DEMO-Based Service Level Agreements

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Abstract. The services industry is currently the fastest growing part of economic activity in the world and some companies are changing their business models from product manufactures to service providers. However, the services quality is still affected by gaps identified two decades ago. One example of these gaps is when the service provider has a perception of what the customer expects that diverges from the real expected service. To solve this problem, we are working on a service quality approach based on the Enterprise Ontology theory. According to this theory, the operation of organizations is all about communication between social actors and their production. Based on it, a Service Level Agreement definition is given and a service quality specification solution is derived. We applied the solution in the Information Technology Division of a private bank and the solution showed to be mature enough to model the bank reality regarding service quality levels.

Keywords: Services Quality, Service Level Agreement, Enterprise Ontology, DEMO.

1 Introduction

While acknowledging the importance of manufacturing, today we live in a "post manufacturing" world. We enjoy the unsurpassed material comfort, because of a vast array of services that comprise nearly 80% of our economic activity [1] [2]. Nowadays services mean jobs and growth, but the companies who have been leading the charge lack a strong conceptual foundation [3]. This lack contributes to the gaps [4] that reduce the services quality for, without a solution to specify it, it is difficult for the service providers and their customers to align their expectations about the services quality. The problem is that the majority of the current solutions used to specify the services quality lack a strong conceptual foundation or/and suffer from *web tunnel vision* [5], i.e. they are focused on technology and they tend to ignore conventional services.

Our research seeks to define an approach based on Enterprise Ontology [6] to deal with the communication gaps that diminish the services quality [4]. In this paper, we focus on gap number 1, the difference between the customer expectations and the perceptions of the service provider regarding those expectations. In order to tackle this problem we propose to model the customers' expectations using DEMO-based SLAs. DEMO (Design & Engineering Methodology for Organizations) is a

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methodology for modeling, (re)designing and (re)engineering organizations and networks of organizations. The theory that underlies this methodology is called Enterprise Ontology (EO) and it was chosen as the basis for our solution because EO is the only theory that produces conceptual models that are coherent, comprehensive, consistent, concise and essential [6]. For this reason, we believe that EO is a perfect candidate to fulfill the mentioned lack for a strong conceptual foundation. Besides that, Enterprise Ontology relies on fifteen years of practical experience using the DEMO methodology [6].

Furthermore, DEMO models are completely implementation independent. The actor roles defined in these models can be executed by human or IT systems, so they do not distinguish from business or web services. Therefore, it appears to be a solid foundation to build a solution that is generic and suitable for any type of services.

At first glance EO and the service concept may not look related, however a recent research [7] defined the service concept using EO terms. This work gave us the connection point needed to use the EO theory as the basis for our proposals. Recently this methodology helped us to conclude that if the service catalogue is produced only by the service provider and without the customer point of view, then the service list will represent what the provider thinks he provides and not what he actually offers [8] [9].

The main contributions of this paper are the mapping between the gaps model and the EO basic transaction pattern (Figure 3), the SLA definition with EO terms, the SLA attributes proposal and relation to Enterprise Ontology (Figure 5) and finally the case study that shows the applicability of the proposal.

Our study was conducted using the Design Science Research Methodology [10] (DSRM) that aims at creating and evaluating IT artifacts intended to solve identified organizational problems. These artifacts include constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices) and instantiations (implemented and prototype systems). This research method includes the following phases [11]: problem identification, objectives definition, design and development, demonstration, evaluation and communication.

This paper is structure as follows. We will start by describing the research question addressed in this paper in Section 2. Next, we provide a brief overview of the literature on the research question area (Section 3). In Section 4, we introduce the theoretical background of this research, the Enterprise Ontology theory. Afterwards, we present our proposal, namely the SLA definition using EO terms and our DEMO-based proposal to specify the services quality (Section 5). In Section 6, we describe the case study at a private bank. In Section 7, we discuss the results of the case study and specify the lessons learned. Finally, we present our conclusions (Section 8).

