

Incorporating Business Impact into Service Offers – A Procedure to Select Cost-Optimal Service Contracts

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ABSTRACT

In this work we address an IT service customer's challenge of selecting the cost-optimal service among different offers by external providers. We model the customer's optimization problem by considering the potential negative monetary impact of different combinations of sequential service incidents on a customer business process – reflected via “business cost”. First, we describe which information a customer typically bases service level agreement decisions upon and analyze which additional information is needed to take a well-founded decision. Second, we define a set of constructs that supports customers and providers when selecting or defining service offers, which address the required service criticality. Third, we develop a procedure enabling customers to solve their optimization problem – given different service offers by risk-neutral providers – using a procurement auction. Introducing this approach, we suggest that customers and providers collaborate to define “business cost measures”, which allow providers to better tailor service offers to customers' business requirements.

Keywords

Service Level Management, Service Level Agreement, Service Level Engineering, Adverse Business Impact, Service Incident, Procurement Auction.

INTRODUCTION

Today, service customers often struggle to identify the cost-optimal **service level agreement (SLA)** for services they purchase from external service providers. Customers aim to determine the service quality levels at which the sum of the monetarily quantified negative business impact and the price at which an SLA is offered reaches its minimum.

In order to identify the cost-optimal SLA, customers have to assess diverse offers by providers, which usually state different service qualities and prices. Therefore, for customers it is difficult to find the efficient trade-off between service price and service quality, as important information about services' adverse business impact is often not available or not sufficiently considered. In contrast, IT providers focus on reaching compliance with technical service levels since they have only little knowledge about a customer's internal processes (Unterharnscheidt and Kieninger, 2010).

In this work, following a design science approach (e.g. Hevner et al., 2004), we address the service customer's challenge of selecting the cost-optimal service offer for a specific end-to-end service (business need). Hereto, we model the customer's optimization problem by considering the potential negative monetary impact of different service quality levels on a customer business process – measured in terms of business cost. First, we analyze which information SLA decisions are typically based upon and elaborate on the question which additional information a rational customer would need to take a well-founded investment decision. Second, we derive a set of constructs (artifact) that supports customers and providers when selecting or defining service offers. Third, based on these constructs, we develop a procedure (artifact) enabling customers to solve their optimization problem – given different service offers by risk-neutral providers – using a procurement auction (method).

Chapter 2 elaborates on literature related to our work. The base scenario addressed is introduced in Chapter 3. Chapter 4 analyzes the negative impact of single service incidents on the performance of a customer business process. Afterwards, the customer's optimization problem is described in detail (Chapter 5). Then, a service procurement auction approach enabling the customer to select the cost-optimal solution is developed (Chapter 6). Finally, Chapter 7 summarizes and discusses our approach and outlines next steps towards the incorporation of adverse business impact into service offers.

RELATED WORK

Focusing on the research field of IT (outsourcing) we identified six papers related to our approach aiming to support the consideration of adverse business impact in service offers. None of these works, however, covers all requirements and characteristics of our scenario and approach, namely: (i) We monetarily measure the negative business impact of service offers (ii) by quantifying the incurred business cost resulting from the occurrence of combinations of service incidents (iii) explicitly considering non-constant marginal business cost functions (iv) in a setting with providers having private information they do not want to disclose.

