number four and answer our research question.

5.3 Comparison with Related Work

In this section we present a table (**Table 5.1**) in which we compare our proposal, the DEMO Engine, with a research we presented in the related work, the DEMO Processor. We make this comparison because both solutions try to bring DEMO to Information Systems in practice by presenting a instantiation of some DEMO models.

	DEMO Engine	DEMO Processor
Core Focus	Service Execution	DEMO models compilation
Quality Specification	DEMO-based SLA	NA
Models Derived From	Prior Definition / Real Use	Prior Definition
Required Knowledge	Few / None	Deep
Models captured	EO Transactions	All but State Model
Process Complexity	One Transaction	Chain of Transactions
Main goal	Improve Service Communication & Co-creation	Produce and Execute correct models

Table 5.1: DEMO Engine compared with DEMO Processor.

In **Table 5.1** we compared these two tools using factors related to the Problem and Objective of the proposal (Core Focus and Main Goal), related to the suitability of solving quality gaps (Quality Specification), the usability of such proposals (Models Derived From and Required Knowledge) and finally factor related to the process complexity that can be captured using said artifacts (Models Captured and Process Complexity).

We can see by looking at **Table 5.1** that both approaches are based on EO and DEMO, but nevertheless have different objectives. While our proposal focus on the execution of any kind of service using DEMO patterns, the DEMO Processor has a bigger concern on creating and compiling the correct DEMO models of an organization.

In DEMO Engine the models can be taken from real use of the system instead of priorly defined. Furthermore, due to this the knowledge of the organization required to use both solutions is very different, while in DEMO Engine anyone can specify services and request them using knowledge from SLM, to use the DEMO processor we need to know with some detailed extent how the organization works. Nevertheless, having more knowledge of the organization allows the DEMO Processor to design several DEMO models like the Actor Transaction Diagram or the Process Model.

Being focused in the execution of services, the DEMO Engine supports the use of quality (from DEMO-based SLA), determinant to tackle the gap number four. DEMO Processor lacks this support.

Another big difference that stands out is that the DEMO Engine only allows independent transaction, or better, composed transactions are not actually linked, there is no formal representation of it. The DEMO Processor enables this linkage, therefore allowing transaction and services with high complexity.

Finally we can sum the difference of these systems with the relation with their goals. The DEMO Engine being focused on improving communications between actors, has a special concern with service quality and allowing interactive communication with a intuitive interface, while also using EO transactions. On the other hand, DEMO processor focus on creating Information Systems compliant with EO, therefore focusing more on creating and compiling models.

5.4 Summary

This Chapter intends to show our purposed artifact to the scientific community, corresponding to the Design & Development phase of DSRM. We start by showing the characteristics we have taken from each of the related work and theoretical background to include in our artifact. Afterwards we sum up the characteristics of our proposed system, the DEMO Engine, and how it tackles the communication challenges that affect gap four. Finally, we present a comparison between an artifact developed to ensure the creation of Information Systems based on EO (the DEMO Processor) and our own proposed artifact (the DEMO Engine), focusing on explaining the differences and the overlappings.

Chapter 6

Demonstration

This Chapter corresponds to the demonstration phase of DSRM. In order to demonstrate our proposal, we have implemented a web-based prototype, we applied the proposal to a fictional case of a service request using a Travel Agency, and we also applied it to the Portuguese Institute of Construction and Real Estate (INCI).

6.1 DEMO Engine Explanation

The prototype was developed using the SCRUM methodology (Schwaber, 1995). The prototype includes the following features:

- **Service Catalog Management**: Create, read, update and delete services and SLAs. The services can be specified using the GSSF (Terlouw & Albani, 2011) and the SLAs using the DEMO-based SLA (Mendes & Mira da Silva, 2012);
- **Organization Resources Management**: Connection between an organization's resources and the actor roles of a DEMO model. In other words, the prototype allows us to define who are the people that can implement certain actor roles and, consequently, execute the respective services;
- **Service Execution Management**: Execution of services according to the EO transaction patterns;
- **Notification Management**: Configure the notifications by user, having the opportunity to select the frequency of the e-mails. When the SLA have performance targets to be fulfilled, calendar appointments are included in the e-mails;
- **Information Exchange Management**: Every act and every service execution is registered and visible to the interested actors.

Whenever users register in the prototype, a service catalogue is automatically created for them to specify which services they want to provide. They are also automatically assigned to a company. The specification of the service catalogue is done using GSSF and DEMO-based SLA.

It is always possible to invite other users (registered or non-registered) to our company by specifying their name, username and e-mail.

When a service is created its respective initiator and execution roles are also generated and automatically assigned to the service creator. Nevertheless, at any given point, the roles can be added to any other user that shares the same service catalogue, i.e., belong to the same company.

The registered users can view the other service catalogues and every user can interact with any service catalogue by requesting the services included in it. Additionally, the users can request custom-made services. This customization may be in terms of a total new service/SLA or modifications to a service/SLA. If the provider agrees to the terms of the request, i.e. promises to deliver it, the service will be added to the catalogue. The same method is valid to add a SLA to the service catalogue.

In **Fig. 6.1** we can see a screenshot of the service execution management feature from the executor standpoint (on the left) and from the customer standpoint (on the right). This figure is based on the standard pattern of a transaction from EO (Dietz, 2006). This pattern includes two actor roles (initiator / customer) and (executor / provider), three phases (operation, execution and result), and 8 possible coordination acts ("rq" - request, "dc" - decline, "qt" - quit, "pm" - promise, "st" - state, "rj" - reject, "sp" - stop and "ac" - accept). We can see in this figure that there are several red and blue numbers. Each of those numbers represents a service execution, this is, 6 represents 6 services executions, 2 represents 2 service executions, and so on.

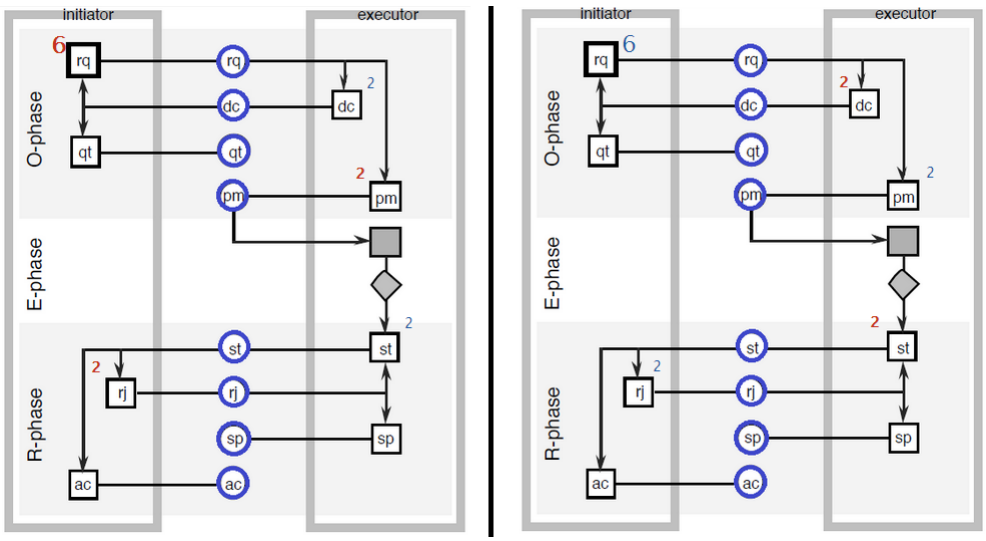

Figure 6.1: Executor standpoint (on the left) and Initiator standpoint (on the right).

