Managing the Alignment between Business and Software Services Requirements from a Capability Model Perspective

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Abstract. In this paper we introduce a framework for capturing and managing the requirements associated with the non-functional part of the services like service management, security management, assurance, for which norms, recommendations and good practices exist. The proposed framework considers these service requirements both from a business and a software perspective. The elicitation, the capture and the traceability issues related to these requirements are solved with goal-oriented requirements engineering techniques, while the structuring and the assessment of the requirements is based on the ISO/IEC-15504 standard. The overall framework is illustrated with a business case run by our research centre in a public/private partnership. It is associated with the design of project management services delivered through a portal and is focusing on the services management requirements in relation with the IT service management ISO/IEC 20000 norm.

Keywords: Business Service Design, Service Level Objective, Capability Model, Goal-Oriented Requirements Engineering, Service management.

1 Introduction

Analogously to [1] we make a distinction between QoS associated with software services (like e.g. those considered in the ISO/IEC 9126 standard [2]) and those associated with the business facet of a service, i.e. that add value to a service at a value web level [3]: the SERVQUAL model [4] or the recent work of O'Sullivan et al. [5] consider credibility, trust, security, availability as business level attributes of QoS. Our view is in line with these approaches but focuses on a specific dimension: the capability of a service provider to offer a service that is compliant with a number of assurance and regulation reference models. Assurance reference models include ITIL [6], ISO 20000 series for service management [7], ISO 27000 series for security management [8]. Regulation reference models include Sarbanes-Oxley [9], COSO [10] or Basel II [11] in the financial sector. These reference models define rules and objectives that organizations need to comply. We claim that the capability to comply should be part of the services the organizations expose since it represents elements of value for the services consumers. We therefore propose a framework that answers the following research issues:

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1. How to identify, to capture and to structure the requirements on the business QoS underlying these assurance and regulation reference models. This is done by using the ISO/IEC 15504 standard [12] (abbreviated to "15504") that offers a template for organizing the requirements into a framework allowing to measure the capability and the performance level of an organization to comply with reference models.
2. How to support the alignment between the business perspective on assurance and regulatory requirements and the lower-level software services requirements implementing the business service.

To answer these two questions, we will use Goal-Oriented Requirements Engineering (GORE) models to support the formalization of QoS requirements as well as in support to their traceability at business and software levels. In the rest of the paper we will use i* [13]. However other GORE notations are also eligible.

We will illustrate the whole approach with a real business case currently managed by our public research centre together with a network of professional consultants in project management [14]: setting up a portal based on a SOA architecture offering project management services dedicated to SME's that usually do not have the resources (money and/or competences) to access complete project management software suites For the sake of this paper, we will focus only on one facet of the assurance requirements associated with these services: the IT service management. IT service management is handled through different norms, including ITIL [6] documented by the British Office of Government Commerce (OGC) and the emergent ISO/IEC 20000 [7] (abbreviated to "20000") organized in two parts under the general title of "Information Technology – Service Management".

In section 2, we present the role of GORE in the alignment between business and software services, and outline our proposed approach. In section 3 we detail the 15504-based approach applied to the structuring and the performance measurements of requirements associated with the IT 20000 service management. The section 4 explains our approach regarding the progressive refinement of business-oriented and software-oriented service management requirements. Finally section 5 wraps up the paper and discusses some open issues.

2 Requirements Engineering and Service Description

Figure 1 revisits the well-known business/IT alignment from [15] and introduces the role that GORE plays in guaranteeing the business/software services alignment thanks to the fact that goals can be used at different decision-making levels. At the bottom of the vertical axis, one can see the traditional use of GORE for the progressive elaboration of IS/software systems from strategic goals. Goals support the characterization of a system in terms of desired state of affairs to be achieved and/or maintained. GORE has been proven useful in the progressive elicitation and structuring of the requirements (usually referred as non-functional requirements – NFR) related to QoS. Such NFR can be attached e.g. to use cases associated with the description of software services. Several examples of this approach can be found in the literature using notations like those provided by KAOS [16] or *i** [13].

