Using DEMO-based SLAs for Improving City Council Services

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Abstract: According to data from the Portuguese Association of City Councils (DGAL – Portuguese abbreviation) the 308 city councils in Portugal employ about 135 000 people and spend about 3.8 billion euros a year (Ministry of Finance and Public Administration, 2010). In this paper we describe the implementation of our most recent proposal to specify the services quality in the city council of Pombal (CMP) in Portugal. This proposal is a new version of the DEMO-based SLAs with a more complex structure of Service Level Agreement (SLA) attributes. This proposal is based on the Enterprise Ontology theory and identifies services that do not create new original results, therefore services with great potential to be automated. We evaluated the new proposal's version by collecting feedback from CMP employees and customers. Moreover, we found some possible improvements that could save millions of euros to the Portuguese state.

1 INTRODUCTION

In previous research we focused on closing the gap between customers' expectations and the perceived service (Parasuraman et al., 1985) by formally specifying the customers' expectations into Service Level Agreements (SLAs) (Mendes et al., 2012) (Mendes et al., 2011) (Mendes and Mira da Silva, 2012), using as a foundation the DEMO methodology and respective Enterprise Ontology theory (Dietz, 2006).

DEMO (Design & Engineering Methodology for Organizations) is a methodology for modelling, (re)designing and (re)engineering organizations and networks of organizations. The theory that underlies this methodology is called Enterprise Ontology (EO) that by itself is based on the speech act theory. We have chosen EO because this theory can help us expand the expressiveness of the service descriptions and, consequently, allow a better alignment between expectations and perceptions (Mendes and Mira da Silva, 2012).

In this paper we propose a new version of the DEMO-based Service Level Agreement (SLA) (Mendes and Mira da Silva, 2012) that has a new structure with more attributes and results from a deeper state of art analysis. We applied this proposal in the Portuguese city council of Pombal (CMP - Portuguese abbreviation), i.e. we specified the service catalogue of CMP including the services CMP provides to Pombal residents and the SLAs they use to comply with the residents' expectations.

To evaluate the new SLA version we collected feedback from 23 employees of CMP and 7 customers. The majority of the proposal attributes (14 in 16) was classified as important since they received a minimum score of 7.6 in 10 while the remaining two received an score of 5.9. Besides these findings, as our proposal identifies services that do not create new original results, we also identified services with great potential to be automated. We present an example of a possible improvement that could save millions of euros to the Portuguese state.

Our study was conducted using the Design Science Research Methodology (DSRM) that aims at creating and evaluating IT artefacts intended to solve identified organizational problems (Hevner et al., 2004). These artefacts include constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices) and instantiations (implemented and prototype systems). This research method comprises the following phases (Peffers, 2008): problem identification, objectives definition, design and development, demonstration, evaluation and communication.

The paper is structured as follows. We will start

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by providing a brief overview of the literature on the problem area (Section 2). In Section 3, we introduce the theoretical background of this research, the Enterprise Ontology theory. Afterwards, we introduce the new version of the DEMO-based solution to specify the services quality (Section 4). In Section 5, we describe an experiment at CMP. In Section 6, we explain the evaluation process, which uses data from the experiment, and specify the lessons learned. Finally, we present our conclusions (Section 7).

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

2 RELATED WORK

This section describes the current solutions for specifying services quality and explains why these solutions do not solve the gaps problem (Parasuraman, Zeithaml, & Berry, 1985).

We analysed several solutions to specify the Service 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 (Office of Government Commerce, 2007) or CMMI (CMMI for Services, Version 1.3, 2010), the second represents the solutions focused on 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 to 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 its 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 (Office of Government Commerce, 2007).

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 (Office of Government Commerce, 2007).

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 but the interactions between these processes (such as Request Fulfilment, Service Level Management and Incident Management) are usually unclear. For instance, the connection between an incident and an SLA is neither clearly explained in ITIL nor in CMMI.