On the left of each coordination act we have in red the number of services that are expecting our interaction at that particular step. For example, on the left side of **Fig. 6.1** (where we are acting as

an executor), we have 6 incoming requests, 2 incoming promises and 2 incoming rejects. Also when the number of services expecting our answer reaches 4 the font increases size, when it goes over 9, it simply presents “9+”.

If we look to the right of each coordination act we have in blue the number of service executions that we are expecting an answer to on that execution step. On the left side of **Fig. 6.1** we see we have declined 2 service executions and we are expecting an answer from the customer. The same goes for state, we have stated 2 service executions and we are expecting an answer from the customer. As for the red numbers on the left, the font size increases when the service executions reaches 4, and are represented as “9+” when above 9.

To better understand this, one can look at the right side of **Fig. 6.1** which represents the same service executions, but from a customer standpoint. If we do the same analysis to the right side that we did to left side, we see that the customer is waiting for 6 service requests answers, has 2 declines expecting a response, and is waiting for 2 responses on promises. There are also 2 states waiting to be answered, and lastly 2 rejects have been done for which an answer is expected.

Looking at **Fig. 6.1** in a whole, we can see the left and right side mirror each other. This happens because the service executions represented in the figure is only made between the two same actors.

There is also the option of clicking on the coordination-facts (the blue circles) at any time. This redirects the logged user to a list of services executions in which the last coordination act was the one clicked. In the list there is additional information about the service executions such as the initiator/executor, a brief description, SLA and answer options.

Additionally, if we hover over each of these numbers, we get information about what our possibilities of answering are (**Fig. 6.2**).

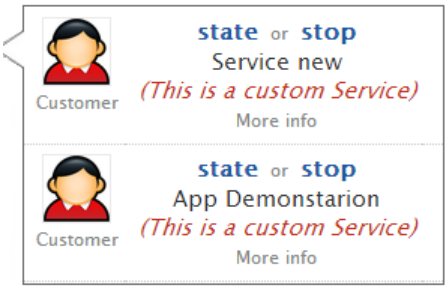

Figure 6.2: Service Execution Pop-up.

In this case, we see that we have 2 services under the step reject and we can answer both either with a state or a stop. Here we have information about the interlocutor of the service (the Customer), the name of the service, a warning telling us that the service is custom, that is, it is either a new service proposed by the customer, has a custom SLA or is a service execution with no SLA specified. Furthermore, if this service execution had specified a SLA, their response/resolution time would also be displayed.

In each pop-up if we choose the negative answer (always the one on the right, in the case of **Fig. 6.2** stop), we are prompted to provide a justification for it. Lastly, clicking on “More info” will redirect the user to a fully-detailed information page of the service execution, regarding service details, service execution information, SLA information and the history of the execution.

Whenever a service execution is close to either its response or resolution time, an e-mail is sent to both the initiator and the executor of the service execution. This e-mail acts as a reminder of the pending request or the promise both actors agreed on and ensures that every part is notified of the possible SLA violation. An example of that e-mail is represented in **Fig. 6.3**.

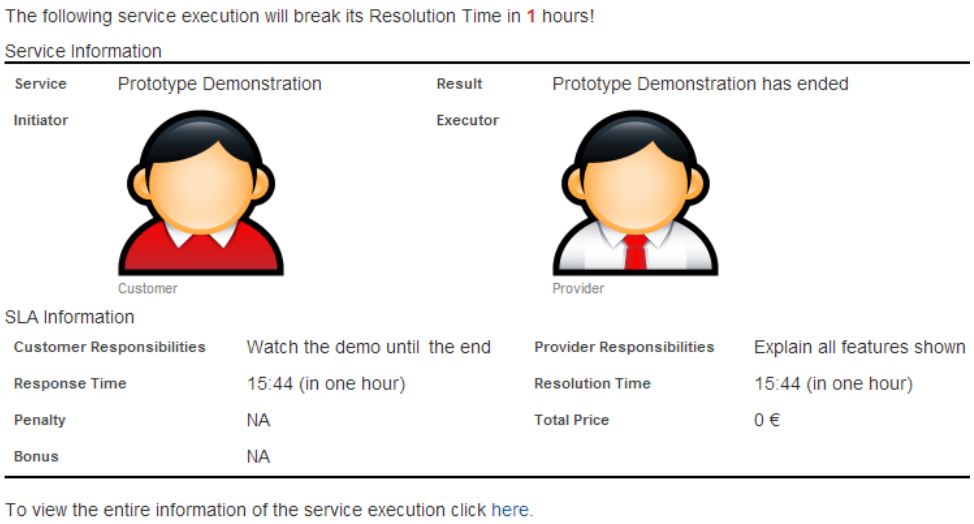

Figure 6.3: SLA warning e-mail.

As we can see, this e-mail provides us with concise information about which service execution and SLA is reaching its deadline. There is also always a direct link to the full-detailed information on the execution where the answer options can be taken.

During the prototype development, the prototype was used by two researchers to request services between them. These two researchers provided weekly feedback that was included in the prototype features.

6.2 Travel Agency Demonstration

In this section we present a fictional case of a service request using a Travel Agency. We will describe all the actions that need to be taken in order to successfully use a service of a ”Trip Advisory”, this is, advisory on which destinations to choose for spending the summer holidays. We are impersonating James, a customer who wants to make a trip in his summer holidays but does not know where. Using the DEMO Engine we will describe how can James solve his problem.

James starts by looking at the Travel Agency service catalogue and he notices a service that might correspond to his needs, the ”Trip Advisory” service (top of **Fig. 6.4**). James then proceeds to click on the request button and he is prompted with a pop-up to select which allows him to select the service characteristics (bottom of **Fig. 6.4**).

On this pop-up James has several other information about the service. He fills in information about the context of the service (why he is requesting it) on the ”Execution Notes” field, he selects John as the service provider and opts for the only SLA associated with the service. James now knows that his request must be answered in the next 5 hours (response date) and finalized over the course of the next 10 hours (resolution date).

