DEMO Engine

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Abstract: The service sector is the biggest of the world economy. It leads the creation of value in organizations. However, the service sector presents quality gaps that reduce customers' satisfaction and revenues. The fourth gap of service quality states that there is a difference between the service delivered and the communication acts involved in that delivery. In this research we proposed an approach based on Enterprise Ontology (EO) theory to mitigate this gap. Our proposal also includes the development of a software system, based on Design & Engineering Methodology for Organizations (DEMO) and Service Level Agreements (SLA), the DEMO Engine. This research was conducted using the Design Science Research Methodology (DSRM). The demonstration of our proposal is done using an artificial example of a use of the DEMO Engine in a Travel Agency. The evaluation was made with feedback collected from 47 academic and by using the 4 Österle principles.

SCIENCE AND TECHNOLOGY PUBLICATIONS

1 INTRODUCTION

The services industry has grown exponentially in the last decades. Throughout the years the service sector has become the number one driver to obtain value in the economy (Central Intelligence Agency, 2011). These services comprise many daily activities, which include telecommunication, mass media, financial, franchising, health care or even tourism. The importance of the service sector can be inferred by looking at the world's GDP – 63.4% is related to services – and workforce – 42.4% of world's population work in the service sector (Central Intelligence Agency, 2011; International Monetary Fund, 2012). Also, the top 20 of the most successful companies are directly or indirectly related to services (Forbes, 2012), whether in their main business focus or related to after-sale services, such as warranties, repairing, etc.

With this impact on the world's economy, it is imperative to ensure that each and every service is done accordingly and satisfies customers' expectations. Achieving customer satisfaction will be dependent on service quality, and this quality will be the major competitive advantage towards other services (Henry Chesbrough, 2006).

In order to control quality, several frameworks and tools were developed to ensure principles that could guarantee service quality. Information Technology Infrastructure Library (ITIL) and Capability Maturity Model Integration (CMMI) are examples of said frameworks that try to bring out these principles. Nevertheless, ITIL and CMMI are based upon best practices, which are not necessarily the best options due to their lack of theoretical background on implementation options. Other approaches from the Web Services community also fail to comprise this factor.

In this research we used the Enterprise Ontology (EO) and the corresponding methodology Design & Engineering Methodology for Organizations (DEMO) (Dietz, 2006) as a mean to reduce the service quality gaps and, thus, achieve higher levels of service quality. Our proposal is based on previous works done in the area of Service Level Agreements (SLA) definition (Mendes and Mira da Silva, 2012; Almeida, 2012) that tackled the first three gaps. Now, we continue the research by also tackling gap number four of service quality. This gap is a result of the difference between the service produced and the service communicated to the customers. This way our solution tackles all the gaps identified by (A. Parasuraman, 1985). At first EO might not seem related to services but another research in the field brought these two areas closer since they defined the service concept using EO terms (Albani et al., 2009).

To validate this research we demonstrated our proposal using a fictional example of a Travel

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Agency. We then evaluated the impact of the application of the system and we collected feedback from 47 academics that granted us with valuable, precise and concise feedback.

In this research we used Design Science Research Methodology (DSRM) (Hevner et al., 2004; Peffers et al., 2008).

The paper is structured as follows. We start by describing the service quality gaps problem (Section 2). Then, we present a system that can be seen as similar to our approach (Section 3). Afterwards, we introduce the DEMO-based solution to specify the services quality (Section 4). In Section 5, we describe the demonstration of our proposal using a fictional example. In Section 6, we explain the evaluation process. Finally, we present our conclusions (Section 7).

2 PROBLEM

This section corresponds both to the problem identification & motivation phase and to the objectives definition phase of DSRM.

Service quality is closely related to increased market share and return of investment, but quality is difficult to be measured and to be assured (A. Parasuraman, 1985). Nevertheless, in order to be successful, organizations need to obtain this quality to gain a competitive advantage. If organizations cannot measure quality, they cannot know if they already provide services with quality or what is needed to be done to improve.

Service quality has five gaps that can be used to assess where the customers' expectations of quality are being corrupted. These gaps serve as a guideline for organizations to know what, where and how to tackle the lack of service quality. This gaps were designed by (A. Parasuraman, 1985):

- **Gap 1**: The difference between the customer's service expectation and the provider's perception of that expectation;
- **Gap 2**: The service specification as used by the service provider differs from the expected service as perceived by the customer;
- **Gap 3:** The difference between the specified service and the delivery of that service;
- **Gap 4**: The gap between the service delivered and the external communication to customers of that service;
- **Gap 5:** The global difference between the customers' expected service and the perceived service they receive.