2 Research Question

Service quality poses a number of challenges and research topics. We decided to focus on the gaps [4] that influence the services quality for they represent the factors that diminish the services quality. Service marketers often use these gaps to illustrate how differences between perceived service delivery and expected service can come about (Figure 1). The net difference between the perceived quality of the services and the expected quality (gap 5) is caused by four other gaps [12]:

- **Gap 1** – The expected service as perceived by the service provider differs from what is expected by the customer. The service provider has a perception of what the customer expects that diverges from the real expected service due to inadequate market research, lack of communication between contact employees and management, and insufficient relationship focus;
- **Gap 2** – The service specification as used by the service provider differs from the expected service as perceived by the service provider. The service designs and standards will not match the service requirements as perceived by the provider by a lack of customer-driven standards, absence of process management, lack of a formal process for setting service quality goals, poor service design and inadequate service leadership;
- **Gap 3** – The actual service delivery differs from the specified services. Service delivery does not follow the service designs and standards because of deficiencies in human resource policies, failures to match demand and supply, and customers not fulfilling their role;
- **Gap 4** – Communication about the service does not match the actual service delivery because of ineffective management of customer expectations, overpromising, and inadequate horizontal communications (i.e. insufficient communication between sales and operations, advertising and operations and differences in policies and procedures across the organization);
- **Gap 5** – The actual service performance differs from the customers' expectations. Judgments of high and low service quality depend on how consumers perceive the actual service performance in the context of what they expected. This gap is caused by the four preceding gaps. Hence, service quality can be increased by closing the first four gaps and, as a result, align the perceived service with the expected one.

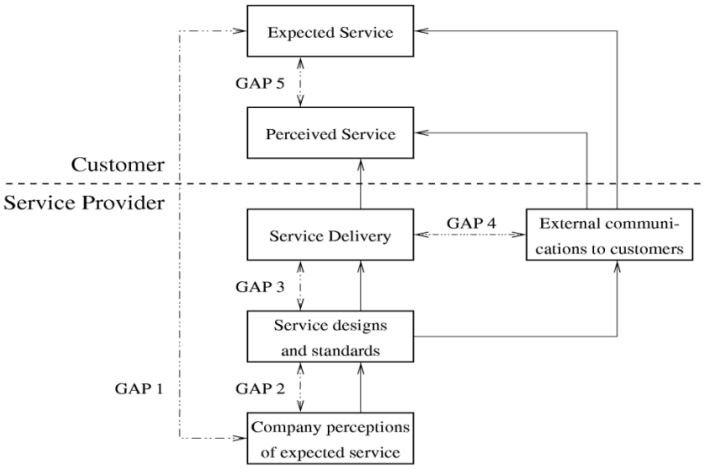

Fig. 1. The Gaps model of service quality [4]

As mentioned before, the context of this paper is limited to gap 1. We are trying to understand if we can model the customers' expectations using DEMO-based SLAs. Therefore, the research question that this paper seeks to answer is:

Can DEMO be used to specify SLAs in order to model customers' expectations?

This gap model has been chosen because we consider it describes the five major gaps that influence the services quality. This paper does not aim to propose changes to this gap model, instead we propose a solution to mitigate the gaps that are perfectly described in it.

This section corresponds to the problem identification and motivation phase of DSRM. It also corresponds to the objectives definition phase.

3 Related Work

This section describes the current solutions for specifying services quality and explains why these solutions do not solve the gaps problem.

We analyzed several solutions to specify the services quality: Service Level Management best practices, web services based solutions and the Generic Service Specification Framework (GSSF). In spite of the different backgrounds, all contributed to the service quality specification. The first solution is proposed by many best practices frameworks, such as ITIL [13] or CMMI [14], the second represents the solutions focused in web services and the third is an Enterprise Ontology-based approach (even though the main goal of the GSSF was to specify the services and not the service quality itself, this framework also contributed in the problem area).