Jin et al. (2002) present a modeling and simulation approach to support composite service modeling and SLA analysis in a web service domain. Business impact is considered by measuring the sensitivity of a business process regarding changes in service level objectives. Sauvé et al. (2005) develop an approach to derive optimal service level objectives from a business perspective. In their model business impact is measured in terms of financial loss generated by an adverse impact on business due to an imperfect IT infrastructure. Optimal SLOs are derived by minimizing the sum of IT infrastructure cost and business financial loss. Cheng et al. (2005) develop a framework for modeling, assessing and quantifying operational risk in business processes. The authors develop a business process model capturing the human, physical and logical infrastructure as well as the risk contained therein. They manage to automatically translate changes in the business process model into changes of the operational risk model. The authors, however, assume customer and provider to have complete information about each others' business operations, cost functions and risks. Barroero et al. (2010) conduct a case study on an IT outsourcing project aiming at the alignment of business performance and IT service performance. Based on the study the authors introduce a conceptual service level management approach correlating the customer business performance with the service levels of the provided IT service. Franke (2012) analyzes the composition of optimal IT service availability by developing a framework to derive cost-optimal outage lengths for a service using simulation. He argues that availability shall not be seen as a mere percentage but that the number of outages, their duration and the variance of outage cost matter when managing service availability. In contrast to our work, Franke does not describe concepts and means to incorporate adverse business impact into service offers. In Kieninger et al. (2012) we discuss the customer's optimization problem to select the cost-optimal SLA having concluded a long-term outsourcing contract with a *single* external provider. We propose a methodology to solve the optimization problem in a scenario *without* penalties.

BASE SCENARIO

In our scenario, a customer company wants to purchase an end-to-end IT service from an external service provider to support a particular business process. This non-mission-critical yet non-commodity service directly affects the customer's business performance, i.e. it contributes measurably to the business value created. Competing providers are able to offer the particular service with different SLAs, i.e. at different service levels and different prices. We assume that all functional and non-functional properties (including base sizing) of the service, except for quality and price, have already been documented in a "request for proposal" (RfP). For this purpose, requirements of the business process to be supported have been considered. The RfP also states a fixed delivery duration, which may be split into a number of reference periods.

To define service quality the customer has specified a set of service level indicators, and associated target values (service level objectives). An SLA is represented by a tuple of **service level objectives (SLOs)** and a service price, which the customer will have to pay to the selected provider on a periodic basis for service provisioning. In the RfP, the customer has also defined penalty functions for each service level indicator that specify the amount of money a provider will have to pay in case of service level breaches. Furthermore, the RfP grants the customer the right to constantly access the monitoring information that the provider collects.

To compare service providers' offers, we assume the customer to monetarily quantify the potential negative impact of imperfect service (at specific service levels) on the business process. Using these "business cost" estimates, the service price and penalty payments the customer can assess the financial implications resulting from the selection of a specific SLA.

Table 1 illustrates the customer's choice of options (SLAs A, B, ... offered by different providers) with the respective tuples of SLOs, and service prices for a single reference period. The column "penalty payments" contains the customer's estimates regarding fines it expects to charge due to future service level breaches by a provider. The customer calculates the **adjusted business cost** for a specific offer by subtracting the expected penalty payments from the business cost (e.g. $c_A + (-\pi_A)$), since penalty payments reduce the business cost the customer has to suffer.

Service Level Agreement customer's option	Service Price	Tuple of SLOs	Adjusted Business Cost Business Cost less Penalty Payments	
			Business Cost quantified neg. business impact	Penalty Payments
A	SP_A	(x_A, y_A, \dots)	c_A	$-\pi_A$
B	SP_B	(x_B, y_B, \dots)	c_B	$-\pi_B$
...

Table 1. The customer has to select an SLA based on information about service price and adjusted business cost.

We assume that the rational customer in our setting aims to identify the cost-optimal service offer minimizing the sum of adjusted business cost and service price, i.e. to minimize **total customer cost** (see e.g. Figure 1).

