Enhancing Service Lifecycle Management - Costing as Part of Service Descriptions

Completed Research Paper

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ABSTRACT

Outsourcing of IT and business processes results in an increased exchange of services. For inter-organizational service exchange to be successful, the participating network players have to establish unified and thus interoperable means of service description. An analysis of contemporary approaches identified a deficit of almost all approaches to address monetary aspects of a service, especially costs. This paper argues that costs are prevalent in almost all stages of a services' lifecycle, and thus its' role within Service Lifecycle Management (SLM) is paramount. Recognizing this discrepancy, the paper proposes a basic version of a costing model that allows for a multi-periodic depiction of service-related costs as part of a service description. It is modeled and implemented as an extension of USDL, the Unified Service Description Language. A case example from the financial services industry demonstrates the artifact's applicability.

Keywords (Required)

Service management, Service science, Service-oriented enterprises (SOE), Service-Oriented Architecture, Service description, Service costing

INTRODUCTION

The breakup of the financial value chain is a trend that follows the concepts of vertical disintegration and concentration on core competences (Berger et al. 2000). Inter-organizational service exchange relies on unified and interoperable service description (Currie and Parikh 2006). In general, service descriptions consist of functional and non-functional elements (Barros and Oberle 2012). While functional elements describe the functional behavior of a service, non-functional elements rather focus on attributes that enable, among others, strategic sourcing decisions by focusing on qualitative and quantitative (monetary) aspects. Especially service-related cost considerations are of importance along the whole service lifecycle. Figure 1 depicts the top level of a generic SLM process (Fischbach et al. 2013) and outlines exemplary activities that depend on structured and high-quality costing data. For instance, knowing the cost base as well as the cost structure is paramount for building cost-based pricing schemes, for taking sustainable make-or-buy decisions, budgeting, performance analyses, disposal decisions, joint service development efforts and many others.

An application example may be a newly developed customer-facing self-service portfolio management service as part of an online-banking system. For this, several business and technical services have to be considered as relevant components that may even be integrated from different partner companies. In order to be able to calculate business cases, quantitative feasibility and prices for end consumers, the costs of each service component need to be transparent and standardized, especially when several collaborating partners are involved in service exchanges.

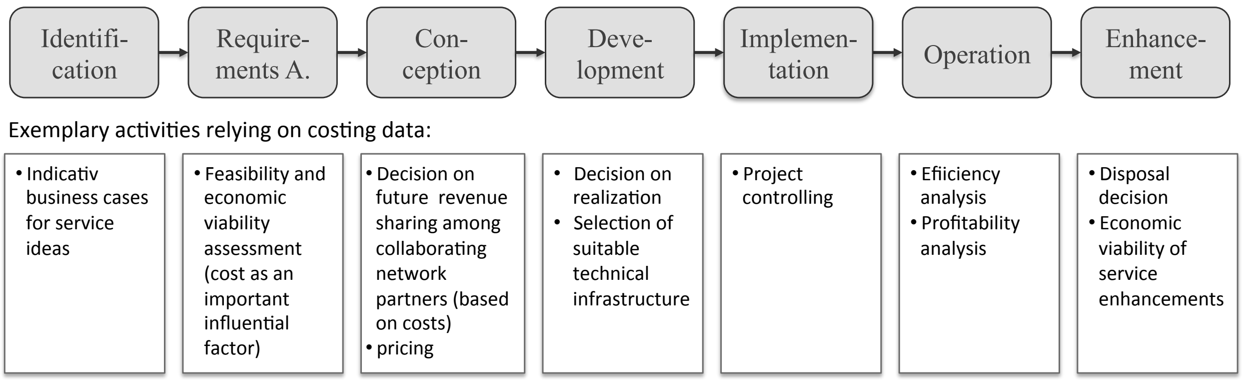

Figure 1: Generic SLM process and exemplary relevance of costs.

Despite the obvious importance of costing within SLM, an extensive analysis of current service description approaches revealed a prevalent shortcoming in this respect. Service descriptions constitute a common information base for SLM (Sailer 2005) and hence should also embody costing aspects. The research described in this paper elaborates on a model to incorporate cost considerations into the service description and thus to facilitate cost-based management tasks throughout the service lifecycle. The model is implemented as an extension of USDL – the Unified Service Description Language (Barros and Oberle 2012). The artifact provides benefits for both, research and practice:

- For *practitioners* it denotes the basis for (semi-)automated application of existing business concepts such as target pricing, zero base budgeting and performance analyses. This in turn enables more frequent and up-to-date analyses. Further, it fosters cost transparency within intra- and joint inter-organizational service development and operation efforts.
- For *researchers* it depicts a first approach to integrate costing-related aspects into a structured service description and constitutes the basis for further detailing and specialization.