Service Level Management is one of the key processes by which organizations manage their services, because it acts as the interface between the customer and the provider. At the most basic level, Service Level Management is involved in the following activities: define, agree, record and manage levels of service. There are a number of key elements required to ensure that services are fit for purpose and use, and remain so throughout their lifetime: service level requirements, targets and agreements [13].

Basically, to understand the Service Level Requirements (SLR) means that the customers' needs and wants are understood, i.e. an SLR is a customer requirement for an aspect of a service. SLRs are based on business objectives and are used to negotiate Service Level Targets (SLT) which are commitments documented in Service Level Agreements (SLAs). SLTs are based on SLRs and are needed to ensure that the service is fit for purpose. SLTs should be SMART: specific, measurable, attainable, realistic and timely. Finally, SLA is an agreement between a provider and a customer that describes the service; it documents the SLTs and specifies the responsibilities of the provider and customer. Over the years it has also been the chosen concept to specify services quality [13].

Regarding Service Level Management solutions, current approaches have two main flaws. First, they lack a strong conceptual foundation because they were derived from best practices of several years of implementations - not from a well-founded theory. Consequently, the inexistence of a theory may cause incoherencies among those solutions (second flaw). Service Level Management solutions are process-driven and not service-driven. These solutions are designed to work individually as processes and the interactions between these processes (such as Request Fulfillment,

Service Level Management and Incident Management) are usually unclear. For instance, the connection between an incident and an SLA is not clearly explained in ITIL nor in CMMI.

These solutions are focused on the activities that must be executed to support the function of an organization, instead of being designed to be customer-driven and centered on the interaction with the customer. This is clearly a drawback for this solution because, as previously mentioned, whatever the answer to closing the gaps is, it should always be customer-driven.

There are some solutions to specify the services quality that had origin in the web services community. In [15] the authors show how to use Web Service Description Language (WSDL) and Web Service Flow Language (WSFL) to specify SLAs. However this work suffers from the web vision tunnel as it is focused in the web services and does not try to specify business services. For instance, the specifications do not include penalties or prices. The researches in [16], [17] and [18] have the same bottleneck. Despite this trend in the web service community, there are some recent researches that try to overcome the mention web service tunnel vision. In [19] a novel framework for specifying and monitoring SLAs for Web Services is introduced, the Web Service Level Agreement (WSLA) framework. This framework is applicable to any inter-domain management scenario such as business process and service management or the management of networks, systems and applications in general. In [20] and [21] business criteria is also included in SLAs. These three solutions represent a new movement in the web service community, however none is based in a strong conceptual foundation.

Another contribution to the gaps problem is the Generic Service Specification Framework [22], which is based on the following generic service definition [23]: *a service is a universal pattern of coordination and production acts, performed by the executor of a transaction for the benefit of its initiator, in the order stated in the standard pattern of a transaction*. This framework defines four main areas of concern for each service: the service executor, the service production, the service coordination and the service contract option. The first one defines who the provider of the service is. The second focuses on the production act to be performed by the executor. The third gives the consumer all the information required for conducting a successful communication with the provider. And finally, the service contract option specifies one or several contract options from which service consumers can choose. Even though the quality aspects are very basic, the Generic Service Specification Framework represents a large contribution to the service specification research area. However, the level of service quality specification is not always sufficient, because sometimes customers and providers have different expectations due to a lack of specification [22].

4 Theoretical Background

This section briefly describes the Enterprise Ontology theory (the theory that supports our proposal) and demonstrates that, by itself, this theory is not able to solve the problem.

Enterprise Ontology [6] is based on four axioms – operation, transaction, composition and distinction – and the organization theorem. The operation axiom 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.

The transaction axiom states that coordination acts are performed as steps in universal patterns (Figure 3). 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 discuss if the transaction result is equal to the expected result.

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.

The distinction axiom states that 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.