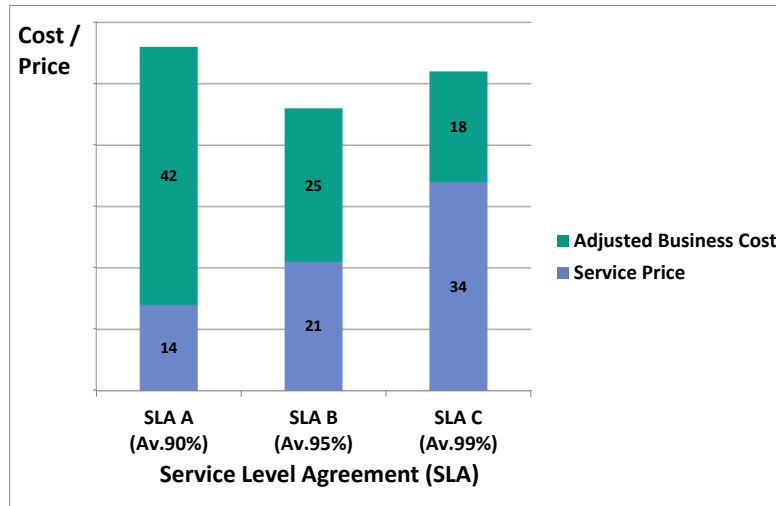


Figure 1. The cost-optimal SLA minimizes total customer cost.

We further assume that experts of the customer's business department (i.e. process stakeholders) are able to make an estimate of the negative impact an SLA s would have on the customer business process and, thus, to assess the resulting adjusted business cost. We will further discuss and position this assumption in the course of our work.

The customer's optimization problem can be described as follows:

$$SLA_{opt} := \arg \min_{s \in SLA} ((c_s + (-\pi_s)) + SP_s) \quad (1)$$

Since customer and provider have agreed on a fixed delivery duration, capital budgeting approaches, such as the net present value method, can be applied to discount cash flows (i.e. total customer cost) of several future reference periods. This allows the comparison of SLAs which state service prices and business cost changing over time, i.e. varying in different reference periods. For reasons of clarity, however, we will focus on a single reference period only in the following.

THE ADVERSE BUSINESS IMPACT OF SERVICE INCIDENTS

Using established service level indicators the customer has no information about the specific probabilities of a service to achieve, to under- or even outperform the stipulated SLOs to certain degrees. Consequently, the customer is not able to precisely determine the adjusted business cost resulting from the selection of an SLA.

Adverse business impact, resulting in business cost, is caused by single **service incidents (SIs)**, i.e. by “unplanned interruptions” to a service or “reductions in the quality” of a service, which are observable from a business point of view (adapted from the definition of an “incident” in OGC (2007, p.254)). Therefore, in order to quantify business cost, it is essential for the customer to understand due to which combinations of single service incidents a specific service performance is achieved and how single service incidents impact business performance differently.

In the following, we will introduce a number of constructs and describe interdependencies between these before we model the customer's optimization problem in more detail.

Service incidents sharing the same set of (one or more) attributes are grouped into the same service incident class (e.g. outage incidents, reduced throughput incidents, etc.). Elements of the same **service incident class (SIC)** affect the performance of a customer business process in a similar manner, but may differ in their attribute values (e.g. in the duration of outage (outage incident) or the degree of throughput reduction (reduced throughput incident)). We will denote a tuple of attribute values of a single service incident as its **service incident level (SIL)**.

To distinguish between stipulated SLOs and the actual future service performance, we call service levels which a provider actually realizes within a reference period **actual service levels (ASLs)**. The ASL of a service regarding one specific service level indicator is usually calculated considering all service incidents belonging to this particular indicator. The attribute values of all service incidents this indicator is based on are aggregated into a single value (the ASL) using an appropriate calculation formula. It is important to note that an achieved ASL may be realized through different **combinations of sequential service incidents (CoSI)**.

Depending on its service incident level (SIL), each single service incident induces specific business cost, which are added up to the business cost of a particular combination. Therefore, the **business cost** induced by different CoSIs may differ. We use business cost functions to describe the business cost caused by single service incidents (depending on service incident levels (SILs) of a service incident class (SIC)).

An example: A logistics company *C* runs a high-bay warehouse with a management system that is operated and managed by the provider *P* as a service. For this warehouse management system the customer has defined a service level indicator "availability", which is calculated considering all service incidents of the class "outage incidents". This service incident class is characterized by the single attribute "outage duration", which can take the attribute values 1, 2 and 3. Since the class has one attribute only, the service incident level (SIL) just depends on the value of this attribute.