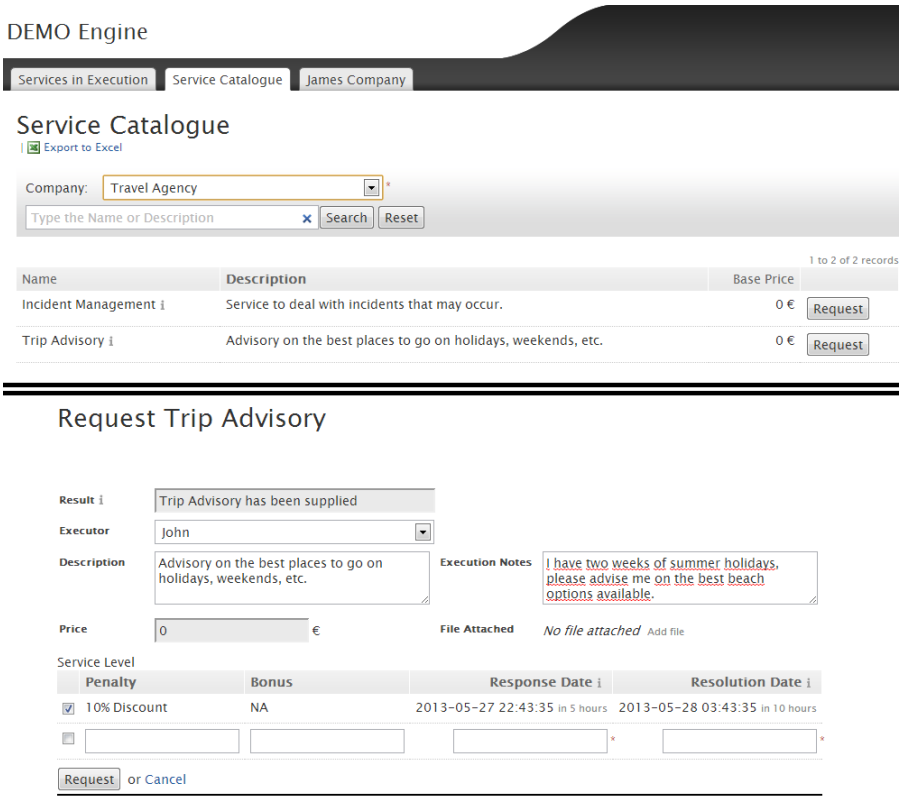

Figure 6.4: Trip Advisory Request (Catalogue on the top and pop-up on bottom).

Now is the turn of John to deal with the request. John receives an e-mail saying he has a request to answer and, after agreeing with the options that James requested, he promises the service directly from the e-mail. Making this promise John agrees with the SLA and agrees to deliver the ”Trip Advisory” service in 10 hours. With this promise John has fulfilled the first performance target of the Trip Advisory’s SLA chosen, the response time. Important to notice that after the promise, both actors (James and John) receive an e-mail with the coordination fact produced and also a Google Calendar notification with the resolution time of the Trip Advisory as deadline.

After the promise being done, John has to execute the service. This execution is not the focus of DEMO and therefore we do not intend to model it. Nevertheless, one can think of the execution as John looking

up in his brochures for several beach resorts and attaching those brochures to the service execution of the DEMO Engine.

When John states that the ”Trip Advisory has been supplied”, James faces a problem. There is no information about Brazil in the brochures, and a close friend of him told him Brazil was a great place to visit. James feels compelled to reject the service and he justifies the reject with his concern (**Fig. 6.5**).

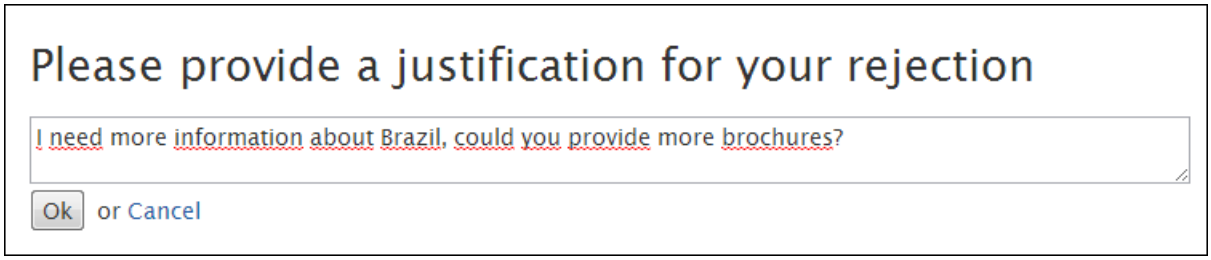

Figure 6.5: Trip Advisory Reject Justification.

John receives the reject from James and now has to analyse it carefully. If he aborts the transaction (making a c-act ”stop”) he will possibly disappoint a customer and damage the company’s image. On the other hand, if he fulfills James proposition (re-executing the service and performing the c-act state) he will need to work more, work that is directly unpaid.

John, being a good employee and caring about the customers, decides to look for brochures of Brazil. After selecting the according ones he attaches them to the ”Trip Advisory” service execution. After the state fact is made, John fulfills the second performance target of the SLA, the resolution date.

Finally James has to reach a final verdict, or he is fully satisfied with the ”Trip Advisory” performed by John or he rejects it again. After reviewing the new brochures, James feels satisfied with the opinions he receives and has decided to spend two weeks on a resort in Rio de Janeiro, Brazil.

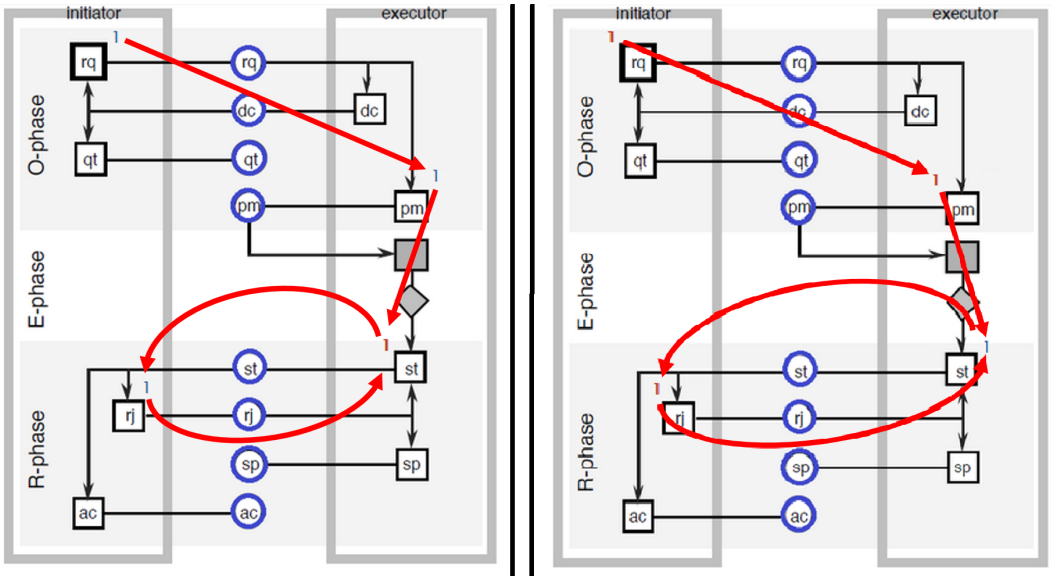

Figure 6.6: Trip Advisory Execution (left - client view, right - provider view).

If we look to **Fig. 6.6** we can see the execution evolution from James (left side) and John (right side) point of view. We can see in this picture the difference that happens in the interface between acts, with the objective of facilitating the communication so we can address our research problem.

James now feels that he needs to book a hotel in Rio de Janeiro, but he wants to do the booking using the Travel Agency. Nevertheless, after looking at their catalogue, James sees that there is no ”Hotel Booking” service. So he proceeds to request a custom service to the Travel Agency specifying the features he wants. We can see James' request in **Fig. 6.7**.

Figure 6.7: Hotel Booking.

James has opted not to fill in the SLA attributes to specify the response date, the resolution date, the penalty and the bonus of the service. This means that the execution must be best-effort (ASAP). After clicking request, John will receive notification of this custom service. Now this service execution flows the EO pattern according to the choices both actors take. If the service is promised by John, the service will be added to the service catalogue so that any customer can request it, further enabling co-creation.

6.3 Public Institute Demonstration

This demonstration occurred in the Portuguese Institute of Construction and Real Estate (INCI), a public regulator entity of the construction and real estate sectors. INCI employs 127 workers and has jurisdiction over all the Portuguese territory. INCI had a problem of managing their services inside the organization, there is no formal communication (only e-mail) when requesting services and that prejudices the communication in the organization. With the use of our DEMO Engine we intended to improve INCI's services and communication.