Although we recognize the qualities of the models derived from this theory, these models by themselves may not close the services quality gaps. This happens because the gaps existence depends on how the ontological models are implemented. For instance, the occurrence of these gaps can be potentiated by a concept that almost all organizations use, the delegation. In EO, by delegation is understood the allowance by the authorized subject to another subject to perform one or more steps in one or more transactions of the corresponding transaction kind. If the expectations and perceptions of two actors can create the mentioned gaps, then we can imagine that the expectations and perceptions of three, four or more actors can be even more difficult to align.

To understand what each gap represents in EO, one has to keep in mind that a coordination act consists of two concurrent acts: the intention act and the proposition act.

In the intention act, the performer proclaims its 'social attitude' in respect to the proposition while in the proposition act, the performer states the fact and the associated time of the intention (Figure 2).

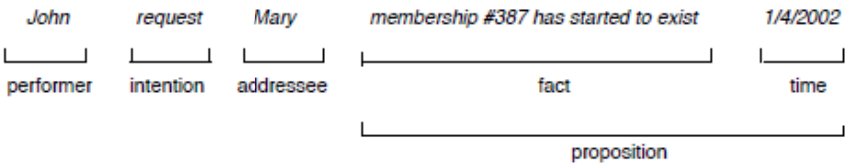

Fig. 2. Standard notation of a coordination act

However, without a clear specification of the proposition the two actors may have different understandings of it. In this example, the time in which John needs the membership in not mentioned and it is assumed to be as soon as possible. Nevertheless, as it is not specified, the initiator (John) may assume that the membership will be given as soon as possible, while the executer (Mary) may think that the request is not urgent. This would represent a clear gap between John's expectations and Mary's perceptions of those expectations that corresponds to Gap 1. Therefore, in DEMO models, the gaps problem is caused by the possible misalignment among notions (one from the initiator/customer and another from the executer/provider) of the agreed proposition.

Figure 3 shows how the five gaps are created in the Basic Transaction Pattern. Gap 1 represents the misalignment between the customer's expectations and the provider's perception of those expectations, i.e. the difference between the proposition in the c-fact request and the proposition in the c-fact promise. This gap occurs when the customer's expectations are not specified into clear service agreements.

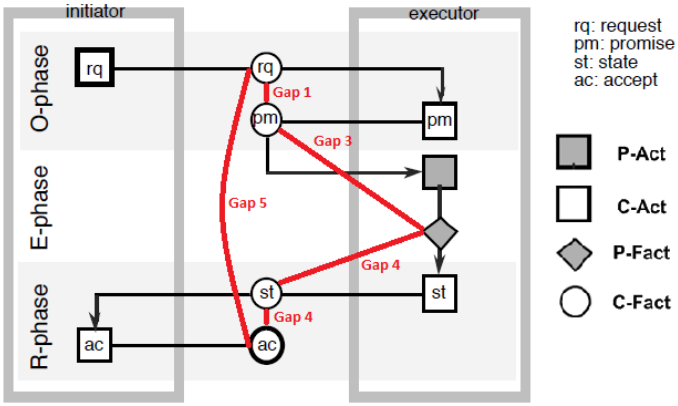

Fig. 3. Basic Transaction Pattern and the gaps model

Gap 2 represents the misalignment between the provider's perception of customer's expectations and what is designed, so it is created at design time and, therefore, has no representation in Figure 3. However, this gap may be visible in the O-phase, more precisely in the difference between the proposition in the c-fact request and the proposition in the c-fact promise.

Gap 3 is the difference between what is designed and what is offered, i.e. the difference from what is promised (c-fact promise) and what is executed (p-fact). Consequently, this gap is influenced by the E-phase. As only the provider knows about the p-fact existence, the initiator only becomes aware of this gap when the c-fact state occurs.

Gap 4 occurs when the communication about the service does not match the actual service delivery, so this gap represents the misalignment between the propositions of the coordination facts involved in the R-phase. This gap may also result from the misalignment between the p-fact and the c-fact state.