The warehouse management system is used to locate goods in the high-bay warehouse that have to be taken out of stock and shipped by truck. Per minute, one truck arrives at the warehouse in order to be loaded. For each minute a truck has to wait to be loaded *C* will incur business cost of € 5. Table 2 shows how the aggregated business cost that *C* incurs increases with longer outage durations.

Outage duration in minutes (SIL / attribute value)	Business Cost per truck waiting			Business Cost of an outage incident (aggregated)	Marginal Business Cost of time (business cost of one more minute of outage)
	truck # 1	truck # 2	truck # 3		
1	5	–	–	5	10
2	10	5	–	15	15
3	15	10	5	30	20

Table 2. Business cost and marginal business cost both increase with longer outage durations.

The column "business cost of an outage incident" defines the customer's business cost function for service incidents (SIs) having an outage duration of one, two or three minutes. We recognize that the increase in business cost which *C* incurs if an outage lasts one minute longer (as it already does) is also increasing in our example. The business cost increase by € 10 if an outage takes two minutes instead of one minute and by € 15 if an outage takes three instead of two minutes. The marginal business cost that *C* incurs increases with longer outage durations (see column "marginal business cost of time" in Table 2).

We refer to functions that define such differences in business cost (e.g. increases) as **marginal business cost functions**. These functions describe the cost a customer incurs if a single attribute value (out of a service incident's set of attributes) changes (e.g. is increased by one minute). We use this expression to point out the analogy with the concept of "marginal cost curves" in the micro-economic theory of production, which "measure the change in costs for a given change in output" (Varian, 2010, p.380).

We argue that in case of non-constant marginal business cost functions, the customer has to consider the CoSIs an ASL is realized through, since different CoSIs will usually lead to different business cost. Consequently, those service level indicators, which aggregate incident attribute values instead of their monetarily quantified negative business impact, are not sufficient to compare different service offers regarding the total customer cost these induce.

CONSIDERING MARGINAL BUSINESS COST IN THE CUSTOMER’S OPTIMIZATION PROBLEM

Referring to one service incident class and one reference period only, we can now more accurately describe the optimization problem of the customer (as shown in Table 3). By estimating the probabilities of different combinations of sequential service incidents (CoSIs) to occur – and of different ASLs respectively – the customer could calculate an estimate of the business cost that would be induced by a specific SLA offered.

SLA customer’s option	SLO target value X	Service Price	Probabilities for a CoSI to be realized customer’s estimate								
			...	CoSI _{i,1} resulting in ASL _i	...	CoSI _{i,v} resulting in ASL _i	...	CoSI _{j,1} resulting in ASL _j	...	CoSI _{j,w} resulting in ASL _j	...
A	x _A	SP _A	...	p _A (CoSI _{i,1})	...	p _A (CoSI _{i,v})	...	p _A (CoSI _{j,1})	...	p _A (CoSI _{j,w})	...
B	x _B	SP _B	...	p _B (CoSI _{i,1})	...	p _B (CoSI _{i,v})	...	p _B (CoSI _{j,1})	...	p _B (CoSI _{j,w})	...
...
			...	c(CoSI _{i,1}) -π(X, ASL _i)	...	c(CoSI _{i,v}) -π(X, ASL _i)	...	c(CoSI _{j,1}) -π(X, ASL _j)	...	c(CoSI _{j,w}) -π(X, ASL _j)	...
Adjusted Business Cost resulting from the realization of a CoSI quantified negative business impact less penalty payments											

Table 3. Combinations of service incidents determine the amount of actual business cost in case of non-constant marginal business cost functions.