There are some solutions to specify the services quality that originated in the web services community. In (Sahai, Durante, & Machiraju, 2002) 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 on the web services and does not try to specify business services. For instance, the specifications do not include penalties or prices. The researches in (Tosic, Patel, & Pagurek, 2002), (Dobson, 2004) and (Frolund & Koistinen, 1998) have the same bottleneck. Despite this trend in the web service community, there are some recent researches that try to overcome the mentioned web service tunnel vision. In (Keller & Ludwig, 2003) 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 (Andrieux, et al., 2007) and (Liu, Ngu, & Zeng, 2004) business criteria is also included in SLAs. These three solutions represent a new movement in

the web service community; however, none is based on a strong conceptual foundation.

Another contribution to the gaps problem is the Generic Service Specification Framework (GSFF) (Terlouw & Albani, 2011), which is based on the following generic service definition (Albani, Terlouw, Hardjosumarto, & Dietz, 2009): *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*.

We adopted this service definition in our research since this definition is the only one that, as our research, uses DEMO as a conceptual foundation.

The GSSF 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 (Terlouw & Albani, 2011).

3 THEORETICAL FOUNDATION

This section briefly describes the Enterprise Ontology theory (the theory that supports our proposal).

Enterprise Ontology (Dietz, 2006) 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. 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.

4 PROPOSAL

This section corresponds to the design and development step of DSRM. Our proposal is composed by the following steps:

1. Identify the services;
2. Specify the executor, production and coordination of the services;

3. Specify the SLAs for each identified transaction/service.

The first step is to identify the services of the provider, using for that purpose a process based on the methodology proposed in (Dietz, 2006). This process is composed by six steps: Enterprise Description, Performa-Informa-Forma Analysis, Coordination-Actors-Production Analysis, Transaction Pattern Synthesis, Result Structure Analysis and Actor Transaction Diagram/Service Identification.

The second step of the proposal is to apply part of the GSSF (Terlouw & Albani, 2011): service executor, service production and service coordination. The service executor area defines who the provider of the service is; the service production area focuses on the production act to be performed by the executor; and the service coordination area gives the consumer all the information required for conducting a successful communication with the provider.

The fourth area, the contract options, is replaced by our definition of SLA presented in Figure . That means for each identified service, one should specify the list of associated SLAs using our SLA definition (step three).

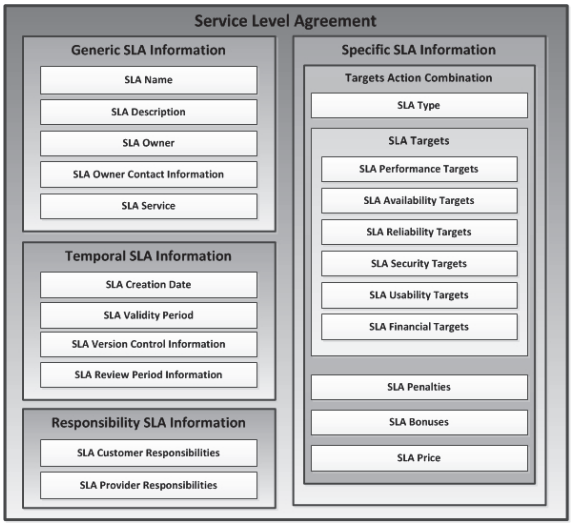


Figure 1: Structure and attributes of the DEMO-based SLA.

Our SLA proposal considers four main areas of concern with their respective attributes that we will now explain. The first section is called **Generic SLA Information** and it defines the name of the SLA (*SLA Name*) and the SLA purpose (*SLA Description*). Additionally, the Generic SLA Information describes who owns this SLA (*SLA Owner*), it also provides a contact of this person (*SLA Owner Contact Information*) and, finally, this section defines the name of the service that the SLA applies to (*SLA Service*).

The second considered section contains information concerning the dates of the SLA and is called **Temporal SLA Information**. In this section the date on which the SLA was established (*SLA Creation Date*) is defined as well as the time interval on which the SLA is valid (*SLA Validity Period*), the information related to the SLA modification dates by the customer (*SLA Version Control Information*) and the information concerning the SLA review dates performed by an entity related to the service provider (*SLA Review Period Information*).

Next, we define a section called **Responsibility SLA Information** that regards the information about the responsibilities of each actor in the execution of this SLA. In this section two attributes are specified concerning the obligations and duties of the customer (*SLA Customer Responsibilities*) and the service provider (*SLA Provider Responsibilities*).