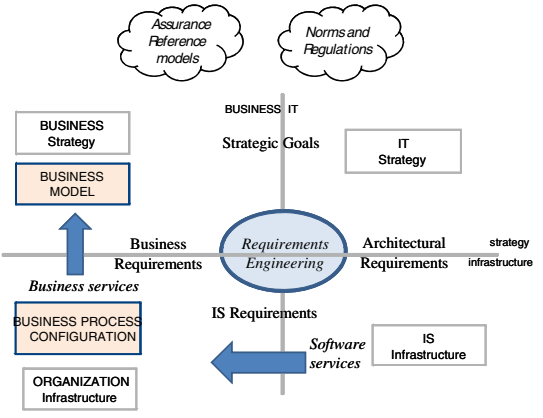

Fig. 1. GORE in support to Business/Software Services Alignment

On the left part of figure 1, we define business services from a business value model perspective: the functional business part of these services directly contributes to the creation of value in a networked value constellation according to the strategy defined by an organization [3]. We do not cover how these business services are discovered but we can refer to approaches as e3value [1] or strategic map [17]. Business strategy does not only include an economic and financial dimension but has to accommodate with constraints from the environment of the organization such as national, cross-industry or industry-specific regulations and assurance best practices. These constraints need to be formalized and structured in terms of requirements (top part of figure 1). In section 3, we present the joint application of GORE and 15504 to meet this objective.

Business services functional and non-functional requirements express specifications against which different solutions in terms of business processes (BP) configurations can be designed and evaluated (left bottom-part of figure 1). Our work does not concentrate on how to design such BP configurations, but once the BP's have been identified, they still need to be realized through an IT/IS (Information System) (right bottom part of figure 1). From a requirements perspective, this calls for a further refinement of business requirements into software requirements. In the domain of QoS attributes we need to refine non-functional business requirements derived from norms and assurance best practices into software requirements that can be functional and/or non functional. Section 4 will illustrate this aspect of our work.

3 Elicitation and Structuring of Service Management Requirements

We use a methodology for the progressive elicitation, formalization and structuring of catalogues of QoS requirements inherent to regulations and assurance norms. This

approach is based on a joint use of GORE and 15504 standard. The methodology has been extensively applied in our Centre for the design of different business requirements compliance frameworks in different domains as, for example: security management [18] (based on ISO 17799 and ISO 27000 series [8]), knowledge management [19], project management, credit management, venture capital management [20], risk management and Anti-Money Laundering compliance management for the fund industry and Basel II operational risk management [21]. In this section we present the results of the application of this methodology on the 20000 IT service management norm. This section summarizes the method defined in [30] and [24] and applied in [22]. In all these domains, the approach is always to capture requirements associated with the QoS of BP to be put in place and to define the required level of performance capability needed from the service provider in their execution.

3.1 The ISO 15504 Assurance and Performance Framework Model

For structuring and organizing the business QoS requirements inherent to regulations and assurance norms, we have found and experimented a valuable requirements template and associated guidelines that are made available through the 15504 standard [12]. In this 15504 a generic requirements' taxonomy and a predefined requirements' structure define a framework used for eliciting and structuring QoS requirements as well as for assessing and measuring the compliance of deployed BP against these requirements. Analogously to standards such as COSO [10] and CMM [23], 15504 (previously known as SPICE) provides an assessment model against which the *assurance* aspects of an organization in terms of realization of its BP and their contribution to business services objectives can be defined and measured. Built on top of those predecessors, the main originality of 15504 "Process Assessment Model" (PAM) is to standardize the structure of assurance requirements by defining a taxonomy of generic BP assurance goals that are applicable to BP of business domains not limited to IT software engineering domain. Figure 2 presents the generic guidelines associated with the construction of a PAM. On the left part of figure 2, from the bottom to the top, one can read the business capability goal of the services at level 1, and then, from 2.1 to 5.2, the different level of assurance that can be associated to this business goal.

According to 15504, a Process Assessment Model (PAM) describes requirements on BP implementing QoS assurance attribute with the purpose and outcomes of each assurance attribute. The **purpose** of an assurance attribute "*describes at a high level its overall objectives*" [12]. Each purpose is fully decomposed into **outcomes**. Each outcome is an observable achievement of some assurance attribute. Actually, an outcome describes that an artifact is produced, or that a significant change of state occurred, or that some constraint has been met. Outcomes can be further detailed with **indicators** focusing on "*sources of objective evidence used to support a judgment about the fulfillment of outcomes*", for instance: work products ("*an artifact associated with the execution of a process*"), practices ("*activities that contributes to the purpose or outcomes of a process*"), or resources (e.g. "*human resources, tools, methods and infrastructure*") [12].