In INCI we used our system to create, manage and execute services related to the infrastructure management of INCI's headquarters. These services comprise, the cleaning of the building, maintenance of facilities and office equipment, etc.

After a brief introduction of our system, explaining the main functionalities and showing the example of the Travel Agency we let the INCI's employees configure and use the DEMO Engine as they pleased. This way we ensured that the services defined come from real-use and reflect the organization needs.

For this demonstration we had three different employees registered in our web-based prototype. These employees acted as both customers and providers of the services, exchanging service executions between them. In the week we deployed the system there were three services created, one related to receiving support on the DEMO Engine and two with the management of infrastructures. We can see one of those services in **Fig. 6.8**.

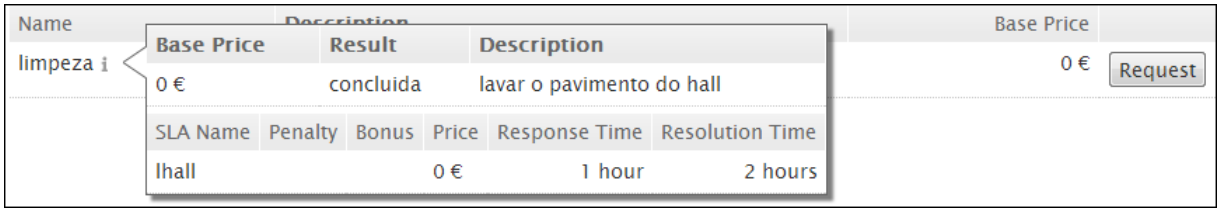

Figure 6.8: Cleaning Service at INCI.

This service concerns the cleaning of the front hall of the building and is allowing INCI to control who is responsible for the cleaning and timing the execution of the service using an SLA with one hour of response time and two hours of resolution time.

The better understand how the execution of services occurred at INCI, in **Fig. 6.9** we present the workflow of the execution of one of the cleaning service.

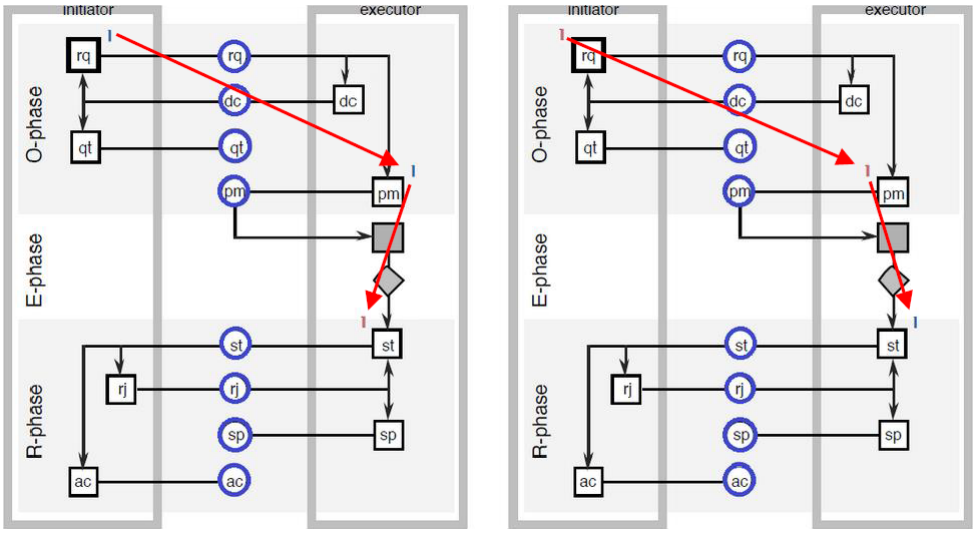

Figure 6.9: Service Execution at INCI.

As we can see in the picture at INCI, the service executions always followed the basic transaction pattern and no negative options were chosen. After an initial request from the customer, the provider always answered with a promise and afterwards a state. To conclude the execution the customer accepted the service. As we have seen previously the execution ends with an accept and has no formal representation in the pattern, nevertheless clicking the blue fact “ac” will send us to a list of all transactions at INCI that ended with and accept.

6.4 Summary

The demonstration Chapter details in three sections respectively, the functionalities of the DEMO Engine, a fictional execution of the DEMO Engine (using a Travel Agency example) and finally a field-study of a real use in a real organization (INCI) of our artifact.

These sections grow in complexity, being the first just a explanation of the features and the last a real use case. While the fictional demonstration may seem lackluster (as it presents no intrinsic connection to the real-world), it proves beneficial when explaining the artifact to the customers and providers and acts as a basis for the final demonstration.

Chapter 7

Evaluation

In this Chapter we will present the Evaluation Phase of the Design Science Research Methodology. In order to assess the quality of our artifact we used the Österle four principles (abstraction, originality, justification and benefit) to our proposal (Osterle et al., 2010) and we used the framework of DSRM Strategies (Pries-Heje et al., 2004) to identify the type of assessment strategy that would be used for each field study. Furthermore, we collected feedback from academic and practitioners, either by personal interviews and e-mail. Every evaluation with practitioners, and the one at ULHT, were also followed by a qualitative questionnaire (see Appendix A).

The DEMO Engine Questionnaire had 12 questions divided by 4 sections: Service Intangibility, Management of Service Promises, Management of Customer Expectations, Customer Education and Internal Marketing Communications. In each question the interviewees had to answer comparing DEMO Engine with systems used at their companies, or with systems they had knowledge about. The questions were rated from 1 (worsened a lot) to 5 (improved a lot). The Public Institute of Construction and Real Estate demonstration was evaluated after analysing the services and executions we showed in section 6.3, and by collecting the feedback of the institute employees.

We do not intend to validate the use of the EO transaction patterns because the theoretical background behind it assures 4c-ness: coherent, comprehensive, consistent and concise models (Dietz, 2006).

To better structure this evaluation we will first present the evaluation strategies behind the evaluation. Afterwards, we show in detail the four live evaluations done with academics and the four live evaluations with practitioners. Then we evaluate the demonstration at INCI (section 6.3). We next present the evaluation using the Österle principles, using all the feedback collected. Finally, we present a brief summary of this Chapter.

7.0.1 Strategies for Design Research Evaluation

The evaluation step is considered as being one of the most crucial steps in the Design Science Research of Information Systems. Without it we cannot verify the real contribution of the proposed artifact and its effectiveness on the problem (Hevner et al., 2004).

In March & Smith (1995), the authors defines evaluation in DSRM as the development of criteria and the assessment of the artefact's performance in comparison to the criteria. It is important to notice that evaluation must not only comprises if the artifact worked, but also how and why it did work.

In order to better evaluate artifacts, Hevner et al. (2004) proposed five different types of methods: Observational, Analytical, Experimental, Testing and Descriptive. Nevertheless, the same authors do not provide sufficient guidance on how to accomplish each method.

To fill in this gap Pries-Heje et al. (2004) developed a framework that could help researchers use and rigorously evaluate design science research and its artifacts. This framework consists on distinguishing evaluation in two separated dimensions: one related to the form of the evaluation, the other concerns the moment of the evaluation.