Table 3, for instance, shows the customer’s estimate that the CoSI_{i,1} (resulting in ASL_i) will be realized with a probability of p_B(CoSI_{i,1}) if SLA B is selected. The index v indicates the number of CoSIs realizing the ASL_i, the index w indicates the number of CoSIs leading to ASL_j. If CoSI_{i,1} occurs during a reference period, the customer will incur business cost of c(CoSI_{i,1}) and, consequently, adjusted business cost of c(CoSI_{i,1})+(-π(X, ASL_i)).

As a consequence, the business cost directly depend on the combination of service incidents that occur (yet only indirectly on the ASL, since ASLs might be realized through different CoSIs and, thus, usually induce different business cost in case of non-constant marginal business cost). Thus, those service level indicators, which simply aggregate incident attribute values, do not reflect the business cost a customer incurs in case of non-constant marginal business cost functions. In our model penalty payments still depend on the degree of deviation of an ASL (e.g. ASL_i) from an SLO (e.g. x_A ∈ X) defined in each specific SLA (e.g. -π(x_A, ASL_i)). The customer has to solve the following optimization problem to identify the cost-optimal service level agreement SLA_{opt}:

$$SLA_{opt} := \arg \min_{s \in SLA} \left(\left(\sum_{i=1}^n \left(\sum_{j=1}^m p_s(CoSI_{i,j}) * c(CoSI_{i,j}) \right) + p_s(ASL_i) * (-\pi_s(x_s, ASL_i)) \right) + SP_s \right) \quad (2),$$

whereas the upper bound of summation n indicates the number of ASLs, the upper bound of summation m numbers the CoSIs resulting in the ASL_n for each n¹ and p_s(ASL_i) = ∑_{j=1}^m p_s(CoSI_{i,j}).

Although the customer could determine the business cost resulting from the realization of certain CoSIs, it is not able to estimate appropriate probabilities for different CoSIs to occur, since these strongly depend on the service delivery environment used to provide the service.

Business Cost Measures

Providers usually possess private information about the **service delivery environments (SDEs)** they use to provide a service. Since outsourcing providers have many customers who purchase similar services, they are able to collect data about the frequency of service incidents to occur when using respective similar SDEs, i.e. to establish service incident histories for each SDE. By analyzing this data, providers can predict the frequencies of occurrence of different combinations of sequential service incidents (CoSIs) when applying a certain SDE. If the customer had the deep insight a provider has, it could use this

¹ That is, in Table 3 the index v corresponds to m for ASL_i and the index w corresponds to m for ASL_j.

information to better address its optimization problem. Providers, on the other hand, have only little understanding of the business cost the customer incurs if a certain CoSI is realized.

In our work we assume the customer to be able to describe business cost functions, which define the business cost caused by single service incidents with respect to their specific service incident levels (SILs). That is, the customer can state BusinessCost/SIL vectors for each service incident class. Furthermore, in the following, we assume the customer to disclose this information to selected providers, treating them as “trusted suppliers”.

Knowing the customer’s BusinessCost/SIL vectors (one vector for each service incident class), providers can combine the information contained therein with their private knowledge of service delivery environments’ incident characteristics. In doing so, they are able to calculate (provider-internal) indicators describing their service delivery environments’ negative impact on the customer business process in terms of business cost. We denote these indicators as **business cost measures**.

Again, considering one service incident class only, Table 4 illustrates a provider’s private knowledge of an exemplary service delivery environment e . It lists the data records about the combinations of sequential service incidents (CoSIs) the provider has collected about this type of service delivery environment when using it (i) during past reference periods (ii) for one or several other customers. The function $f_t(\text{SIL}_{a,b,\dots,n})$ describes the absolute frequency with which service incidents at the level $\text{SIL}_{a,b,\dots,n}$ occurred during a specific reference period, whereas the index t labels a data record. We denote this table as CoSI/SIL frequency matrix.