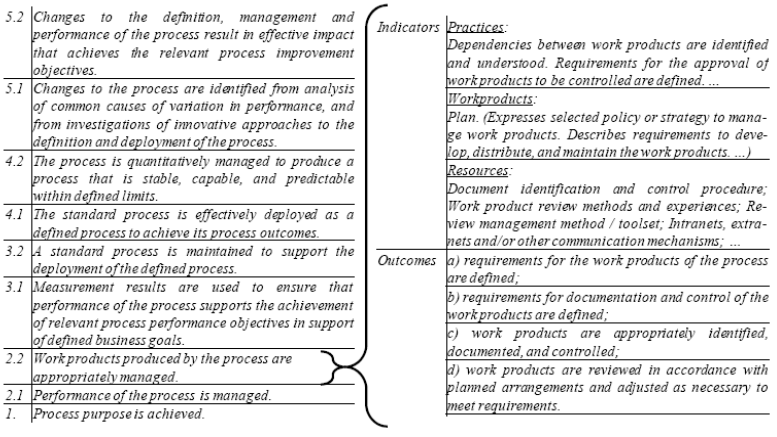

Fig. 2. GORE in support to Business/Software Services Alignment

Outcomes and indicators are organized into different aspects. The first aspect is related to the main activity while the other aspects are related to different assurance aspects associated with the activity. This results in a taxonomy of assurance requirements goals. The right part of Fig 2 lists the different aspects and details the objectives of the outcomes and indicators associated with the assurance aspect "2.2".

Service Level Management	**1**	**2.1**	**2.2**
Purpose	Service Level is defined and agreed with the service customer, and recorded and managed	…	The service level agreement is adequately managed
Outcomes	a) Service level is agreed on the basis of the customer needs and documented b) Service level is monitored according to the agreed SLA c) Service level are monitored and reported against targets		a) SLA is standardised b) SLA is reviewed internally
Indicators	Practices: Agree SL; Monitor SL; Report SL Work Products: SLA; SL Report		Practices: Standardise SLA Work Products: Standardised SLA

Fig. 3. Requirements associated with the Service Level Management QoS attribute

For ease of understanding, a concrete example (instantiation) is given in figure 3 with a fragment of the final result of our methodology applied to the 20000 IT Service Management document. The application of the methodology has resulted in the transformation of natural language flat requirements from the norm to structured requirements in a PAM. This work has been performed by a CRP Henri Tudor's team in the context of a New Work Item accepted in the Sub Committee 7 of the ISO/IEC JTC1 (Joint Technical Committee on Information Technology) dealing with Software and Systems Engineering. More details about this application can be found in [24]. The presented fragment illustrates a part of the requirements associated with one QoS related to "Service Level Management". In total 17 other QoS attributes have been characterized in terms

of their associated requirements. They include e.g.: Incident Management, Problem Management, Change Management, Information Security management.

3.2 Building Compliant 15504 Service Management Requirements Models

As explained in the preceding section, 15504 helps to better structure goal-based QoS requirements models with PAM. Difficulties arise when creating those PAM: 15504 does not provide any guidance in the incremental elaboration of a PAM. It provides generic concepts used in PAM and rules (meta-requirements) that must be satisfied by PAM, but gives no guidance to the identification of the business processes, nor the formalization of the knowledge domain which is needed for that. This guidance can be given by GORE techniques, such as *i** [13] which relies on a taxonomy of concepts close and compatible to those of 15504. The rules and heuristics that we have discovered regarding the use of *i** in support to the progressive and systematic elaboration of PAM are presented in [24]. They are summarized in the next paragraph in the context of the elaboration of the paraphrased result presented in figure 3.