The first one, the form of the evaluation, can either be artificial or naturalistic. In an artificial evaluation, the solution is evaluated in a contrived and non-realistic way (using for example simulations, laboratory experiments and mathematical proofs). On the other hand, in a naturalistic evaluation the solution's performance is tested in real environments using real users, real systems and to solve real problems.

The second one, the moment of the evaluation, can be ex-ante or ex-post. Ex-ante means that the evaluation takes place before the artifact is developed, meaning that it is not absolutely necessary to construct an artifact to evaluate a theory. On the other hand, ex-post means that when the evaluation is conducted, the artifact is already developed.

A better view of the framework can be seen in **Fig. 7.1**.

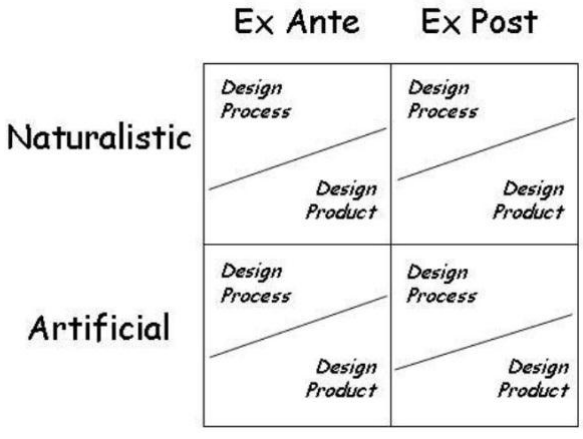

Figure 7.1: Strategies for Design Science Research (Pries-Heje et al., 2004).

In summary, the framework proposed by Pries-Heje et al. (2004) can be formulated through the following questions:

- **When** evaluation takes place?
- **What** is actually evaluated?
- **How** is it evaluated?

For the **when**, we can choose either ex ante, ex post or both. On the second question, the **what**, we specify whether it is an artifact design process or a product design. Finally, to answer the **how** we can select from a real setting with real users (naturalistic) or based on laboratory experiments.

In our evaluations we have always addressed the three questions (What, How and When) the same way. This is described in **Table 7.1** and in the following topics:

- **What is actually evaluated?** The artifact evaluated is the proposed system elaborated in Chapter 5 (a design product), the results achieved by creating a prototype, the feedback collected among academics and practitioners and the results of applying this system in practice;
- **How is it evaluated?** The feedback given from the academic community and practitioners proves valuable to evaluate our system. We also implemented our proposal in a Portuguese public administration (INCI). This represents a naturalistic evaluation since it was conducted using a real artifact - a prototype developed using Outsystems. We also use a fictional field-study, using a Travel Agency which represents an artificial evaluation;
- **When was it evaluated?** In this case the evaluation was made ex post, that is, after the design product was developed. We first constructed the prototype and only afterwards proceeded with gathering feedback among academics and practitioners.

	Ex Ante	Ex Post
Naturalistic	—	**P:** Interviews with practitioners and academics, INCI Demonstration **C:** Tackling of Communication Challenges
Artificial	—	**P:** Travel Agency Demonstration **C:** Tackling of Communication Challenges

Table 7.1: Evaluation Strategy.

In **Table 7.1** P summarizes the essential characteristics of the evaluation Process, while C indicates the evaluation Criteria.

7.1 Academic Feedback

In this section we will present in detail all the academic feedback collect in order to evaluate our proposal. It comprises interviews, workshops and presentations done with different academic audiences over the course of this thesis. In total, we collected feedback from 47 different academics.

DEMO Workshop with Japanese DEMO Community

The first evaluation took place in a DEMO workshop held in Lisbon by the DEMO Portuguese community with a professor representing the Japanese DEMO Community. There were 12 workshop attendees including Portuguese academics (professors and researchers) and Junichi Iijima, a Japanese professor from Tokyo Institute of Technology (TokyoTech, Japan). Junichi Iijima is the Dean of the Graduate School of Decision Science and Technology of TokyoTech since 2011–2012.

This evaluation started with a presentation of what is this thesis, explaining the proposal and the artifact developed. Afterwards, there was a demonstration of the main functionalities of the prototype followed by several questions from the audience. This questions provided essential feedback to continue the development of the prototype and gave us confidence in our proposal.

This feedback had two major concerns. The first is related to the interactiveness of the EO patterns, increasing communication quality, helping co-creation and a real representation of the organization. The second is related to the potential of data mining with real data from organizations, specially concerning what are the best services for an organization, which bring more value and which do not.

Virginia Commonwealth University

The second live evaluation occurred also in Lisbon in a workshop held with students and professors from the Virginia Commonwealth University (VCU). The VCU is a public research university located in Richmond, Virginia, USA. VCU was founded in 1838 and currently has 31000 students pursuing 222 degrees and certificate programs through VCU's 13 schools (including a School of Engineering) and one college.

There were over 30 people attending. The audience was characterized by being students of a Fast Track Executive MS Information Systems in VCU. These students were mostly also IT practitioners in different areas (consulting, engineering, medical, etc.).

Like the first one, this evaluation started with a presentation of this master thesis, followed up by a live demonstration of the prototype. The feedback received after was very important because not only the DEMO Engine makes sense to a wide range of IT practitioners but also to a wide range of geographically dispersed audience.

This feedback collected was mostly related to the importance of the topic, the relevance of the research problem and motivation to keep pursuing the mitigation of gap number four of service quality.

DEMO Workshop with Switzerland DEMO Community

This evaluation was made in a DEMO Workshop, held in Lisbon, with a representative of the Switzerland DEMO Community, Antonia Albani. Antonia Albani is Senior Researcher at the University of St. Gallen, Switzerland and also member of the CIAO! Executive Board. The University of St. Gallen is a research university located in St. Gallen, Switzerland. Established in 1898, it is specialized in the fields of business administration, economics, law, and international affairs. Antonia Albani is also one of the contributors of the definition of service according to EO (Albani et al., 2009) and the GSSF (Terlouw & Albani, 2011), which we use as a theoretical background to support our proposal. Because of this fact, the feedback collected in this evaluation proves very important to our research.

After the presentation of the work developed in this thesis and a demonstration, we collected important feedback that allowed us answer the Österle principles. This feedback was specially concerned about the connection between our proposed system, the DEMO Engine, and the DEMO Processor (section 3.5). This workshop was one of the main drivers to the creation of section 5.3.

Interview at ULHT

As a final evaluation with academics we opted for an interview with an academic that had access to the DEMO Processor and could provides us with important and concise feedback over the two systems. We interviewed Sérgio Guerreiro, an Assistant Professor of Information Systems and Computer Engineering at Universidade Lusófona de Humanidades e Tecnologias (ULHT).

After a small introduction to this thesis and the problem it aims to solve, we did the Travel Agency Demonstration to Sérgio Guerreiro. Then we asked him to fill a questionnaire (Annex A). The most positive feedback we receive was regarding the Management of Service Promises: Service Standardization. According to him, our proposal makes use of the EO patterns and that reduces the communication mismatch in service delivery. Also the Management of Customer Expectations was considered as a major impact of the DEMO Engine, specially because of the DEMO-based SLA, Act visibility and clarification of who participates in the service execution. The factor that least improved with DEMO Engine was the Service Intangibility: Service Perception. This was mostly due to the lack of service context in the system.

7.2 Practitioners Feedback

In this section we will show the feedback collected from practitioners from live interviews in several organizations. In total we interviewed eight practitioners from different organizations.