Finally, the last section is called **Specific SLA Information** and for each type of SLA (*SLA Type*) it specifies six different types of targets (*SLA Targets*), which can give rise to actions if they are not fulfilled (*SLA Penalties*), but if they are fulfilled, this should be rewarded (*SLA Bonuses*). Each type of SLA is also associated to a price (*SLA Price*).

Several of these attributes can be gained from DEMO diagrams, such as, for example, the SLA Owner that can be identified by the Actor Transaction Diagram (ATD) or the SLA Penalties and the SLA Bonuses that can be gained from the Action Model (AM).

Thus, this research intends to reduce the gaps by formally specifying the SLAs, using EO theory as a foundation.

5 DEMONSTRATION

This section corresponds to the demonstration phase of DSRM. We evaluated the proposal using an experiment in order to validate its applicability. The demonstration occurred in a Portuguese city council named Pombal (CMP). Pombal is located in Leiria District and is composed of 17 parishes. It has a total area of 626.1 km² and a total population of 58,617 inhabitants. The population of the city of Pombal is about 18,000 inhabitants. CMP employs a total of 389 people with 203 men and 189 women and has five major departments divided into divisions, units and sections. In 2010 CMP spent a total of 20 553

200 € from which 7 542 250 € in human resources (Pombal City Council, 2011).

In order to identify the services (step one of the proposal) we interviewed individually 17 employees from CMP. With the purpose of having an overall perspective of the entire CMP we have selected employees from all the departments. During the interviews participants were asked to describe the activities performed by CMP. 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 (Kvale, 2007).

The interviews allowed us to develop an enterprise description of CMP that was used as input for the service identification step (proposal first step). We do not fully describe the six sub steps of the service identification step due to space limitation, nevertheless these sub steps are based on DEMO (Dietz, 2006) and are described in previous publications (Mendes, Ferreira, & Mira da Silva, 2011) (Mendes, Ferreira, & Mira da Silva, 2012). The result of this first step is called the Actor Transaction Diagram (ATD) and we decided to show only the ATD with information regarding the Human Resources and IT Service due to space limitations (Figure).

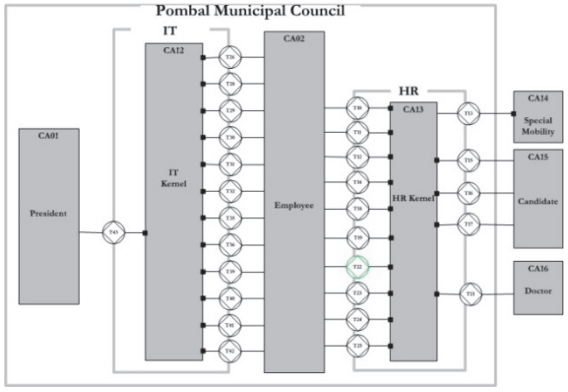
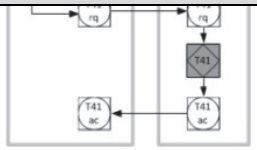


Figure 2: ATD with HR and IT.

In the ATD, a transaction/service is represented using a diamond in a disk that contains the respective combination of C-acts and a P-act. Each transaction is connected to two boxes, representing the initiator and executor actor roles. The initiator is connected to the transaction symbol using a solid line, while the executor is connected to the transaction using a solid line ending in a black square. The grey boxes refer to composite actor roles, i.e. elements whose exact structure is not known. All the environmental elements, i.e. elements outside the organization that we are studying, are represented with grey boxes for that reason. This also means that we can represent the studied organization with a grey box when referring to the kernel of the organization, which can be further specified by using elementary actor roles represented by white boxes.

We identified 173 services of which 145 are ontological, 17 are infological and 11 are datalogical (see Section 3). These services correspond to all services provided by the five major departments that constitute the City Council. Figure 2 illustrates seven major Composite Actor Roles (President, IT Kernel, Employee, HR Kernel, Special Mobility, Candidate and Doctor) on a total of nearly 50 across the entire City Council.

Table 1: Service "*Application Development*" Specification.