Our main focus, gap number 4, can be caused by sales overpromising, ineffective management of customers' expectations or inadequate horizontal communication. An example of this gap can be a customer not being informed when a bug he/she reported was repaired. We only focus on gap number 4 since the previous researches that supports our work (Ferreira, 2010; Almeida, 2012; Mendes, 2013) have already tackled gaps 1, 2 and 3.

This gap 4 presents five communication challenges: Service Intangibility, Management of Service Promises, Management of Customer Expectations, Customer Education and Internal Marketing Communications.

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 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 (Dietz and Albani, 2011).

We can summarize our research problem as **"Does a system that register all the coordination acts involved in the service exchange diminishes the gap between the service delivery and the related communication? "**.

Even though the result of this research question might seem trivial, there is no research that actually proves the result. Therefore, answering this question appears to be a pertinent and innovative research. Notice that with this system we only intend to tackle the communications with the customer inside gap number four. For example, defining the marketing plan of an organization is not the purpose of this research and can be seen as a limitation.

3 RELATED WORK

In a recent research (van Kervel, 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.

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*.

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.

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 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 6 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.

4 PROPOSAL

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

Our proposal is the creation of a **system that combines knowledge from EO, DEMO, Generic Service Specification Framework (GSSF) and DEMO-based SLAs in order to mitigate gap 4 of service quality**.

Not only we propose to register all coordination acts and production facts involved in a service exchange, 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.

We intend to achieve 4c-ness in our proposal: coherency, comprehensiveness, consistency and conciseness (Dietz, 2006). We do not focus on the essential characteristic of EO because we opted for supporting ontological, infological and datalogical services.

Furthermore, we intend to tackle the gap 4 communication challenges in the following way:

- **Service Intangibility:** To create a simple service catalogue that can be understood by the customer using both GSSF (Terlouw and Albani, 2011) and DEMO-based SLA (Mendes and Mira da Silva, 2012). 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 overpromise 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. 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 do not change from execution to execution so the customer always knows about the existing choices, they perceive what they have to do, how and when;
- **Internal Marketing Communications:** Make 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.

5 DEMONSTRATION

This section corresponds to the demonstration phase of DSRM. In order to demonstrate our proposal, we have implemented a web-based prototype. The prototype was developed using the SCRUM methodology (Schwaber, 1995).

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. 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 and Albani, 2011) and the SLAs using the DEMO-based SLAs (Mendes and Mira da Silva, 2012). This management is done in collaboration with the providers and the clients;
- **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 SLAs 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.

To better present these features we will use a fictional example of a Travel Agency, where we have James (the customer) who is requesting a "Trip Advisory" service and John (the provider) who answers James's request.

James starts by looking at the Travel Agency service catalogue and he notices a service that might correspond to his needs, "Trip Advisory" (top of Fig. 1). 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. 1). 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 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).

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

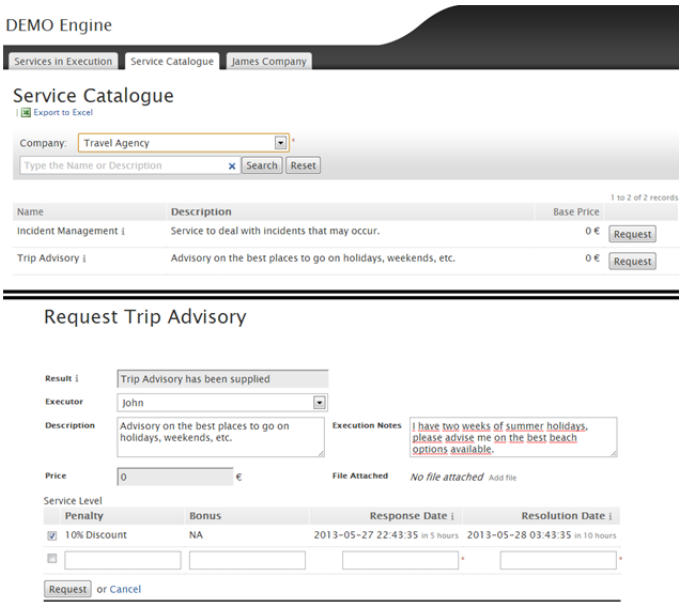

Figure 1: Trip Advisory Request (Catalogue on the top and pop-up on bottom).

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.

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.

If we look to Fig. 2 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. 3.