Software Company

In order to enrich our proposal we went to different companies that offer services so that we could evaluate the benefit of our proposal. We first went to a Portuguese software company. This is a recent company that currently has over 140 employees. We interviewed two employees, the Principal Software Engineer, and a Software Engineer.

We started by explaining the problem we intend to solve with the DEMO Engine and afterwards we used the Travel Agency example to demonstrate to functionalities of this system.

Nevertheless, after presenting the system, the feedback was not very positive. While they could see the benefits of the DEMO Engine, adapting it to a software company context proved very difficult. Also, the overheads created by the constant register of coordination acts might not seem adequate in an agile environment. This was important to make us notice that some industries have certain characteristics that can difficult acceptance of the DEMO Engine.

Telecommunication Company

To have feedback from different sectors we also evaluated our proposed system, the DEMO Engine, with a Telecommunication company. This is a nationally spread organization and employees over 1150 people. To evaluate our system we reached out for a Service Desk Support Engineer working there. At this organization, they receive many requests on the service desk but many of them are lost during the resolution process, and the communication is never transparent.

After the recurrent explanation of the thesis problem and proposed system, we also used the Travel Agency example to further elaborate on its characteristics. Lastly, we presented the qualitative questionnaire (Annex A).

The feedback collect in this interview was very positive, the Service Intangibility and Management of Service Promises challenges were given high classifications. Nonetheless, there is a major downfall of the DEMO Engine, the context of the service is not present. Trying to make a more generic system, we do not give the providers and customers enough information about the world state before and during the execution of the service. Also, the delegation of services (not present in DEMO Engine) is an important need present in the daily work at the organization. Furthermore, the ability to know the hierarchy inside a company was particular concern that we do not address. Finally, regarding Customer Education, there

is a clear notion of what, when and how the customer should act but the **why** (the context) is missing and would be very important to add to the system.

Cloud Services Provider

One other sector we evaluated our proposal to was cloud providers. In order to so do we analysed a Portuguese Cloud Services Provider that currently employs over 56 people. In this evaluation we interviewed the CEO, the Outsourcing Services Director and the ServiceDesk Manager of the Cloud Services Provider.

Again we started with an overview of the work develop in the master thesis, an explanation of the problem and the Travel Agency Demonstration so we could collect important feedback (both informally and by a questionnaire).

The major downfall we receive is that, by creating systems like the DEMO Engine one can not expect that companies will migrate their own systems to a new one, there needs to be integrations so that the DEMO Engine can co-exist with a company's existing systems. On the other hand, a great contribution of this research is the reduction of e-mail usage to communicate inside a company. E-mail is not the best option as one can never know if it has reached the destination or when someone will read it. The c-facts ensure that both the customer and the provider know what is happening in the service and can not claim ignorance of some fact. Another important feedback we collected was that in some companies despite existing a service catalogue it is not visible to customer, and therefore is not flexible. This happens mainly in smaller companies, where customers request a service and the provider has the responsibility to map it to what he can really offer the client.

Lastly, the Customer Education was the communication challenge that was better addressed using the DEMO Engine. With the use of the same workflow on every service execution, customers do learn and get used to what, how, when should be done.

7.3 INCI

For the last evaluation we will assess the demonstration we made at INCI (section 6.3). We gathered important feedback on them before implementing the system (using a questionnaire) and evaluated the results of the use of the systems.

At INCI, we gathered feedback that shows us that the DEMO Engine is better when using it on fast-execution services, this is services whose execution time (the creation of the p-fact) is reduced. This derives from DEMO not being focused on the execution aspects of a transaction, but rather on the coordination aspects.

Another important contribution of this evaluation was the importance of the SLA attributes in a service execution. Being a public institution, INCI does not charges employees for their services, nevertheless the penalty and bonus can be used with other benefits in order to ensure the service is properly done. Related to these attributes is also the Response date and the Resolution date that can be used as important tools when controlling various executions and to see which services are behind schedule. Furthermore, the notification on every c-fact created (by e-mail) was considered very important so that the parts involving a service exchange now what is happening.

By analysing the use of the DEMO Engine at INCI we can see that with few knowledge on EO, DEMO, GSSF or DEMO-based SLA the employees could use it and configure the DEMO Engine to their needs. In particular, the record keeping of every communication act was very appreciated to create responsibilities for services and people that executes them.

7.4 Österle Principles

According to (Osterle et al., 2010), an artifact evaluation can be done through surveys, interviews, expert review or field experiments. In this Memorandum it is specified that one Scientific Research must comply with four basic principles:

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

These principles are fundamental to evaluate researches that use DSRM and are also have a great support by the scientific community. Next, we will present the evaluation of the proposed artifact using this framework. This evaluation is based on the feedback received with academics and practitioners, which we have described in the previous sections.

- **Abstraction**:The artifact we propose (the DEMO Engine) can be applied to all types of services, may they be ontological, infological or datalogical. These services are defined by the people that really use them and adaptable for different organizations, from software industries to public organizations;
- **Originality**: The combine usage of DEMO and SLA to tackle service quality gaps was used in

recent researches (Ferreira, 2011; Almeida, 2012; Mendes, 2013) but not to the gap number four. Also, using EO patterns and oblige customers to explicit every coordination act they make is a novel approach to service management;

- **Justification**: The artifact is justified by all the evaluations and positive feedback we gathered during this thesis (as we will see in the next sections). The related work and theoretical background we present in chapters 3 and 4 further contribute to the relevance of this principle;

- **Benefit**: the DEMO Engine artifact provides a way to reduce the difference between the service delivery and the communication involving that delivery. Consequently, there is an increase in the service quality.

7.5 Summary

In this Chapter is shown the evaluation of our artifact and the evaluation of the demonstration performed. With regard to our proposal, the evaluation was taking into account the four principles laid down in the Memorandum of Information Systems (Osterle et al., 2010), workshops with 47 academics in the field of Enterprise Engineering and also interviews with 8 practitioners in the service sector were conducted. The evaluation is complemented by the evaluation of the demonstration at a real-world organization, INCI.

Using ex post naturalistic and artificial evaluation we managed to assess the abstraction, originality, justification and benefit of this thesis.

In all the interviews and field study, we first introduced the research problem and made a demonstration of the prototype that implements our proposal (using the Travel Agency). In most of these interviews we also used a questionnaire to better assess the extent to which our proposal addresses the communication challenges (Annex A). The results of these qualitative questionnaire are shown in **Fig. 7.2**. Looking at this feedback we can perceive the results using a pentagon, where each of the vertexes represent a Communication Challenge and there are 5 layers, representing the five ratings possible (1 being worsened a lot, 2 somewhat worse, 3 no change, 4 somewhat improved and 5 improved a lot).

The Management of Customer Expectations is the communication challenge better addressed by the DEMO Engine. The use of DEMO-based SLAs, the notion of who is participating in the service exchange and the visibility of acts contribute to decrease of the gap 4 of service quality.

Management of Services Promises is also given very high classifications. The use of DEMO patterns enables a standardization of services, every service follows the same path and no provider can over-promisse the execution of a service. Also with the use of actor roles, we have promise jurisdictions to prevent an organization's employee to promise a service he is not responsible for.