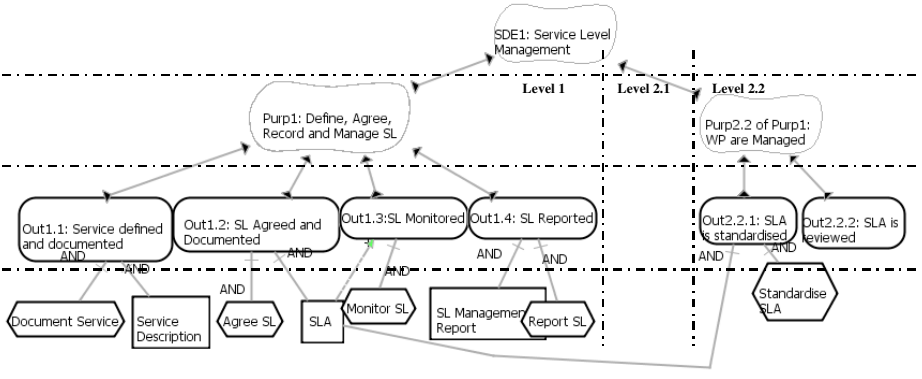

Fig. 4. Requirements Goal Tree Associated with the Service Level Management Attribute

Let us now review *i** concepts used in this model. Following [24], the QoS goals are expressed in terms of i* soft-goals and goals. The 15504 standard makes an explicit link between the purpose and the set of objectives to be fulfilled when executing BP that implement the service. So, as indicated in figure 4, purposes are modeled with a soft-goal and this soft-goal can be detailed by refining it into an equivalent collection of other soft-goals and/or goals associated with domain knowledge model. Because outcomes are objectively observable, they are modeled as goals (which can be further refined) and never with soft-goals. Indicators are added and modeled according their types, e.g. practices, work products and resources needed for the performance of the BP realizing the desired QoS. They are easily mapped into *i** concepts of task (for practices), *i** resources (for work products and resources) and actors (for resources).

To conclude, we would like to stress that our current contributions reported at the beginning of this section has convinced the ISO 15504 community that our GORE methodology was helpful in supporting the development of models compliant with ISO/IEC 15504. More details on this issue are reported in [30] and [24].

4 From Business to Software Services QoS Requirements

Our research centre is currently developing project management services dedicated to the network of SME partners, and aiming at defining and steering the projects the SME's partners of the Centre run. This system is a set of business services that support the management of projects where several partners are involved; it is realized by software components and human processes, that both cooperate to deliver the required business level objectives.

Step 1: value analysis. A value analysis, supported by e3-models, allowed us to identify that our research center could provide project management services to our SME network, and that we can therefore act as an actor in this network.

Step 2: business service identification. We identified our business services according to the normalized five successive phases of business collaboration of ISO Open EDI value-based model [25]: 1) planning, 2) identification, 3) negotiation, 4) actualization and 5) post-actualization. The business services required to support those phases are amongst others: "Define Proposal" in phase 1, "Steer Project" in phase 4, and "Negotiate Contract in phase 3". The business service "Define Proposal" allows a project manager to define and manage a project proposal involving multiple partners, including its review and acceptance.

Step 3: strategic dependency model. We adopted a goal-oriented technique to first identify the business level objectives of the business services. A strategic dependency model captures the relevant business services and their interactions with the business actors, as illustrated in figure 5. The objectives of the Project Owner (the SME) are supported by the objectives of the ProjectMgt Service Provider (our research centre), which is derived into three business services ("Define Proposal", "Steer Project", "Negotiate Contract"). The business services of Step 2 are therefore modeled by describing their objective in the strategic dependency diagram. The Project Partners (actor Partner) have a basic objective of participating to projects, which is not further detailed in this paper.

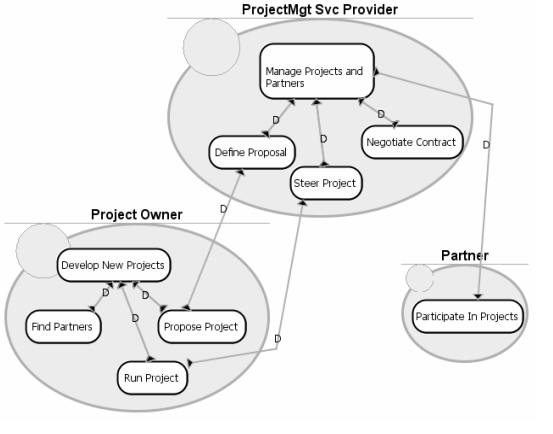

Fig. 5. Strategic Dependency Model – Context for Project Management Services

Step 4: refining with service catalog. Once identified and represented in their context, the business services objectives are refined by selecting and instantiating the appropriate requirements from the catalogue introduced in the previous section. In our case, regarding IT service management, and referring to figure 4, the collaboratively designed business service results in a goal tree, as illustrated in figure 6. In this excerpt of the model, level 1 of service level management has been selected, and instantiated to the "Define Proposal" business service. A specific service level requirement is shown in figure 6: the Turnaroud Time associated with the review and acceptance of the project proposal.