Section 2 briefly sketches the research design. While section 3 defines services and elaborates on the research gap, section 4 introduces required basics of service costing and USDL. Building on these, section 5 presents the proposed costing model, an exemplary implementation and application. Finally, section 6 draws conclusions and states future research opportunities.

RESEARCH DESIGN

The research is part of the consortium research program Competence Center Sourcing in the Financial Industry at the universities of Leipzig, St. Gallen and Zurich. The basic principle of consortium research is the collaboration between academic institutions and companies, ensuring both an academic and a practice oriented view on the problems and as such it denotes elements of Action Research resp. Canonical Action Research (Baskerville et al. 2005; Davison et al. 2004). The applied consortium research method grounds on a process model for Design Science Research (Peffers et al. 2008) and the corresponding guidelines of (Hevner et al. 2004). The anticipated artifact is going to be a result of both, bilateral and multilateral arrangements. While individual, company-specific service description and costing approaches were gathered and discussed bilaterally, generalization, implementation and verification took place on a multilateral basis. The research process allows for multiple feedback loops and recurrent occurrences of each phase. Figure 2 depicts the undertaken activities in a subsequent manner and maps them to the consortium research phases “analysis”, “design”, “evaluation” and “diffusion” (Österle and Otto 2010). Thereby the figure shows the steps that already have been performed. The further research activities are planned to follow the same cycle.