		Absolute frequencies of SIs at a certain SIL (historical data)				
		$\text{SIL}_{1,1,\dots,1}$	...	$\text{SIL}_{1,1,\dots,n}$	...	$\text{SIL}_{a,b,\dots,n}$
Service Delivery Environment e	CoSI₁	$f_1(\text{SIL}_{1,1,\dots,1})$	...	$f_1(\text{SIL}_{1,1,\dots,n})$	...	$f_1(\text{SIL}_{a,b,\dots,n})$
	CoSI₂	$f_2(\text{SIL}_{1,1,\dots,1})$	...	$f_2(\text{SIL}_{1,1,\dots,n})$	...	$f_2(\text{SIL}_{a,b,\dots,n})$

	CoSI_t	$f_t(\text{SIL}_{1,1,\dots,1})$	...	$f_t(\text{SIL}_{1,1,\dots,n})$	...	$f_t(\text{SIL}_{a,b,\dots,n})$

Table 4. A provider’s private knowledge of the incident characteristics of a specific service delivery environment e (CoSI/SIL frequency matrix).

In order to calculate a business cost measure – for a single service incident class and a certain service delivery environment – a provider multiplies the CoSI/SIL frequency matrix F (as defined in Table 4) with the BusinessCost/SIL vector b . Equation 3 formally describes this operation.

$$F * b = r, \text{ whereas } F \in \mathbb{R}^{p \times q}, b \in \mathbb{R}^q, r \in \mathbb{R}^p \quad (3)$$

Each element of the resulting vector r represents a business cost value the customer would have incurred in a specific past reference period. Assuming historical data to allow the prediction of CoSIs to occur in future reference periods, providers can determine accurate business cost measures. Business cost measures reflect the adverse business impact a customer incurs in case of constant *and* non-constant marginal business cost functions. Using this private information, providers can better understand the impact of their services on customers’ business and, thus, define their service offers accordingly.

A PROCUREMENT AUCTION TO INCORPORATE ADVERSE BUSINESS IMPACT INTO SERVICE OFFERS

Based on the constructs introduced in the previous sections, we develop a procedure enabling a customer to solve its optimization problem – given different service offers by risk-neutral providers.

Today, a typical contract negotiation in IT outsourcing follows a structured approach (Bräutigam, 2009, pp.795-799). First, sending all potential service providers a non-committal request for information, the customer identifies those suppliers that offer the service in question. Afterwards, the customer defines a request for proposal specifying additional information about technical, economic and legal characteristics (sizing, mission-criticality, service partnership models, etc.) and further reduces the number of potential partners before the actual negotiation process begins.

In the following, a service procurement auction is used to conduct the negotiation. Auctions constitute a way to elicit bidders’ private information (Krishna, 2010, p.6). In our scenario we use an auction to allow the customer to draw conclusions regarding the providers’ reservation prices for delivering their services. Thus, we enable the customer to better compare different service offers. In procurement auctions providers “compete for the right to sell” their services (Krishna, 2010, p.1).

For reasons of clarity, the method presented focuses on a single reference period only. As discussed in Chapter 3, capital budgeting approaches could be applied to compare multi-reference period service contracts, which state service prices and business cost changing over time.

Definition of the procurement auction

The objective of our approach is to compare and select offers in order to identify the total customer cost minimal service offer. Therefore, we define an “optimal mechanism” for the procurement of the service (Krishna, 2010, p.67). In the following we assume the customer to reveal its business cost functions to the selected providers participating in the procurement auction. Furthermore, we assume that the future contractual partner will have to compensate the customer for every single service incident to occur in the amount of business cost defined in the corresponding customer business cost function. Due to this “1:1”-penalty rule, providers will directly add the business cost measures (for all service incident classes) to their service prices.

Since the customer has defined all service incident classes in a way that these are independent of one another, providers will add up all business cost measures and the service price to a single monetary value. Therefore, we can use a single-attribute auction to determine the cost-optimal service offer for the customer. In such a “single-attribute context” where the customer reveals the negative impact of service incidents on business and providers have different “market expectations” first-price auctions seem to achieve the best results² (Bichler, 2000). Based on these findings, we define a single-attribute, first-price, sealed-bid auction for our setting (see e.g. Krishna, 2010, pp.13).