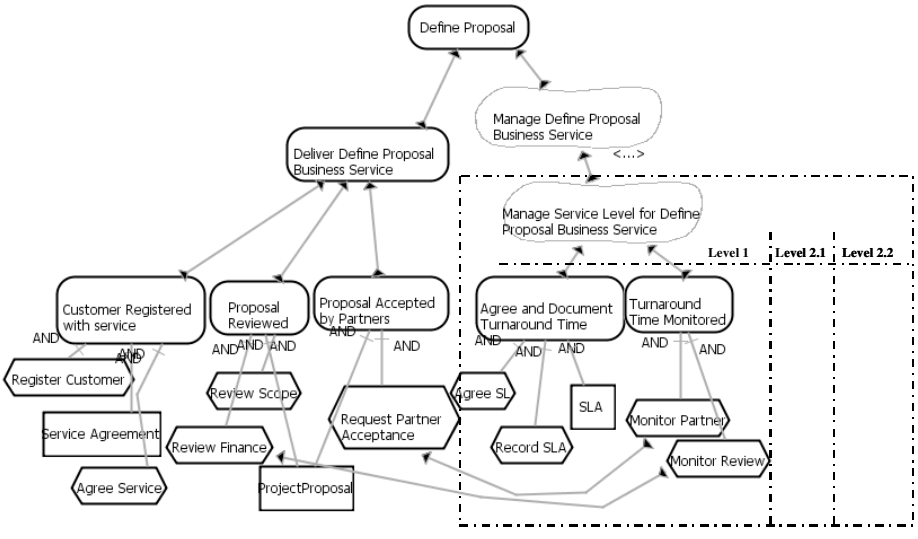

Fig. 6. Business Requirements on Business Service "Define Proposal"

Step 5: operationalization of core services. Once specified from the business perspective, the business level objectives of the services are operationalised by allocating human and technical resources to perform the required activities. The business processes supporting the required tasks and work products are modeled, integrating the service level management tasks. The requirements of the "Define Proposal" business service are supported by two BP deployed by the service provider: a BP is dedicated to the registration of the customer with the service, and implements the core tasks "Register Customer" and "Agree Service", but also the service level management tasks "Agree SLA" and "Record SLA"; a BP is dedicated to the actual service performance (and orchestrating the core business tasks). Figure 7 illustrates the BP model in a UML activity diagram.

Step 6: identification and modeling of software services. Although the business process "Register with Service" is not automated (the agreement on the service and on the required service level is still a human-based process), we decided to electronically record the SLA. The activity "Record SLA" of the business process becomes an automated task and requires the support of a software-based system. We come back to

the intentional model (the goal tree in figure 8 that specifies the business service) to design this system: the requirement "Record SLA" is realised by a software-based task "Store eSLA". This task, together with other related tasks ("Retrieve eSLA", "Version eSLA") are tasks of the new software service "Manage eSLA". Some business level requirements are not realized with business processes, like "Monitor Review" and "Monitor Partners". We indeed decided to implement them directly with the supporting information system. They therefore are transformed into a software level objective ("Monitor the System"), which is the root objective of the software service "Monitoring Service".

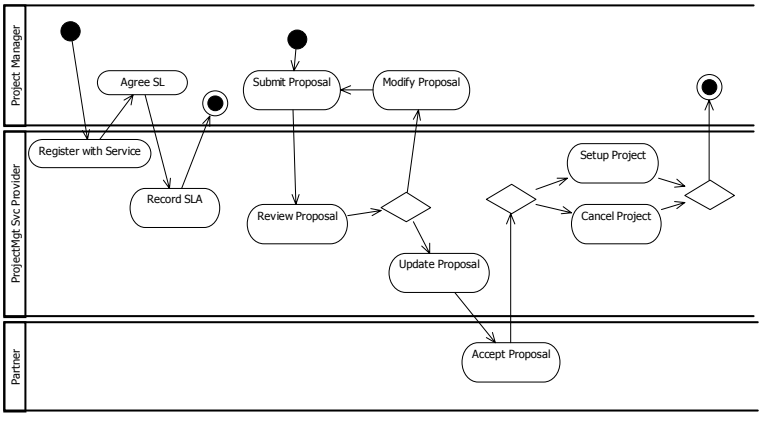

Fig. 7. Business Processes Supporting Business Service "Define Proposal"