Gap 5 is the difference between what customers request and what they really get, i.e. this gap is the difference between the proposition of the c-fact request and the c-fact accept. Therefore, Gap 5 is influenced by all the transaction phases and by the other four gaps. Indeed, Figure 3 shows this influence more clearly than Figure 1.

EO has already a mechanism to deal with these gaps. In the R-phase, if the customer is not satisfied with the transaction result, he has the possibility to reject it. However, in these situations, both actors lose. The customer does not get the expected result and the service provider will probably lose this customer (not to mention the time and resources both used in the transaction). We propose to diminish the misalignments at their root instead of treating them after the creation. For this reason, the quality of the service exchange must be specified at the O-phase, stored and available to any actor that interviews in the service.

5 Proposal

This section corresponds to the design and development step of DSRM.

In order to show what an SLA looks like using the EO, let us start with a simple example of a transaction conducted during a face-to-face communication between two subjects. The example describes a customer (C) buying a bouquet of flowers from a florist (F):

(1) F: Hello! How can I help you, Mister Bean?
(2) C: I want to buy a bouquet of flowers.
(3) F: Do you want something specific?
(4) C: Yes, I want roses.
(5) F: How many?
(6) C: 15 please.
(7) F: When do you need the bouquet?
(8) C: In the next 5 minutes.
(9) F: Ok, that will cost you 30€.
(10) C: No problem, but I only have 5 minutes.
(11) F: Ok, one moment, please.

(12) < F makes the bouquet and puts it in front of C >
(13) F: Here you are, Mister Bean.
(14) C: Thanks.

The analysis of this example in terms of the three kinds of communicative acts yields the following result:

(1) Expressivum; will be disregarded.
(2) Performative act; intention: request; proposition: <unknown>.
(3) Informative act, serving to clarify the proposition.
(4) Informative act, serving to clarify the proposition.
(5) Informative act, serving to clarify the proposition.
(6) Informative act, serving to clarify the proposition.
(7) Informative act, serving to clarify the proposition.
(8) Informative act, serving to clarify the proposition.
(9) Informative act, serving to clarify the proposition.
(10) Informative act, serving to clarify the proposition.

Both the intention and the proposition of the performative act in line 2 are fully known at this point, so the request is considered to be performed successfully. Hereafter, we denote the proposition '*Deliver a bouquet of 15 roses in 5 minutes at 30€, otherwise the customer won't wait'* by P.

(11) Performative act; intention: promise; proposition: P.
(12) Material act related to the production act
(13) Performative act; intention: statement; proposition: P.
(14) Performative act; intention: acceptance; proposition: P.

According to this example we can argue 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.**

A first analysis of the agreed proposition shows that an SLA may have at least four elements, as illustrated in Figure 4.

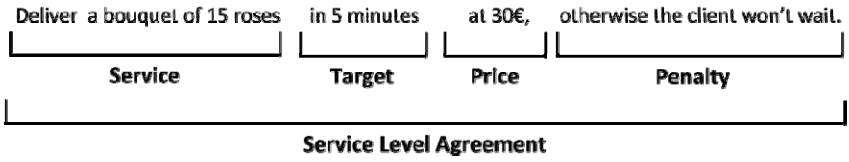

Fig. 4. Service level agreement elements (first analysis)

The first element that must be defined in a SLA is the service. This is a mandatory element of any SLA, because there is no SLA without a service. In this example, the service is to deliver a bouquet of 15 roses.

The second element is the target which defines a clear goal to be achieved when the service is delivered. As stated before, the target should be SMART: specific, measurable, attainable, realistic and timely. In this example, the target is to deliver the

bouquet in 5 minutes, i.e. the florist state act should be done up to 5 minutes after the promise act; otherwise the agreed penalty applies.

The third element is the price that in fact represents the price of choosing that specific SLA. In this case the price is 30€. The price should always be quantitative (ex. 30) and the currency should be explicit (ex. € or $), so there is no room for misunderstandings about this element. In the example, the total price of the service is equal to the price of the SLA, but they are conceptually different. Although the SLA price influences the service price, they are not the same. The SLA price is just a component of the total price of the service, however the relations with other components that may also affect the services price will be dealt with in future work.