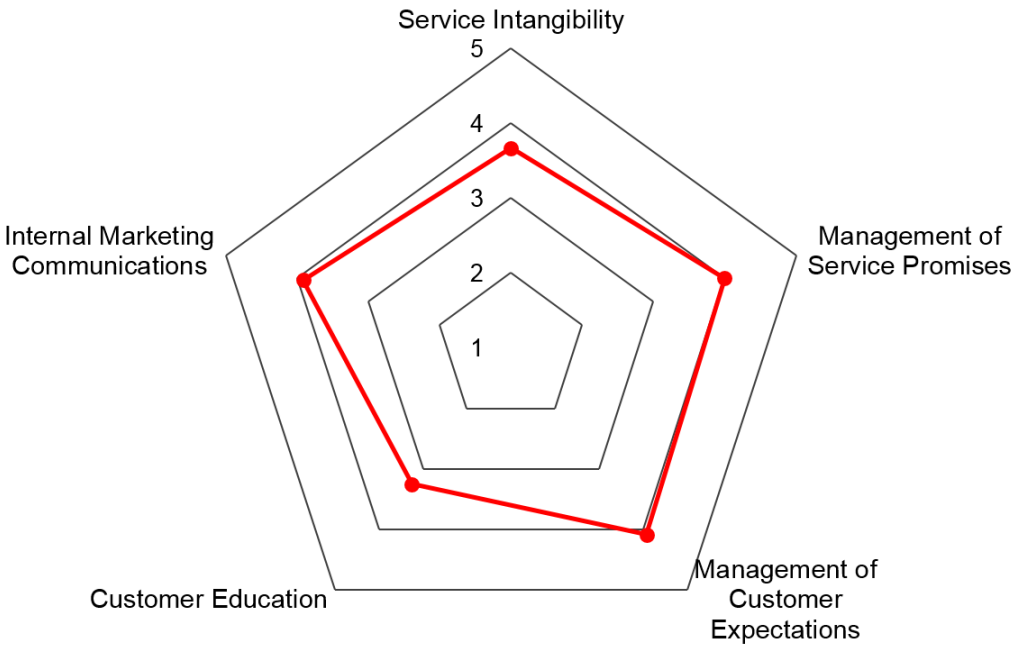

Figure 7.2: DEMO Engine Questionnaire Results.

We can conclude that Internal Marketing Communications is also very well addressed. Despite not being our focus to create an internal marketing plan of the organization, the visibility of actor roles, service catalogue and execution history inside the organizations decreased the communication's gap.

Service Intangibility while still addressed, has not received better classifications possibly because we interviewed only providers, and the flexibility of service catalogues might be more important to customers than providers.

Opposite is the Customer Education challenge, mostly because of the lack of context is least addressed. EO terms can also difficult this education, as customers and providers need some explanation to know the meaning of some DEMO Engine attributes. Nevertheless, the rating of this challenge is still positive and contributes to a mitigation of the communication's gap.

Chapter 8

Conclusion

The service sector is the largest economy sector and is the driver for value creation in modern organizations. With so many new services being created quality becomes a distinct factor between them. However quality in services is difficult to measure and control. This is mostly due to the service characteristics of intangibility, perishability, inseparability and heterogeneity. Nevertheless, it was created a model to better understand the challenges services faced. This model decomposed service quality in five gaps. The gaps model was the first step towards determining how to achieve quality services.

This research is focused on reducing the difference between the expectations and perceptions of customers when requesting services. We take off from work done tackling other service quality gaps (Ferreira, 2011; Almeida, 2012; Mendes, 2013) and focus on the difference between the service delivery and the communication of that delivery, namely, **gap number 4 of service quality**.

Current solutions like ITIL, CMMI, and others, fail when providing consistent and sustained solutions. They also fail to focus on the customer needs and while the ideas behind them may be valid, the implementation is not. Also, SLM or WSBS are used to manage services and customers expectations. Nevertheless, there is a strong lack of background to ground such solutions. Our approach being based on EO, DEMO and GSSF guarantees there is no lack of sustain in the decisions and it also ensures the 4c-ness of solutions: **coherent, comprehensive, consistent and concise**.

We intended to evaluate the impact of using the communication patterns of DEMO to close gap number 4. For that purpose, we are developing a system that enables transparency, readiness and easiness in communication between the customer and the service provider. We intend with this system address the **Service Intangibility, Management of Service Promises, Management of Customers Expectations, Costumer Education and Internal Marketing Communications**.

To do so, our system (the DEMO Engine) is implemented in a software prototype that enables an overall better service exchange between the customer and the provider, and enabling **co-creation**. In order to

specify the contract of each service, we use SLA knowledge (Mendes & Mira da Silva, 2012) and service specification (Terlouw & Albani, 2011).

This research was done using Design Science Research Methodology since it can be applied in the context of Information Systems through the creation of IT artifacts to solve real-world organization problems. We developed an artifact (an instantiation) we called the DEMO Engine that supports our proposal.

To better demonstrate the functionalities and capabilities of the DEMO Engine, we demonstrated the system using a fictional example of a service request to a Travel Agency, and then we have applied this same DEMO Engine to a Portuguese public administration institute.

The evaluation of this research was done by applying the Österle principles, gathered feedback from both academics and practitioners (in workshops, personal interviews and questionnaire).

8.1 Lessons Learned

Over the course of this dissertation there were several aspects that were raised which are important to mention. These aspects resulted from the application of the DSRM process to this research, mostly in the problem identification step, the objective definition step, the design step and the evaluation step. We will structure this section to match these steps.

In the **Problem Identification** step we discovered that despite the service sector being the largest sector of human activity, and expected to keep growing in the future, there is much still to learn when it comes to quality. Service quality gaps are a problem with at least 28 years that no solution has managed to solve completely. Despite many different approaches, all of them lacked in some aspect (costumer focus, intangibility, lack of support, etc.). The gaps that affect quality still exist nowadays and can be seen in every service execution if we pay close attention to it. Although we are in the communication era, the fourth gap (related to communication) is still there, contributing negatively to the quality of services.

To better define the **Objective** of the proposal to solve the problem, we looked into many different approaches (ITIL, CMMI, SLM, WSBS) that intended to tackle the quality gaps. Doing this we learned that we must never forget the focus on the customer when searching for quality, like Parasuraman et al. (1985) said, *quality is the difference between **customer's** expectations and perceptions*. We learned that only with a strong and solid theoretical background can we tackle the quality gaps effectively, and in a **4c-ness** (coherent, comprehensive, consistent and concise) way. This is the main reason for using EO and subsequent works like GSSF and DEMO-based SLA.

Design & Development of the DEMO Engine arouse several lessons. On one hand, the usability of a system. If we want to create usable system we need to make it simple enough that people perceive it and use it without deep knowledge on the concepts behind it. The use of EO patterns allowed us this, they

are easily understandable by customers and providers. This can lead to a strong co-creation process, combining efforts from the customer and the provider to deliver the best service. On the other hand, the integration with existing systems. One can not force an organization to give up on their systems an start using another one, there must be connections between systems that allow employees to use all systems transparently.

Lastly, through **Evaluation** we finally had the opportunity to gather feedback from customers and providers, which characteristics are more innovative and which made less sense. The co-creation and flexibility aspect of the system was one of the most relevant factors collected in this step. But also the SLA and educational aspects of the DEMO Engine. Despite this, we also learned that such system may create overheads that are unsustainable for smaller organizations, and in all cases the integration of the system is crucial for its success.