Service Specification - *Application Development (T30)*	
Service Executor	
Actor Role	*Developer (A02)*
Contact Information	General Email: suporte@cm-pombal.pt Email: xxxxx Phone: xxxxx
Service Production	
Production Act	Application Development is the act of designing and developing new applications or features required by other units of the Municipal Council or by the IT Division.
Production Information Used	The object classes used in this services are: Application, Handbook, Employee, Course
Production Fact	Application App has been developed
Production Kind	The production kind of this transaction is: Ontological
Production World Semantics	Application, Handbook, Employee and Course (See Figure)
Preconditions	Hardware Installation (T28)
Postconditions	ND
Service Coordination	
Coordination Acts	 Figure
Coordination Kind	This service is a Human Service
Protocol	1. Contact the IT Division; 2. Specifies the Application requirements; 3. Wait for the end of development; 4. Test Application; 5. Application available to the target audience.
Location	Email, Phone

The IT division operates and maintains the computer equipment, develops new tools, supports their applications, and conducts courses to enhance learning of the new features. We identified 13 services provided by this division: *Network Configuration* (T26), *Hardware Installation* (T28), *Hardware Uninstallation* (T29), *Hardware Substitution* (T39), *Application Development* (T30), *Incident Resolution* (T31), *Database Management* (T32), *Software Installation* (T35), *Software Uninstallation* (T36), *Backup Realization* (T40), *Handbook Definition* (T41), *Training* (T42) and *Business Intelligence Study Realization* (T43).

In order to proceed to the second step of the proposal (specify the executor, production and coordination of the services), first we had to model the Process Model, the Action Model, and the State Model of Pombal City Council, since some aspects of the GSSF (used in the second step of the proposal) depend on these models. We do not present all of these models due to space limitations.

We applied the Generic Service Specification Framework (GSSF) to specify the services of Figure (second step of the proposal). An example of this specification is illustrated in Table . This table describes the attributes of the service *Application Development* that implements the T30 transaction and is provided by the IT Division.

The service specified above is called *Application Development* and is carried out by a Developer whose contact is available in the Service Executor section. In the Service Production area, it is specified that a new application is produced, which makes this an ontological service and, based on the State Model (Figure), we found the information classes used in this service: Application, Handbook, Employee and Course.

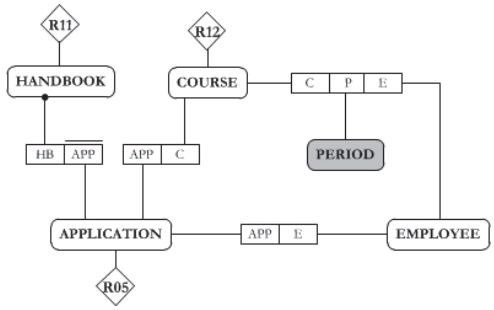


Figure 3: State Model for Service *'Application Development'*.

The ontological coexistence rules between these classes are the following: an Application may have a Handbook, several Courses and Employees using it. Additionally, a Course concerns an Application and it is taught in a certain period to a number of Employees.

Before this service execution, a precondition must be guaranteed, since the application development must be preceded by the hardware installation (T28). Regarding the post conditions there are none associated with the *Application Development* service. Concerning the Coordination area, the coordination acts involved in this service are illustrated by the Process Structure Diagram (PSD) (Figure 4).

In this diagram we see that the employee makes a request for a new application or feature and this request is handled by the developer that, when the development of the new application ends, starts two new transactions: write the user manual (*Handbook Definition – T41*) and schedule a training on this new application (*Training – T42*). In addition, in the Coordination area the procedure or protocol to successfully contact the service provider is specified as well as the location of the service that, in this case, is by email or phone.

In the third step of the proposal we specified the SLAs associated to the CMP services using our SLA proposal (Figure 1). Table illustrates an example of this specification for the service *Application Development*.

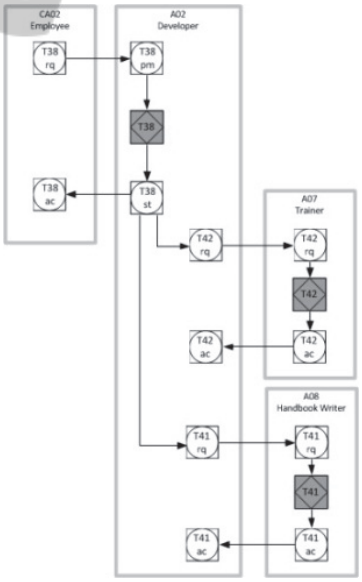


Figure 4: PSD for Service *'Application Development'*.