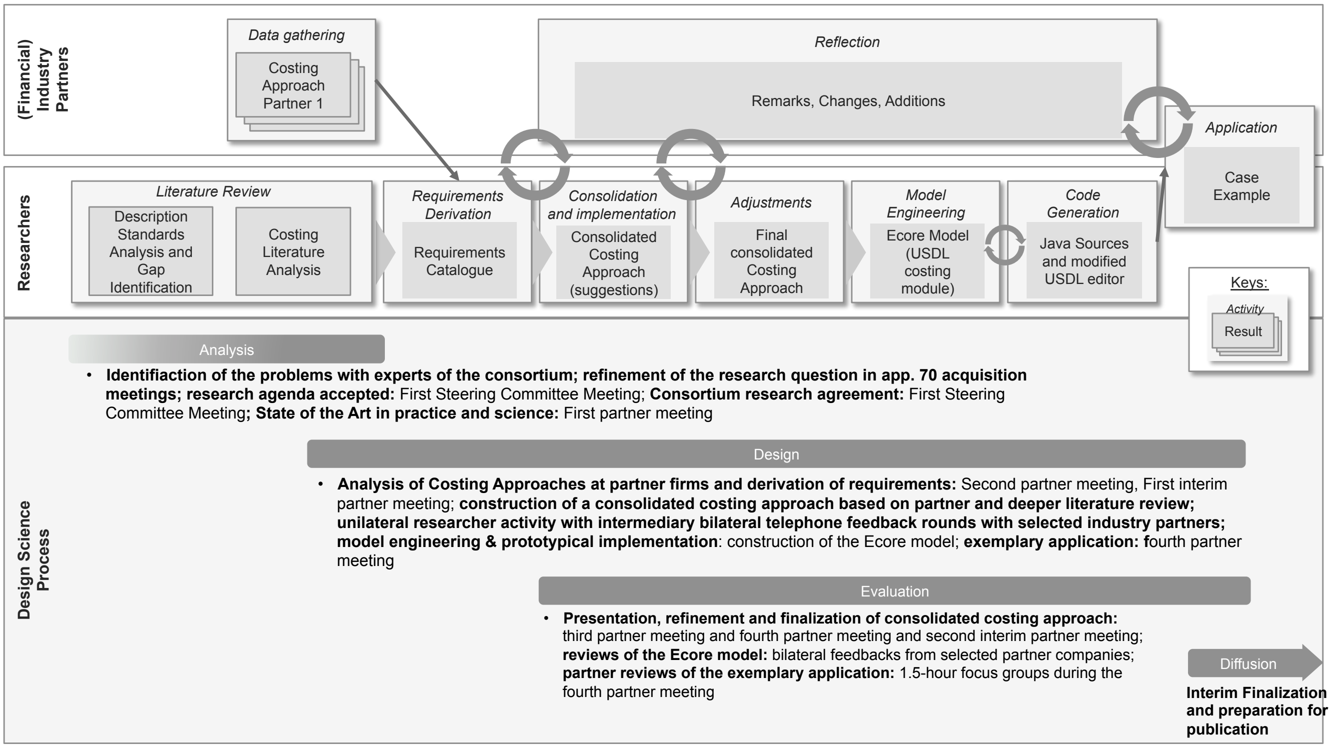

Figure 2: Instantiated research process. Please note that venues and dates are removed for the review process.

SERVICES AND SERVICE COSTING

SOA is "a paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains" (MacKenzie et al. 2006). These capabilities are encapsulated in services. Historically, the IS community regarded services as standardized software artifacts that are automatically exchanged between electronic agents (e.g. as webservices) (Erl 2007; Baida 2006; Lawler & Howell-Barber 2007). Accordingly, research efforts were technically oriented, focusing on issues regarding service implementation and technical discussions on service communication, for example. In recent years, a trend towards a more business-oriented understanding that regards services as "the outcome of a specific chunk of operations that is performed by an organization" (Sanz et al. 2007) is prevalent. A large academic body of knowledge is concerned with the identification of different types of service (Bardhan et al. 2010) and especially with the construction of service typologies that aim at aligning business- and technical service types (see e.g. (Erl 2007; Krafzig et al. 2007; Marks and Bell 2006; Rosen et al. 2008; Steen et al. 2005)). These efforts are owed to the fact that most service systems embody both, business- and technical services. For example, the processing of customer bank payments (obviously a business service) requires many fine-granular technical services.

The monetary factor is a non-functional element of a service and denotes a measure for the objective quality, which in turn can be accessed by objective financial metrics (e.g. currencies). The monetary factor comprises two elements, costs and revenues. Generally, two kinds of cost exist, depending on the perspective: the costs of a service provider and the costs of a service consumer. While the latter corresponds to the price and charging model set by the service provider as well as all additional costs that occur during service exchange (transactions costs) (Carr et al. 2009; Ellram et al. 2008; Gray 2008), the former indicates the amount a provider or a network of collaborating providers has to spent for service production and delivery. Cost calculation for a provider is a multi-faceted problem, as a service encapsulates a multitude of resources, including labor, circuits, equipment, software and others (Gerlach et al. 2002). Gerlach et al. identify three objectives a costing approach has to achieve: (i) costs and efforts (especially of IT resources in IT intensive environments) can be allocated to the cost objects in an objective manner, (ii) all costs are considered and (iii) the composition of the costs of a service is transparent and comprehensible. While the ability to satisfy these criteria depends on different aspects such as costing data granularity and costing data quality, the costing scheme this research presents cannot necessarily ensure a proper fulfillment on its own; it can and does, however, support the achievement of the objectives by providing a suitable structure. For instance, it should consider general characteristics of costs such as absoluteness or relativeness to support objective (ii). Further it should provide means to differentiate cost positions in order to support objective (iii). Objective (i) should be tackled mainly by means of proper organizational integration of the proposed approach, which constitutes a future research need.

SHORTCOMINGS OF CURRENT DESCRIPTION APPROACHES

Requirements regarding the description of a service vary widely between different service types, which becomes obvious when comparing syntactically highly structured webservice description files (e.g. WSDL artifacts) to high-level text description documents of large Business Process Outsourcing (BPO) services such as the transaction processing services offered by a financial provider, which requires many more degrees of freedom in its description. Therefore, this paper argues that the basic service description approach applied in an organization or a collaborative industry network should cover all types of service. An assessment of contemporary service description approaches shows that only few of them consider pricing-related concepts, while none of them concerns with costs. The decision to use USDL as a suitable approach for the integration of the costing model grounds on a two-step analysis of contemporary service description approaches:

Step 1, approach identification and filtering according to the following necessary prerequisites:

- *Non-industry-specificity*: this is to not restrict the application of the resulting artifact to one industry domain, but rather to be general in this respect
- *Type-independency*: given the argumentation before, the description approach needs to address different types of services rather than to be restricted to one type (e.g. WSDL only targets completely automated (web-)services)
- *Availability of implementations*: concrete implementations have to be available for the description approach, as the authors seek to provide a prototypically implemented solution in order to show its' applicability