On the negative side we have learned over the course of this thesis that the prototype we have developed and used in demonstrations is only an example of an instantiation of the DEMO Engine, we do not claim that this prototype can be put in production to improve communication in organizations. Being a generic implementation of the DEMO Engine, there are industry characteristics that are not captured by our proposal and, as we have seen in the Software Company evaluation, may not be fit for everyday real-world use.

8.2 Main Contributions

We reached the proposal by doing a deep literature research in the service communication area, service definition and quality definition. We propose an instantiation of a DEMO Engine, which we will later demonstrate and evaluate with feedback from academics and practitioners. We concluded that our proposal based on DEMO can be used in the real world because our proposal showed to be useful and flexible to all the people who have used our solution.

In this dissertation, we only focus on the gap 4 (Parasuraman et al., 1985) that concerns with the difference between the service produced and the service communicated to the customers. The gap 1, gap 2 and gap 3 are explicitly out of scope of this thesis. Nevertheless, we use work done on the other gaps (Ferreira, 2011; Almeida, 2012; Mendes, 2013) in combination with our proposal. Also, while a mitigating gap 4 we can say that there is a decrease also of gap 5 because gap 5 depends on the magnitude of the other four gaps.

In this dissertation the main contributions are:

- 1st Contribution: The creation of a **DEMO Engine** that can execute DEMO Services with DEMO-based SLA;

- 2nd Contribution: Enabling service **co-creation** based on EO;
- 3rd Contribution: How to **address communication challenges** using EO terms.

The first major contribution that this work intends to pursue is the creation of an engine that can enable an organization to have its Information System based on DEMO, managing services with 4c-ness, while also simplifying the DEMO concepts to make then usable for people that do not know DEMO concepts. To this systems we have called the DEMO Engine and through several demonstrations and evaluations we have proven its effectiveness and reliability in a real context.

The second contribution we expect of this research is the enabling of service co-creation based on EO. We have developed and demonstrated a way to allow costumers and providers reach a better understanding on what, when and how they can exchange services and SLA. This was possible by using dynamically defined services and SLA that are negotiated over the course of an execution of a EO transaction pattern.

The last major contribution that this dissertation pursues, is how to address the service communication challenges of service quality gap number four in EO terms. For this we have used combine knowledge from EO, DEMO, GSSF and DEMO-based SLA assigned to each on of the five challenges.

8.3 Communication

The last step of the DSRM is communication of the artifact developed to the proper audience and highlight its contributions. To do so, we decided to do opt for two ways: demonstrations to practitioners and academics and by submission of scholarly publications.

The demonstration and evaluation with interviews and workshops with academics and practitioners was already described in the evaluation Chapter (Chapter 7). These interviews and workshops comprised different organizations, people from distant geographic areas, and from different backgrounds.

To achieve the second part of the communication we submitted two scientific publications to international conferences:

- P. Matos de Carvalho, C. Mendes and M. Mira da Silva. (2013) Service Request Management based on DEMO, 11th International Conference on Service Oriented Computing (ICSOC 2013), Berlin, Germany **(Submitted)**
- P. Matos de Carvalho, C. Mendes and M. Mira da Silva. (2013) DEMO Engine, 5th International Conference on Knowledge Engineering and Ontology Development (KEOD 2013), Vilamoura, Algarve, Portugal **(Submitted)**

The first paper is related to the how can we address gap number four of service quality and service

request management using DEMO, and a practical example in a Protuguese Public Administration, more specifically at INCI. We focus on the evaluation with practitioners and of the INCI field-study.

On the second one we focus more on the DEMO aspects of the Engine, we relate the communication challenges with EO terms, and we present a fictional example of a Travel Agency. In this paper we evaluate the fictional demonstration with academics and practitioners as well as the extent to which our proposal can address the service quality gap number four.

8.4 Limitations

The limitations associated with our proposal are mostly related to the demonstrations done and the industry sectors considered in the evaluation.

The usage of a fictional demonstration has the objective of showing in a simple manner how can a service execution be performed using the DEMO Engine, we do not intend to describe the general method to ask for a Trip Advisory service or a Hotel Booking. Nevertheless, after having used this demonstration to successfully explain the proposal to several people we feel confident of its relevance.

Also, in this dissertation we have only analysed industries that are closely related to the IT business (telecommunication, cloud services, software) and a public administration institute. We do not state definitively that this same proposal can be applied to others industries or different size organizations. Nevertheless, the feedback we collect from different practitioners, and academic give us some indications that it might be possible to apply the DEMO Engine to other sectors.

8.5 Future Work

In this section we present a description of future works to further complement the knowledge we present in this dissertation.

We believe that an extensive use of the proposed artifact (the DEMO Engine) in several other sectors would present a great contribution to further validate it, using different sized companies and geographically dispersed organizations.

We can also expand the scope of this thesis and focus on how can semiotics influence the gap number four, as semiotics is the study of signs and sign processes, indication, designation, likeness, analogy, metaphor, symbolism, signification, and communication (the focus of the gap number four).

There is also important notions that can be added to the DEMO Engine that can prove important when creating a real-world Information System.

First, the possibility to create processes based on DEMO. Currently we only have transactions associated to the Engine, if we could hypothetically increase the complexity of services (creating chains of ontological, infological or datalogical services) we could better represent the real-world.

Secondly, creating an easy integration with present day systems. This is very important because the feedback we gathered pointed out that the DEMO Engine must be capable of integrating with others systems (CRM, ERP, ticketing systems, etc.) to provide more useful information (like service context) and making it practical to use.

Also another important aspect is to create the notion of delegation. If one actor is not capable of executing a service it should be possible for him to delegate that service th some other actor. Connected to this is also the notion of creating an act jurisdiction (only certain actors can perform certain acts) and the concept of hierarchy inside an organization.

At the moment the DEMO Engine can only represent transactions. As future work it would be relevant to include other DEMO models, like for example the state model, and therefore increasing the connection with real-world systems.

Finally, the data mining aspect of the DEMO Engine still needs work. Imagine if we could know which are the faster services providers/customer, the nicest (based on a star-rating for example), which SLA are mostly broken and why (resolution/response time), at which step SLA are broken, the percentage of successfully concluded services (at the accept state) or seeing which c-acts take longer to perform.

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Appendix A

Questionnaire on the DEMO Engine

DEMO Engine Questionnaire

This questionnaire will focus on the demonstration of the DEMO Engine. It consists of 10 questions addressing the communication challenges of service quality.

The DEMO Engine tries to mitigate the gap 4 of service quality, this is, the difference between delivered serviced and communication of that service to the customer. It uses knowledge from Service Level Management, Enterprise Ontology and Service Marketing in order to better tackle the gap 4.

This questionnaire will take around 15min to answer. Please classify from 1 to 5 the following questions addressing the communication challenges of service quality, where 1 stands for worsened a lot, 2 stands for somewhat worse, 3 stand for no change, 4 stands for somewhat improved and 5 stands for improved a lot.

Regarding Service Intangibility:

	Classification
Service Perception	
SLA Perception	
Service Catalogue Flexibility	

Regarding Management of Service Promises:

	Classification
Service Standardization	
Promise Jurisdiction	

Regarding Management of Customer Expectations:

	Classification
SLA Attributes	
Clarification of Participants	
Act Visibility	

Regarding Customer Education:

	Classification
Customer knows what he is expected to do, when, how	

Regarding Internal Marketing Communications:

	Classification
Actor Role visibility	
Service catalogue visibility	
Service Execution History visibility	