James opts 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 EVALUATION

This section corresponds to the evaluation phase of

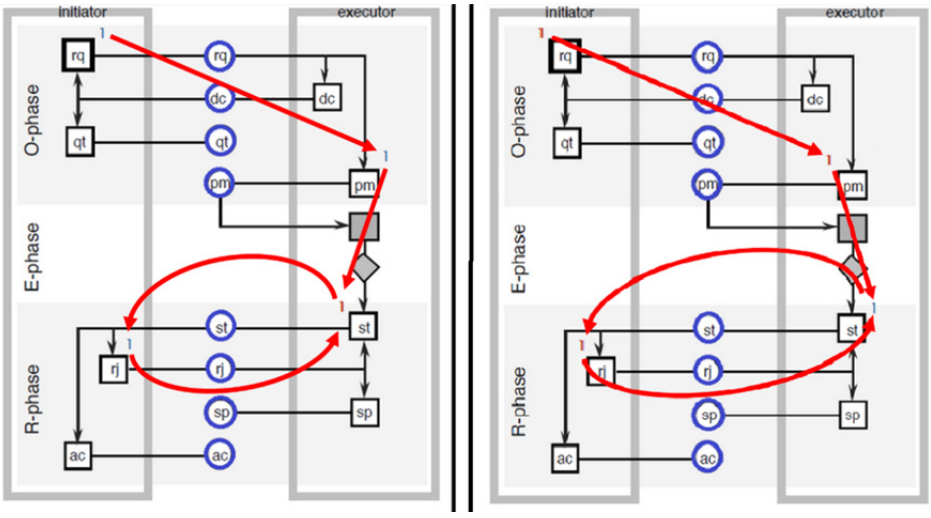

Figure 2: Trip Advisory Execution (left - client view, right - provider view).

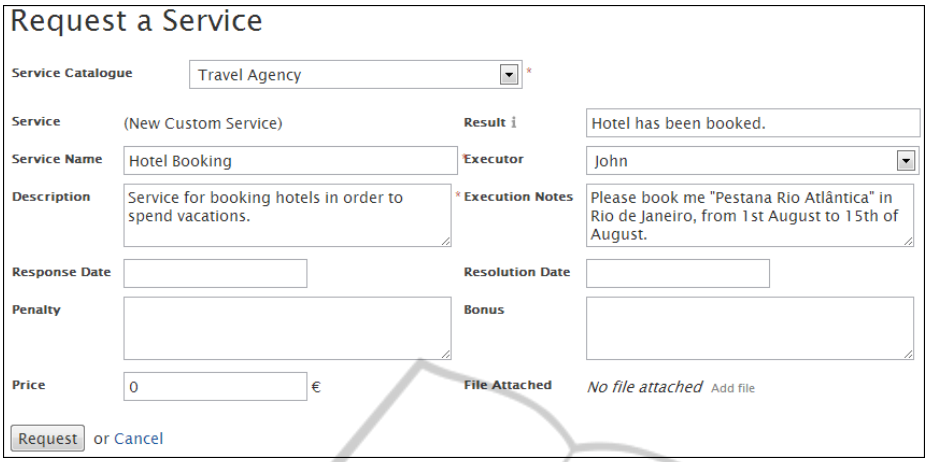

Figure 3: Hotel Booking.

DSRM and in order to explain the evaluation, we use the framework proposed in (Pries-Heje et al., 2004). This framework identifies what is actually evaluated, how it is evaluated and when the evaluation takes place.

We evaluated the artifact evaluated is the proposed system elaborated in Section 4 (a design product), the results achieved by creating a prototype and the feedback collected among academics.

We did an artificial evaluation using the Travel Agency example. We also used feedback given from the academic community and a comparison between our proposal and the DEMO Processor (van Kervel, 2012).

The evaluation was made ex post, that is, we first constructed the prototype and only afterwards proceeded with gathering feedback among academics.

In order to evaluate the system we propose, we compared it with the related work (the DEMO Processor) (van Kervel, 2012).

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 prior defined. Furthermore, 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 how the organization works.

Being focused in the execution of services, the DEMO Engine supports the notion of service 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 an 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.

We also gathered feedback from 47 academics to better evaluate our proposal, this feedback was given in interviews, presentations and workshops. All feedback was collected after a presentation of this research.

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 and Japanese academics (professors and researchers).

The feedback collected 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, especially concerning what are the best services for an organization, which bring more value and which do not.

The second live evaluation occurred in Lisbon in a workshop held with students and professors from the Virginia Commonwealth University (VCU). There were 30 people attending. The audience was characterized by being students of a Fast Track Executive MS Information Systems in VCU.