Step 2, in-depth analysis: The filtered approaches are analyzed with respect to the coverage of qualitative and quantitative valuation aspects (costing and pricing). While some approaches address pricing issues, none of them is concerned with incorporating costing into a service's description. The analysis process yields two approaches, namely USDL and Serviguration (Baida et al. 2003). Finally, the authors chose USDL, as it can be regarded as a standard and be considered more complete and mature than Serviguration. Further, USDL is based on the Eclipse Modeling Framework, which allows for a more systematic extension than Serviguration. The analysis results are depicted in Table 2 in the appendix.

USDL AND EXTENSTION WITH SERVICE COSTING

On the Structure and Extensibility of USDL

USDL is a service description approach that aims at capturing the business and operational aspects of a service and combines them with the technical perspective (Cardoso et al. 2010). It is implemented using Ecore, a meta-model for describing models and their runtime support. Currently USDL consists of nine different modules, each addressing certain aspects of the service description, as e.g. pricing, legal, and functional[1]. The objective is to provide a comprehensive, standardized approach for the description of services in order to foster inter-organizational service exchange by enhancing searching, composition and integration of services (Kona et al. 2006).

Especially in an inter-organizational context, a sufficient description of services has to combine both construction and evaluation aspects that enable potential business partners to completely specify the object of transaction. Construction aspects mainly address service-design, -composition and -functionality issues (Lankhorst 2005; Tang et al. 2008). Evaluation aspects in turn address objective as well as subjective metrics upon a defined, accepted and traceable set of criteria (Bakalov and Nanji 2005; McIvor et al. 1997; Poppo and Zenger 1998). USDL has a broad coverage of the former, e.g. by providing description facilities for dependencies, functional attributes, technical interfaces etc. However, it offers only partial support for the latter: it does enable to describe arbitrary kinds of availability-, security- and other kinds of metrics; USDL also includes a pricing module to flexibly define pricing schemes; however, costing considerations are not yet part of it.

EXTENDING USDL WITH BASIC COSTING CAPABILITIES

Requirements

To construct the USDL costing module, a requirements-based approach is chosen. During the consortium research process the industry partners expressed several basic requirements that serve as the basis for costing model derivation:

[1] As a comprehensive entry point, the reader should refer to the respective specification documents, see (Barros et al. 2011) as an entry point.

1. *Multi-periodicity*: consideration of multiple time periods
2. *Multiple cost positions*: capturing of an arbitrary number of different cost positions
3. *Linkage between cost position and service constituent*: a cost position clearly denotes the associated service constituent it relates to
4. *Costing scheme characterization*: incorporating means to depict various attributes of the costing scheme, namely: fix/variable, direct/indirect, unit (unless absolute), internal/external origin, cost-driver tagging, absolute amount, additional remarks
5. *Simulation*: providing the data basis for basic cost simulations
6. *Multiple cost schemes*: possibility to define multiple costing schemes for one service
7. *Means to specify the applied costing scheme* (e.g. activity based costing)
8. *Possibility to specify the currency*
9. *Service level specificity:* Mapping a costing scheme only to certain service levels, if desired.

Based on these requirements, a first Excel-based costing sheet "prototype" has been built. The reason why the authors did not choose to directly construct the Ecore model is twofold: first, all industry partners are familiar with MS Excel and thus were able to directly alter and apply the costing sheet, which improved feedback quality. And second, feedback-based changes in the underlying logic could much faster be realized in excel compared to Ecore/Java. Figure 3 depicts the resulting excel-based costing sheet and indicates where the requirements influenced design. For illustration purposes the costing sheet incorporates some cost positions from a simplified payments processing service. Further it shows the mapping between the costing sheet contents and the USDL costing model, which is presented in the next section.