The last element is the penalty that describes what happens if the target is not achieved. In this example, the penalty is that the customer will leave without completing the transaction, i.e. the customer will cancel his request.

In this SLA case, the role accountable for fulfilling the target is the provider's, but we can easily think of an example in which the customer is the one accountable for the target fulfillment. For example the situations in which the customers must pay for the service in a specific period, otherwise they stop having access to the service value. So, an SLA must have a fifth element, the one accountable for achieving the SLA target.

Therefore, each SLA is composed by five elements: entity responsible for achieving the SLA, service, target, price and penalty. Figure 5 illustrates the relations between these SLA elements and the DEMO models and diagrams.

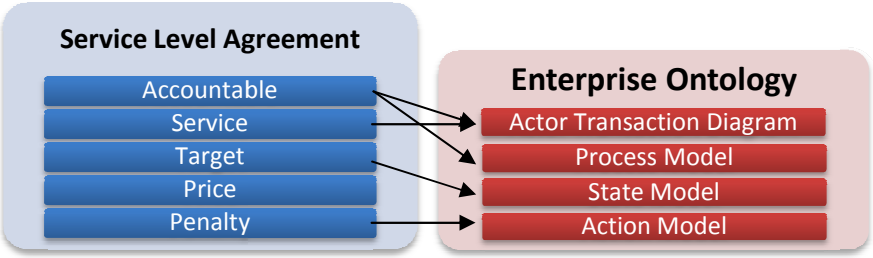

Fig. 5. Service level agreement proposal and relation to Enterprise Ontology

The first element, the one accountable for the SLA, can be gained from two types of diagrams provided by the Enterprise Ontology: the Actor Transaction Diagram and the Process Model. The service can be specified by using the Actor Transaction Diagram. The target, though, may be partially obtained from the State Model, because this model specifies the state space of the P-world: the object classes and fact types, the result types, and the ontological coexistence rules. The price has no direct representation in the DEMO models and diagrams, as it is implementation dependent. Information about the penalties is gained from the Action Model of the EO because this model defines the operational business rules of an enterprise.

In this case, the service is provided with only one SLA attached. However, a real-world example would be a lot more complex. So, we propose that a service may have several SLAs attached to it. This way the services quality may be specified through an infinite combination of targets, prices and penalties. The relation between these SLAs is a work in progress.

In this example, the SLA is defined at runtime, i.e. the provider and the customer decide the service quality when the service is being delivered. However, the service quality may also be defined at design time, i.e. the provider and the customer define several levels of services quality from which the customer can choose when requesting the service.

The proposal to specify the services quality is composed by the following steps:

1. Model the service provider in DEMO;
2. Specify SLAs for each identified transaction/service.

The first step is to model the service provider in DEMO, using for that purpose the methodology proposed in [6], or assume given DEMO models. For each identified transaction/service, one should specify the list of associated SLAs using our SLA definition (second step). Thus, this proposal intends to reduce the gap 1 by formally specifying the SLAs, using as foundation the EO theory.

6 Case Study

This section describes the demonstration phase of DSRM. We evaluated the proposal in one case study in order to validate its applicability. This case study was done in the Information Technology Division (ITD) of a private bank. ITD is constituted by 482 employees and provides services to about 10500 users.

The starting point to model the service provider in DEMO is called Enterprise Description and is characterized by producing a text which summarizes the actions performed by the service provider. In order to produce this text we interviewed six persons from ITD. During the interviews participants were asked to describe the activities performed by ITD. The interviews were recorded and transcribed as well as checked and discussed by two interviewers each ensuring unbiased findings and avoiding misinterpretation as specified in [24].