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.

The third evaluation was made in a DEMO Workshop, held in Lisbon, with a representative of the Switzerland DEMO Community.

With this workshop we collected important feedback that allowed us answer the Österle principles. This feedback was especially concerned about the connection between our proposed system, the DEMO Engine, and the DEMO Processor.

As a final evaluation with academics we interviewed a Portuguese academic that has access to the DEMO Processor and could provide us with important and concise feedback over the two systems.

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, especially 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.

To conclude the evaluation we present how the Four Principles from (Österle et al., 2011) were accomplished in our research. The **Abstraction** because the artifact we propose can be applied to all types of services, ontological, infological or datalogical. The **Originality** because the combine usage of DEMO and SLA to tackle service quality gaps was used in recent researches (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. The **Justification** because the artifact is justified by all the evaluations and feedback we gathered. **Benefit** because the DEMO Engine artifact provides a way to reduce the difference between the service delivery and the communication involving that delivery, therefore increasing the service quality.

7 CONCLUSIONS

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. 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, 2010; Almeida, 2012; Mendes, 2013) and focus on the difference between the service delivery and the communication of that delivery.

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

This research was done using DSRM. We developed an artifact (the DEMO Engine) using 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 and Mira da Silva, 2012) and service specification (Terlouw and Albani, 2011).

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. The evaluation of this research was done by applying the Österle principles and gathering feedback from academics.

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 EO concepts to make then usable for a wider range of people.

The second contribution is the enabling of service co-creation based on EO. This was possible by using dynamically defined services and SLA that are negotiated over the course of an execution of an EO transaction pattern.

The last major contribution that this research pursues, is how to address the service communication challenges of service quality gap number 4 in EO terms.

As for future work there is the possibility of creating processes based on DEMO to better represent the real-world. Currently we only have transactions associated to the DEMO Engine.

Also an important addition would be the integration with present day systems to provide more useful information and making it practical to use.

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REFERENCES

A. Parasuraman, V. Z. (1985). A Conceptual Model of Service Quality and its Implication for Future Research. *Journal of Marketing*.

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

Almeida, M. (2012). *Specifying Customers Expectations using DEMO-based SLAs.* Lisbon: MSc Thesis - Instituto Superior Técnico.

Central Intelligence Agency. (2011). *The World Factbook.* Washington, DC: Central Intelligence Agency.

Dietz, J. (2006). *Enterprise Ontology - Theory and Methodology.* Delft: Springer.

Dietz, J., & Albani, A. (2011). Enterprise Ontology Based Development of Information Systems. *International Journal of Internet and Enterprise Management, 7*(1), 41-63.

Ferreira, J. (2010). *Implementação de Gestão de Serviços de Informática.* Lisbon: MSc Thesis - Instituto Superior Técnico.

Forbes. (2012). *The Forbes Global 2000*. Retrieved December 2012, from http://www.forbes.com/global2000/list/

Henry Chesbrough, J. S. (2006). A Research Manifesto for Services Science. *Communications of the ACM, 49*(7), 35-40.

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

International Monetary Fund. (2012). *World Economic Outlook Database.* Retrieved December 2012, from http://www.imf.org/external/pubs/ft/weo/2012/02/weodata/index.aspx

Mendes, C. (2013). *A Method Based on DEMO for Managing Service Quality.* Lisbon: PhD Thesis, Instituto Superior Técnico.

Mendes, C., & Mira da Silva, M. (2012). DEMO-Based Service Level Agreements. *Exploring Services Science, 103*, 227-242.

Österle, H., Becker, J., Frank, U., Hess, T., Karagiannis, D., Krcmar, H., . . . Sinz, E. (2011). Memorandum on Design-Oriented Information Systems Research. *European Journal on Information Systems, 20*, 7-10.

Peffers, K., Tuure, T., Rothenberger, M., & Chatterjee, S. (2008). A Design Science Research Methodology. *Journal of Management Information Systems*, 45-77.

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

Schwaber, K. (1995). Proceedings of the Workshop on Business Object Design and Implementation at the 10th Annual Conference on Object-Oriented Programming Systems, Languages, and Applications .

Terlouw, L., & Albani, A. (2011). An Enterprise Ontology-Based Approach to Service Specification. *IEEE Transactions on Services Computing, 99*, 1939-1374.

van Kervel, S. a. (2012). Enterprise Ontology Driven Software Engineering. *ICSOFT'12*, 205-210.