The Costing Model

The proposed costing model comprises basic concepts to express costing schemes (e.g. the one in Figure 3) within a USDL service description. The costing module specifically refers to (or is referred by) five concepts from USDL, three of which are from the Foundation and two from the Service module[2]:

- the *Resource* concept is meant to represent classes of real-world objects such as applications and tools. The concept is re-used in the costing context to identify the resources the specific cost time series originates from.
- *Description* provides means to describe arbitrary concepts in the USDL world by means of free text. The concept is used heavily throughout the costing module to provide descriptions.
- *StartToEndInterval* allows specifying time-zone aware time intervals, which is especially useful to denote the different time periods in a costing scheme.
- The referred concepts from the Service module, i.e. *NetworkProvisionedEntity* and *ServiceVariant* are necessary to integrate the costing module with the other USDL modules. Expressed in an object-oriented way, these referrals ensure the integration of the costing scheme objects into the remaining object graph and thus into the service description as a whole: a *NetworkProvisionedEntity* is the central concept of USDL and the main entry point into the model. It represents all entities exchanged within a value creation network. This concept is an abstract super class for the concrete classes *Service* and *ServiceBundle*. The authors of this paper included a reference from the *NetworkProvisionedEntity* concept to the concept *CostingScheme* (in the costing module) in order to integrate the costing module into USDL. Optionally, a costing scheme can refer to a certain *ServiceVariant* (requirement 9).

After having specified the main integration points with USDL, the presentation of the costing model follows.

CostingScheme: The main artifact and entry point is the concept *CostingScheme*. A *CostingScheme* encapsulates all cost-related information. Exactly one *NetworkProvisionedEntity*, e.g. a service, refers it, as it is unique to such. A *NetworkProvisionedEntity* can refer to an arbitrary number of *CostingSchemes*, which allows to depict multiple costing approaches or different costing scenarios. In cases where more than one variant exists for a given service, the corresponding variant optionally can be linked against the *CostingScheme*. Direct attributes of a *CostingScheme* comprise the *currency* and the *costingMethod*. The former denotes the currency the scheme assumes; the latter indicates the applied costing method, such as "Activity Based Costing". A *CostingScheme* relates to one or more *TimePeriod*s. Additionally it can define *SimulationParameter*s, a concept discussed in a moment. *CostingScheme*s are identified by their name and further described by means of a description attribute. *CostingScheme*s can differ in several respects. For example, they could target different

[2] Subsequently, properties are styled as follows: (direct) attributes are styled „*attribute*", while (relationships to other) concepts are styled „*Concept*".

phases of a service's lifecycle (e.g. development vs. operation cost planning). Further, schemes might relate to different time frames and either capture actual or planned cost data.

AbsoluteCostTimeSeries** and **RelativeCostTimeSeries: Each *CostingScheme* contains an arbitrary number (>0) of *CostTimeSeries (CTS)*. A *CTS* contains all general and period-related information about a specific cost position. An exemplary cost position is the maintenance of the hardware infrastructure for a bank's payments processing service. A *CTS* contains the respective cost elements for each of the scheme's covered time periods, along with additional information:

- a *CTS* usually relates to one or more resources that cause the costs, represented by the USDL *Resource* concept. In order to provide further description and naming facilities for the entirety of related resources, these are encapsulated in a concept called *AssociatedResource*. Besides the related resources, this concept contains a name and description of the "resource bundle".
- a *CTS* can either be *internal* or *external* (in inter-organizational settings the internal flag denotes whether a service constituent is provided by one of the collaborating companies or sourced from external companies) and *fixed* or *variable*, both represented as Boolean attributes.
- tagging a *CTS* as a *costDriver* indicates a prioritized treatment within simulation activities.

The *CTS* is an abstract concept, the costing module distinguishes two concrete subtypes, *AbsoluteCostTimeSeries* and *RelativeCostTimeSeries*. The former contains *AbsoluteCostElement*s, while the latter contains *RelativeCostElement*s. Additionally, the former specifies the respective *unit* of measurement, e.g. "FTE", "transaction" or "piece", while the latter always is percentual.

AbsoluteCostElement *(ACE)* and ***RelativeCostElement*** *(RCE)*: *CostElement*s are part of exactly one *CTS* and relate to exactly one *TimePeriod* in the *CostingScheme*. An *ACE* specifies costs by providing a quantity and a *unitCost*. For instance, a cost element might specify that the maintenance cost of hardware infrastructure for a scanning service is planned to amount to USD 80'000 in June 2013, given a planned scanning quantity of 5mn.