This SLA concerns the development of an application named WebDoc2.0 and the SLA Owner is the IT Division Chief. Multiple contacts of the IT Division Chief are specified in order to be contacted by the service customer at any time. This SLA was made on the first day of January of 2011, was valid

until 31 of November of 2011 and was changed in July 15. To fulfil this SLA, the service provider needs to complete all the points specified in the SLA Provider Responsibilities (completion of ERP integration, improvement of communication between citizens and putting into production all features developed).

Table 2: SLA *"WebDoc 2.0 Development*" Specification.

Service Level Agreement Specification	
Generic SLA Information	
SLA Name	**WebDoc 2.0 Development**
SLA Description	SLA concerning the development of a tool for document management.
SLA Owner	Nome: Nuno Salvador Category: IT Division Chief Organic Unit: IT Division
SLA Owner Contact Information	Email: xxx Phone: xxx
SLA Service	*Application Development* (T30)
Temporal SLA Information	
SLA Creation Date	January 1, 2011
SLA Validity Period	Until November 31, 2011
SLA Version Control Information	July 15, 2011
SLA Review Period Information	NA
Responsibility SLA Information	
SLA Customer Responsibilities	NA
SLA Provider Responsibilities	1 - Finish ERP Integration; 2 - Improve communication between the citizens; 3 - Place in operation all the features developed.
Specific SLA Information	
SLA Type	**Overcome Goal**
SLA Targets	
Performance	Until November 15, 2011
SLA Penalties	NA
SLA Bonuses	Evaluation Score: 5 Career: Allows career evolution
SLA Price	0 €
SLA Type	**Fulfillment Goal**
SLA Targets	
Performance	Until November 31, 2011
SLA Penalties	NA
SLA Bonuses	Evaluation Score: 3
SLA Price	0 €
SLA Type	**Non Fulfillment Goal**
SLA Targets	
Performance	After November 31, 2011
SLA Penalties	Evaluation Score: 1 Career: Can be fired with probable cause
SLA Bonuses	NA
SLA Price	0 €

This SLA has three types that depend on the date of completion of the development. Penalties and bonuses are translated into career points that influence the career development.

On the one hand, in case of SLA Type "Overcome goal", the SLA Owner wins five career points and can evolve in his career.

On the other hand, if the service provider does not meet the deadline the SLA Type "Non Fulfilment Goal" applies and the SLA Owner only wins one career point and can be fired with probable cause.

Note that this SLA has no price defined because this is an internal service to the CMP and no chargeback is made among the CMP departments.

6 EVALUATION

This section corresponds to the evaluation phase of DSRM and in order to explain the evaluation we use the framework proposed in (Pries-Heje, Baskerville, & Venable, 2004). This framework identifies what is actually evaluated, how it is evaluated and when the evaluation takes place.

Table illustrates the answers to the three main questions that this framework proposes to answer:

- **What is Actually evaluated?** The artifact evaluated is the proposed set of steps of Section 4 (a design process) and the results of applying these steps to the CMP (Services and SLAs; a design product);
- **How is it evaluated?** We used CMP employees' feedback to evaluate the DEMO-based SLA structure and the CMP services and SLAs. This represents a naturalistic evaluation since it was conducted using a real artifact in a real organization facing real problems;
- **When was it evaluated?** It was evaluated ex post (after the design artifact was developed).

P summarizes the essential characteristics of the evaluation Process, while C indicates the evaluation Criteria.

The evaluation was naturalistic since we applied our proposal in a real organization with real data. The evaluation was ex post since it occurred after

Table 3: Evaluation strategy.

	Ex Ante	Ex Post
Naturalistic	Design Process / Design Product	P: CMP employees' feedback & customers' feedback C: SLA Attributes Quality
Artificial	Design Process / Design Product	Design Process / Design Product

the demonstration in the CMP. We evaluated both the proposed set of steps of Section 4 (including the DEMO-based SLA structure) and the results of applying these steps to the CMP (Services and SLAs specification). In order to evaluate the DEMO-based SLA structure (see Figure) and the Services and SLAs specification from CMP we collected feedback from 23 CMP employees and 7 CMP customers. They were arbitrarily chosen and were asked to classify the attributes of the SLA proposal from 1 to 10 according to the importance (being 1 irrelevant and 10 essential). Figure 5 illustrates the average and standard deviation per attribute. As can be seen there was little variation in the answers of the interviewees in most attributes.