Having the Enterprise Description, the next step is to do the Perfoma-Informa-Forma Analysis and the Coordination-Actors-Production Analysis, both perfectly described in the EO book [6]. After these analyses, it is time to define the existent transactions in this text, by clustering the identified C-acts/facts and P-acts/facts, in what is denominated by Transaction Pattern Synthesis. The Transaction axiom can be helpful in this step, because it guarantees that each P-act/fact or C-act/fact previously found corresponds to a complete transaction. Then, for each identified transaction type, the result type (i.e., the P-fact created) should be correctly and precisely formulated, which can be achieved by identifying an entity uniquely, using variables. This result is represented in Table 1, called Transaction Result Table.

Table 1. Transaction Result Table

Transaction types / Services	**Result types**
T01 internal policies production	R01 internal policies P have been produced
T02 employee training	R02 employee E has been trained for internal policies P
T03 improvement implementation	R03 improvement I has been implemented
T04 feature development	R04 feature F has been developed
T05 implementation plan change	R05 implementation plan IP has been changed
T06 production environment change	R06 production environment PE has been changed
T07 audit	R07 audit A has been done
T08 implementation plan production	R08 implementation plan IP has been produced
T09 equipment access	R09 equipment access EA has been provided
T10 voice & data communication installation	R10 communication network N has been installed
T11 security access	R11 secure access SA has been granted
T12 file storage	R12 file storage FS has been provided
T13 specialized software access	R13 specialized software access SSA has been provided
T14 failure support	R14 failure FA has been solved
T15 general employee satisfaction evaluation	R15 satisfaction of employee E and semester S relating ITD function has been evaluated
T16 employee satisfaction evaluation	R16 employee satisfaction evaluation of failure FA has been done
T17 mandatory feature certification	R17 feature F has been certified as mandatory
T18 risk feature judgment	R18 feature F has been judged as risky
T19 business case benefits decision	R19 decision about the benefits of the business case B has been taken

After identifying the Transactions and the Actor roles involved, it is possible to develop the Actor Transaction Diagram (ATD) presented on Figure 6.

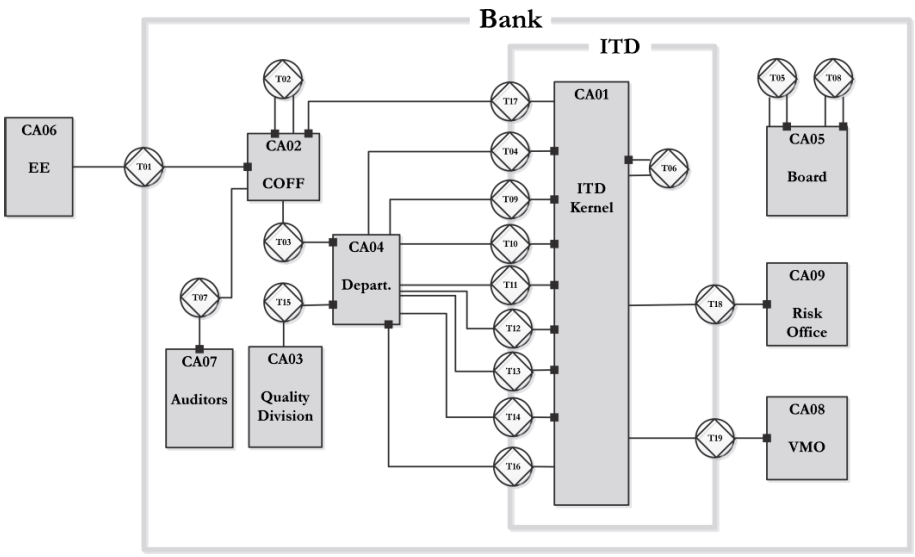

Fig. 6. Global ATD of the bank

As we mentioned before, each identified service can have several SLAs associated. We focused in the SLAs associated with the service 'failure support' (transaction T14) and we identified five SLAs for this service. The first one is related with the time to answer the phone calls. ITD employees accountable for failure support service have indications to answer the phone calls in one minute. This SLA attributes are described in Table 2.