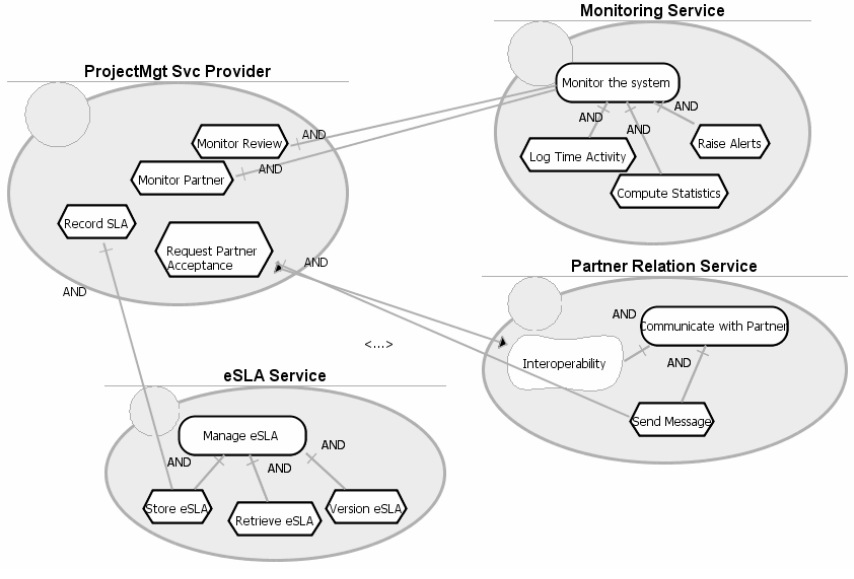

Fig. 8. Requirements for Software Services Supporting Business Level Requirements

Step 7: management of services. The introduction of the service management aspect as business level objectives introduces additional software services dedicated to the realization of the requirements associated with these business service management objectives. Figure 8 illustrates the requirements associated with these new software services, and shows an excerpt of the traceability we reach by using a goal-oriented modeling technique. The software services supporting the business level requirements are abstracted as new actors in the *i** model. We apply the same modeling steps that we used for modeling business service: the software service is modeled as a root goal (the objective of the service), which is refined into other soft goals, goals, tasks and resources. The software services are not only issued from the non-functional aspects (service management) associated with the business service. Figure 8 illustrates a software service identified from a functional requirement associated with the business service: "Request Partner Acceptance" justifies the introduction of a software service dedicated to the management of the partners ("Partner Relation Service"). The most prominent quality requirement associated with this service is interoperability, modeled as a soft goal of the software service.

5 Conclusion and Future Work

In this paper, we have reported on our framework related to the use of GORE techniques in the context of the management of QoS requirements expressed both at business and software levels. This framework applies to specific requirements whose are those inherent to norms, regulations and assurance domains. In these domains, information provided is often poorly structured and organized. In most cases, ambiguities, incompleteness, and even sometimes inconsistencies can be found in the available documents and sources of information. So, as it is claimed in e.g. [26, 27, 28], there is much sense to use requirements techniques (and GORE in particular) for the purpose of requirements clarification and formalization. With respect to these works, our work differs in its application to the characterization of e-services QoS as well as in the use of 15504, which allows us to organize requirements according to different capability levels that an organization may want to reach and expose to its customers. As illustrated in the presented case study, an organization can decide to adopt a service management of a level that can vary from 2 to 5. This variability issue is one that we need to further consider in the future. Analogously to [29], we need to consider variability associated goals graphs and requirements.

Another important issue considered in our approach is traceability. As explained and illustrated, a part of the QoS requirements at the software level can be systematically derived and traced to requirements identified at the business level. By establishing explicit traceability links between requirements at the two levels it is possible to demonstrate the compliance of software services with respect to regulations, norms and assurance recommendations. In a world where these compliance aspects are becoming crucial we feel that the proposed approach is a very first answer in the services domain. As part of our future work, like in [26] we intend to better formalize the traceability model underlying our framework in order to support a more effective deployment. We also intend to further refine our approach through the handling of new real business cases, which require this business/IT services alignment perspective.

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