Two types of quantity subsist: an *internalQuantity* is directly typed in, whereas an *externalQuantity* is a reference of type *SimulationParameter* – a centrally maintained quantity that can be re-used by multiple *AbsoluteCostTimeSeries*, e.g. "Prospected Sales Quantity 2013: 23'000". This kind of central quantity maintenance makes it easier to perform simulations such as adverse market movements. For example, the estimated quantity of the aforementioned scanning service might depend on the prospected quantity of payments transactions during that period. In contrast, an *RCE* only specifies a percentage and a relation to a cost element ("*onCostElement*"). Thus, an *RCE* represents a cost amount that is determined by taking a certain *percentage* rate from an arbitrary *CostElement* within the *CostingScheme*.

Figure 3 shows the complete costing model as well as the referenced resp. referencing USDL concepts. As becomes obvious, currently we do not incorporate a direct link between the USDL pricing module and the proposed costing module. One might argue in favor of such a link, as pricing decisions frequently depend on costs. Consequently, while an integrating would certainly yield benefits in this respect, an integration would require substantial further research efforts. According to the authors' current opinion, it is hard to generalize this relationship, due to the existence of different pricing techniques, each of which treats costs in a distinct way. Table 1 provides a linking between the model's concepts and the addressed requirements.

Concept	Addressed Requirement
CostingScheme	6,7,8
AssociatedResource	3
TimePeriod	1
CostTimeSeries	1,2,3,4.1,4.2,4.3,4.4,4.5,4.8,9
CostElement	4.6,4.7,4.8,5
SimulationParameter	5
Unit	4.3

Table 1: Mapping between model concepts and requirements.

Exemplary Application

The following example depicts a service that offers domestic payments processing between a sender and a receiver, i.e. the transfer of electronic money between the two parties. A multitude of process steps are involved, ranging from authorizations over payments slip scanning, interbank processing (e.g. SIC in Switzerland) to the printing and shipment of customer receipts. Depending on the business model, the steps are performed by a bank itself or by an external provider (e.g. Entris Banking (now Swisscom) in Switzerland, BankTec in the U.S. or Equens in Germany). For simplicity, the example assumes that the only resources this service needs are permanent and hourly-based employees, workplaces, a building, the interbank processing and some product management efforts. Permanent personnel are measured in fulltime employees (FTEs), whereas hourly-based personnel are measured in hours. While the former need a workplace, the latter work in shifts and thus have shared workplaces. The building is leased from an external company, with a yearly re-negotiation of the lease agreement. The interbank processing is performed by an external provider and billed on a per-transaction basis. Finally, product management is an internal activity provided by another division and charged as a percentage on the fixed personnel cost. Figure 4 depicts the example in a spreadsheet and maps its constituents to the corresponding concepts from the costing scheme. The costing extension has been modeled in Ecore and implemented as an extension of the freely available USDL editor. The prototype was presented, discussed and validated at a Focus Group meeting (see Figure 2).