Table 2. SLA attributes for the service 'failure support'

Service	Failure support (T14)
Target	Answer the phone in 60 seconds (the first coordination act must occur in a 60 seconds period after the request)
Accountable	Help Desk employee
Price	0 €
Penalty	Not defined

The following four SLAs are related with the time to solve the failures. Each SLA represents a different priority. Table 3 describes the SLA attributes for the service 'failure support' with critical priority.

Table 3. SLA attributes for the service 'failure support' with critical priority

Service	Failure support (T14)
Target	Solve failure with critical priority in 6 hours (the state act must occur in a 6 hours period after the promise)
Accountable	Help Desk employee
Price	0 €
Penalty	Not defined

The failure support service had also a SLA with high priority (the state act must occur in a 12 hours period after the promise), a SLA with medium priority (the state act must occur in a 60 hours period after the promise) and SLA with low priority (the state act must occur in a 120 hours period after the promise). From these last four SLAs the users of ITD could choose one on requesting time.

7 Evaluation

This section explains how we proceeded in the evaluation phase of DSRM.

The main objective of this research was to verify the maturity of the proposal, namely to validate if the SLA attributes were detailed enough to model the reality. We conclude that the proposal was mature enough to model the reality of the bank, because the current attributes were sufficient to specify the service levels. Indeed, the proposal has two attributes that were not used in this case, the price (always 0€) and the penalty. Although this fact, these two attributes are important in our proposal. The price is always 0 in these cases, because the services exchange is between departments of the same organization and there is no chargeback.

The penalty is also important in the definition of the SLAs, because not having penalties may diminish the efficiency of the service exchange. Besides that, penalties should be progressive. Imagine that in the studied bank an employee call the ITD reporting a failure, a minute passes and the call is not answered (the SLA target is not fulfilled). Then, for the service provider, it is the same if the call is answered passed two minutes or 10 minutes, however for the client it is completely different. Thus, the penalty should be a punishment aggravated according to time, for instance: for each minute M that passes and the call is not answered, then the service provider loses M credits.

Therefore, this case study **indicates** that the answer to this paper research question is yes, **DEMO can be used to specify SLAs in order to model customers' expectations**. As the EO theory describes the interaction between the customer and the provider in a very formal way and since the Service Level Management acts as the interface between customer and provider, the EO provides a solid basis for formalizing the notion of SLA. Nevertheless, the compatibility of a single case study with the SLA attributes does not indicate that the proposal is fully complete. It only indicates that it is compatible with the reality of the given case. However, the incremental results that are being obtained by each case study, gives a qualitative sense of confidence towards the completeness of the solution.

8 Conclusion

In this paper we tackled the old problem of the gaps that influence the services quality. There are several solutions that contributed to closing the gaps, but none solved the problem completely. Some lacked detail in specifying the services quality (like the Generic Service Specification Framework), others were not based on a strong conceptual foundation (such as ITIL, CMMI or WSLA) and majority of the web services based solutions suffer from the web service tunnel vision.

We are working in a solution to the gaps problem based on a methodology with a strong theoretical background. This fact allows for future solutions that, based on the same theory, could be integrated with the current proposal with no coherence problems. For instance, in the future one can propose a solution to describe an incident with EO concepts and integrate that proposal with our own.

Another contribution made by the paper is how to apply EO for specifying SLAs, thus using the existing knowledge in an innovative way (one of the design-science research objectives). We explain our proposal relevant notions on the basis of real-company example, which increase the practical relevance of our study and obtain an in-depth insight into how our proposal can assist in the service quality specification.

The last step of DSRM, communication, is being achieved through scientific publications aimed at the practitioners and researchers within the service science area.

As future work, we intend to apply the proposal in an organization with a service exchange more complex, namely one with penalties defined. We also intend to design a new diagram to integrate the SLAs in the DEMO models. For instance, we could develop a symbol to represent the SLAs and use it in the Actor Transaction Diagram, this way we could easily check out which services had SLAs.

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