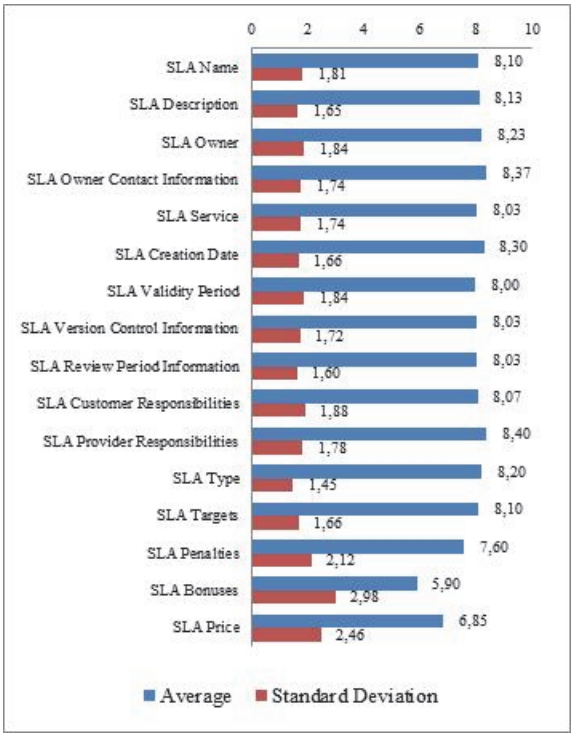


Figure 5: Rating of proposal attributes.

The first 14 attributes had high average scores (from 7.60 to 8.40) and the remaining two (Bonuses and Price) had lower classifications (5.90 and 6.85).

These results indicate that the majority of the proposed attributes (14 in 16) were classified as important since they scored a minimum of 7.60 in 10 possible points. The remaining two attributes (Bonuses and Price) scored 5.90 and 6.85 revealing that they were classified as less important when comparing to the first 14. These results can be explained by the fact that there are no chargeback among the departments of the 30 inquired persons. Therefore, they value more the attributes that describe the service quality than the ones that capture the costs.

Besides this validation, we also validated the service catalogue from the IT Division with the IT chief that agreed with all 13 identified services. The same validation method is being used for other units of the City Council hoping to have the same acceptance that in the IT Division.

The definition of a city council service catalogue has great potential, because the services that this type of organizations provides to the citizens are similar. For instance, in Portugal there are 308 city councils and in theory they all have the same purpose. Having identified the service catalogue of one city council we can validate if it is applicable to other city councils and eventually find some services that could be provided in cooperation.

Knowing the services and the type of services provided allows one to understand how the service provider can improve his performance. For instance, the service *Collect Water Usage* – T155 is a datalogical transaction since it neither involves the creation of new original facts (ontological) nor information processing (infological). Hence, it has large potential to be optimized, since technology can be used to reduce the effort needed to execute datalogical acts (Dietz, 2006).

CMP has four employees dedicated to collect water usage. Assuming that CMP spends 77 555 € a year with these four employees ((7 542 250 € / 389 employees) * 4 employees) and the other 307 city councils in Portugal do not have this service automated and use similar resources on it, then this would represent an expense of 23 809 468 € a year in a service that has great potential to be automated. This value is estimated using only the costs of the employees' wages so if we add the supporting costs (IT support, HR support, etc.) then the estimated value would certainly be higher.

This kind of analysis has special value because of the current situation Portugal is in since it points

some solutions to a number of current challenges imposed by the Troika memorandum.

7 CONCLUSIONS

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 the majority of the web services based solutions suffer from the web service tunnel vision.

In this paper we apply our most recent proposal to specific services in a Portuguese city council. This proposal is based on the Enterprise Ontology theory and identifies services that do not create new original results, therefore services with great potential to be automated. In this particular city council we found services that if automated could save the Portuguese state millions of euros.