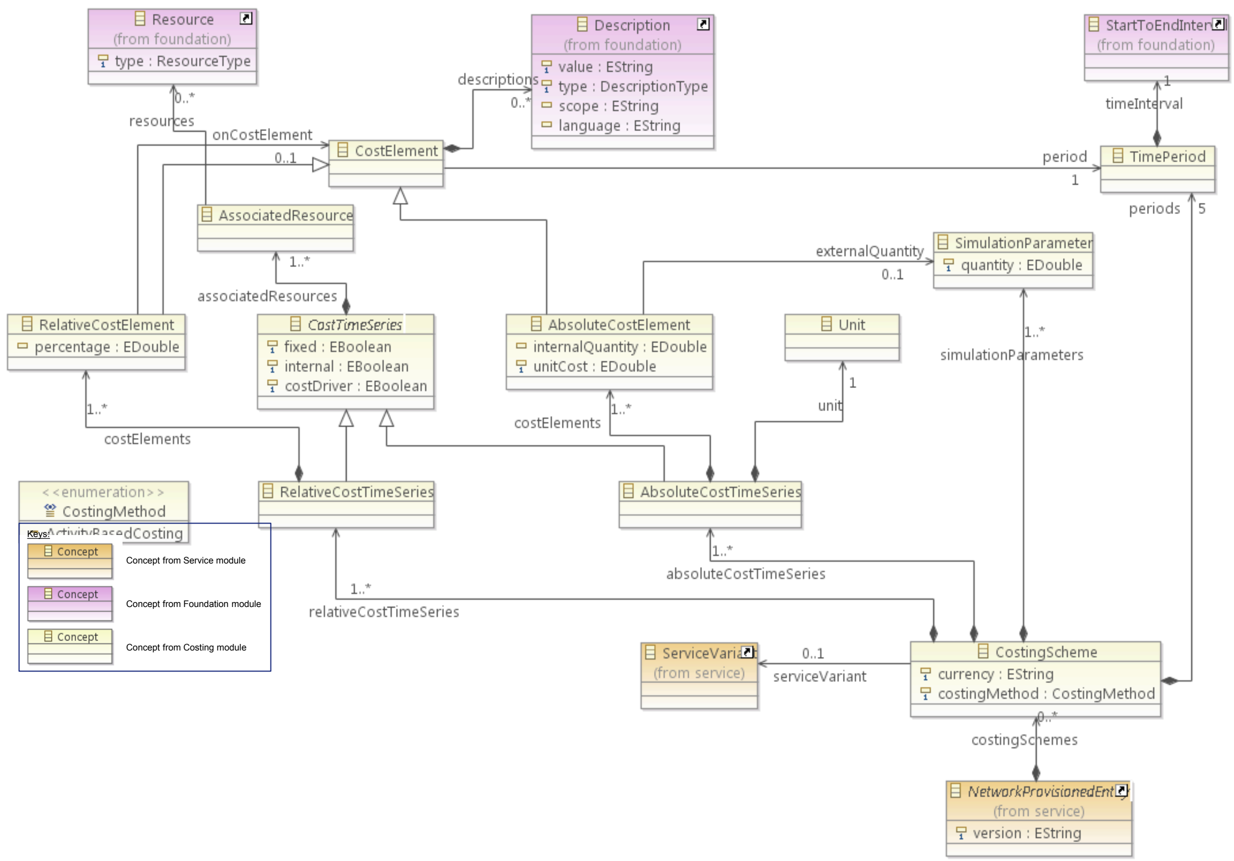

Figure 3: Proposed costing model and integration with USDL.

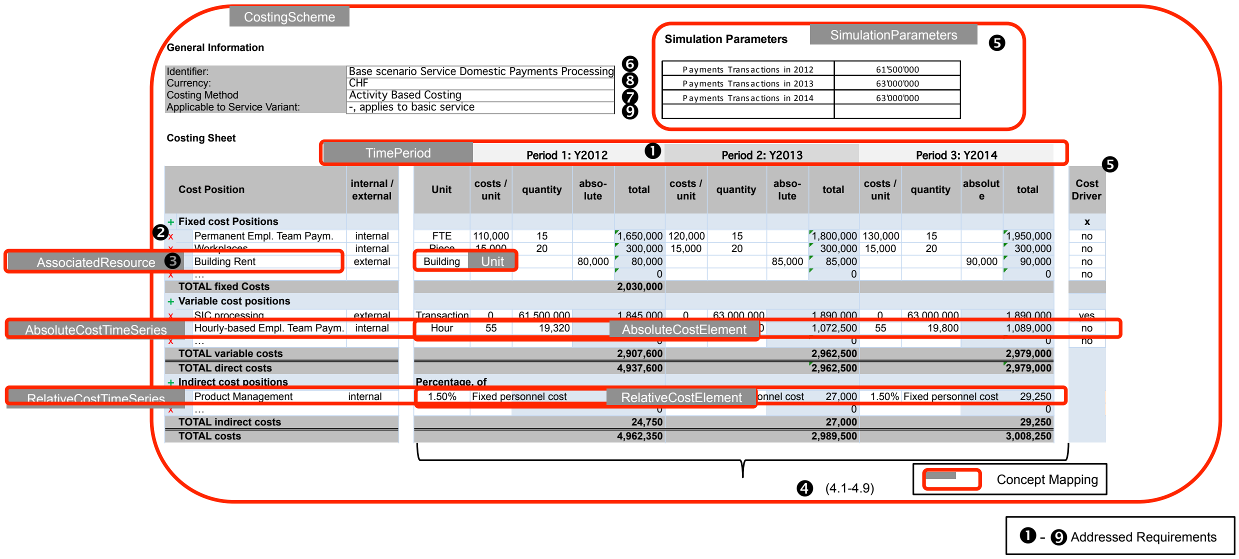

Figure 4: Application to the payments processing example and requirements mapping.