Our new SLA proposal revealed to be more flexible and mature when comparing to the previous one. The employees' and customers' feedback revealed that in the CMP context 14 in 16 of the proposal attributes were considered important. This indicates that this new version of DEMO-based SLAs has more potential to capture the customers' expectations than the older version of the proposal that had only 5 attributes. By specifying these attributes, customers can structurally define their expectations which may help the alignment between customers and service providers. The specification of the customers' expectations into SLAs helps the service providers to understand those expectations and consequently reduce the gaps among the two.

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 evaluate the proposal using practitioners' feedback. Presently, we are interviewing recognized practitioners involved in SLAs specification. Furthermore, we will apply our proposal in an organization with a more complex service exchange.

REFERENCES

Albani, A., Terlouw, L., Hardjosumarto, G., & Dietz, J. (2009). Enterprise Ontology Based Service Definition. Amsterdam, *The Netherlands: 4th International Workshop on Value Modeling and Business Ontologies*.

Andrieux, A., Czajkowski, K., Dan, A., Keahey, K., Ludwig, H., Nakata, T., et al. (2007). Web Services Agreement Specification (WS-Agreement). *Open Grid Forum.*

CMMI for Services, Version 1.3. (2010). Software Engineering Institute - Carnegie Mellon University.

Dietz, J. (2006). Enterprise ontology - theory and methodology. Springer.

Dobson, G. (2004). Quality of Service in Service-Oriented Architectures. Retrieved June 2, 2011, from http://digs.sourceforge.net/papers/qos.html

Frolund, S., & Koistinen, J. (1998). QML: A Language for Quality of Service Specification. *HP Software Technology Laboratory.*

Hevner, A., March, S. T., Park, J., & Ram, S. (2004). Design Science in Information Systems Research. MIS Quarterly.

Keller, A., & Ludwig, H. (2003). The WSLA Framework: Specifying and Monitoring Service Level Agreements for Web Services (Vols. 11, No. 1). *Journal of Network and Systems Management.*

Kvale, S. (2007). Doing interviews. London: Sage Publications.

Liu, Y., Ngu, A., & Zeng, L. (2004). QoS Computation and Policing in Dynamic Web Service Selection. New York, USA: *13th International World Wide Web conference on Alternate track papers & posters*, ACM.

Mendes, C., & Mira da Silva, M. (2012). DEMO-based Service Level Agreements. Geneva: *3rd International Conference on Exploring Service Science, Lecture Notes in Communications in Computer and Information Science*, Springer.

Mendes, C., Ferreira, J., & Mira da Silva, M. (2011). Comparing Service Using DEMO. Paris: *3rd International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management - Special Session on Enterprise Ontology*.

Mendes, C., Ferreira, J., & Mira da Silva, M. (2012). Identifying Services from a Service Provider and Customer Perspectives. *Lecture Notes in Communications in Computer and Information Science*, Springer.

Ministry of Finance and Public Administration. (2010, October). 2011 State Budget. Retrieved April 09, 2012, from http://static.publico.clix.pt/docs/economia/PropOERel2011.pdf

Office of Government Commerce. (2007). ITIL v3 – Service Design. *The Stationery Office*.

Parasuraman, A., Zeithaml, V., & Berry, L. (1985). A Conceptual Model of Service Quality and its Implication for Future Research. Journal of Marketing.

Peffers, K. e. (2008). A Design Science Research Methodology for Information Systems Research. *Journal of Management Information Systems*, M. E. Sharpe.

Pombal City Council. (2011). 2011 Pombal City Council Budget. *Pombal City Council*, Pombal.

Pries-Heje, J., Baskerville, R., & Venable, J. (2004). Strategies for Design Science Research Evaluation. *16th European Conference on Information Systems* (ECIS), pp. 255-266.

Sahai, A., Durante, A., & Machiraju, V. (2002). Towards Automated SLA Management for Web Services. *Technical Report, Hewlett-Packard Company*.

Terlouw, L., & Albani, A. (2011). An Enterprise Ontology-Based Approach to Service Specification. *IEEE Transactions on Services Computing*.

Tosic, V., Patel, K., & Pagurek, B. (2002). WSOL – Web Service Offerings Language. (C. '. '02, Ed.) London, UK: *International Workshop on Web Services, E-Business, and the Semantic Web*, Springer.