CONCLUSION AND FUTURE RESEARCH STEPS

Networked business processes become a major critical success factor for companies. SOA as "a paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains" (MacKenzie et al. 2006) is intensely discussed as the solution for organizing distributed IT resources. With a growing maturity and diffusion of the concept, companies are faced with managing services along their whole lifecycle. As we showed, many related activities and decisions throughout the lifecycle require structured and consistent cost-related input. A prerequisite for this are service description standards that enable interoperability and include costing aspects as part of a service's description. An analysis of contemporary approaches revealed a clear shortage in this respect. This paper focuses on the development of a costing model and its implementation as part of the service description standard USDL.

The costing model provides organizations with a common data model to capture and exchange the costs associated with a service along its lifecycle and to attach the information to the service's description. For example, a costing scheme might focus on run-time costing, while another scheme focuses on the planned development costs of a new service. A vast number of potential application scenarios can take advantage of the costing module, including, but not limited to, business cases or different cost scenario simulations. It is the basis for the (semi-)automated application of existing business concepts such as target pricing and performance analyses. For researchers, it comprises the first comprehensive approach to integrate costing-related aspects into a standardized service description approach.

The model is able to depict sophisticated cost structures including interdependencies between different cost elements (e.g. over a time series) and it accounts for individual cost situations of a service's different service levels. Therefore, it provides (collaborating) companies a standardized common instrument for structured cost planning and analysis. Due to strict adherence to consortium research guidelines, the artifact has been evaluated, refined and subsequently accepted by researchers and practitioners. Nevertheless, future research needs to aim in two directions.

Direction 1, model generalization:

- *Application to other industries and further cases*: the costing model is the generalized result from an analysis of current practices in multiple financial institutions. Further cases from other industries would ensure its general applicability.
- *Application within other description approaches*: a transfer of the model to other service description approaches is the next step of generalization.

Direction 2, model refinement/extension:

- *Multiple dependencies between cost elements*: Some costs might depend on a combined measure of other costs. This is currently supported by manual entry. Especially with regard to scenario simulations the direct incorporation of this knowledge would be useful.

APPENDIX

Approach	Industry Un-Specificity	Type-Independency	Implementations available	Standard	Concepts for qualitative valuation	Concepts for quantitative valuation (Pricing)	Concepts for quantitative valuation (Costing)
USDL: Unified Service Description Language	●	●	●	●	●	●	○
Serviguration	●	●	●	○	●	●	○
SML: Service Modeling Language	●	●	○	◑	○	○	○
SNN: Service Network Notation	●	●	○	○	●	●	○
Alter	●	●	○	○	○	○	○
O'Sullivan	●	●	○	○	●	●	○
SoaML: Service Oriented Architecture Modeling Language	●	○	●	●	●	○	○
UDDI: Universal Description, Discovery and Integration	●	○	●	●	●	●	○
WSDL: Web Services Description Language (incl. extensions)	●	○	●	●	●	●	○
OWL-S: Web Ontology Language for Services	●	○	●	◑	○	○	○
SA-REST: Semantic Annotation of Web Resources	●	○	●	◑	○	○	○
SAWSDL: Semantic Annotations to Web Services Description Language	●	○	●	◑	○	○	○
WADL: Web application description language	●	○	●	◑	○	○	○
MicroWSMO	●	○	●	◑	○	○	○
RESTful Web Services	●	○	●	○	●	○	○
IRS-III: Internet Reasoning Service III	●	○	●	○	○	○	○
MSM: Minimal Service Model	●	○	●	○	○	○	○
SEMF: Service Evolution Management Framework	●	○	●	○	○	○	○
e3Service-Ontology	●	○	●	●	○	○	○
SaaS-DL: Software as a Service Description Language	●	○	●	○	○	○	○
SWSF: Semantic Web Services Framework (including FLOWS, SWSL,	●	○	●	◑	●	○	○

SWSO)							
WSML: Web Services Modeling Language and WSMO: Web Services Modeling Ontology (normal & lite)	●	○	●	◑	●	○	○
Service Design Model	●	○	●	○	●	●	○
e3Value-Ontology	●	○	●	●	●	●	○
SOA-RM: Reference Model for Service Oriented Architecture (OASIS)	●	○	○	●	○	○	○
RO-SOA: Reference Ontology for Semantic Service Oriented Architecture	●	○	○	◑	●	○	○
FpML: Financial Products Mark-Up Language	○	○	●	◑	●	●	○
MDDL: Market Data Definition Language	○	○	●	◑	●	●	○

Table 2: Service-Related Approaches Analysis Results.

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