In our first-price auction, each provider is asked to submit one sealed bid, which states the service price it offers. The provider who submits the lowest bid wins the auction and has to be prepared to deliver the service as described in the RfP and at the offered price.

Conducting the procurement auction

In the following, we briefly describe the different steps of the procurement auction:

1. **Definition of service incident classes** (customer): For the service in question, the customer formally describes the different business-relevant service incident classes including their corresponding sets of attributes. Furthermore, the specific value range of each attribute is defined.
2. **Definition of service incident levels** (customer): The customer divides the value range of each attribute (characterizing a single service incident class) into a set of disjoint intervals. Therefore, the endpoints of each interval are defined in a way that attribute values leading to significantly different adverse business impacts are elements of different intervals. Then, the customer calculates the Cartesian product of the different sets of attribute intervals for each service incident class, i.e. all service incident levels to be considered are defined.³

Example: The service incident class “reduced throughput incident” is characterized by the two attributes “duration of throughput reduction” (measured in minutes) and “degree of throughput reduction” (measured in percent) with the value ranges $(0;c]$ and $(0;z]$. Considering the negative business impact of different attribute value combinations the customer now divides the range of the duration interval into three parts – $(0;a)$, $[a;b)$ and $[b;c)$ – and the range of the degree interval into four parts – $(0;w)$, $[w;x)$, $[x;y)$ and $[y;z]$. Calculating the Cartesian product of these two sets of attribute intervals, twelve service incident levels (3×4) are defined.

This step is repeated for all service incident classes of the service in question.

3. **Business cost assessment** (customer): The customer considers the negative business impacts, which service incidents at the different service incident levels (SIL) might cause, and assesses these monetarily. Consequently, for each service incident class the customer specifies a BusinessCost/SIL vector stating the business cost for each SIL defined in step 2. That is, the business cost function regarding each service incident class (SIC) is defined.
4. **Invitation of providers** (customer): The customer invites a number of selected providers to take part in the procurement auction and sends the RfP including the business cost functions to these trusted suppliers.

² compared to second-price and English auctions

³ The classification of attribute values into attribute intervals reduces the number of service incident levels to be considered and, thus, improves the applicability of our approach.

5. **Definition of bids** (providers): According to the procedure introduced in the previous chapter, each provider calculates the business cost measures of all service incident classes. Afterwards, it defines a service offer which incorporates the negative business impact into the service price.
6. **Bidding** (providers): The providers submit their sealed bids to the customer.
7. **Winner determination** (customer): Among all service offers the customer identifies the lowest bid and, thus, determines the winner of the auction.

The provider bid winning the procurement auction constitutes the upper limit of total customer cost, since the winner of the auction has to completely compensate the customer for every single service incident that occurs.

CONCLUSION AND OUTLOOK

In this work we addressed a service customer's optimization problem of selecting the cost-optimal service offer for a specific end-to-end service among different options by external service providers, which address the required level of service criticality. First, we modeled the customer's optimization problem considering the potential negative monetary impact of different service levels on the customer business process – reflected via the concept of “business cost”. Second, we derived a set of constructs that supports customers and providers when selecting or defining service offers. Third, based on these constructs, we developed a procedure enabling customers to solve their optimization problem – given different service offers by risk-neutral providers – using a procurement auction. Our suggested seven step approach enables providers to calculate business cost measures and, thus, to predict their services' quantified negative business impact using the customer's business cost functions. Thus, providers can tailor service offers according to customers' business requirements and serve their clients' needs more profoundly. Using the information contained in the customer's business cost functions as the only penalty rule agreed on, providers are free to balance resources they use to deliver a service. Furthermore, the application of our procedure enables the customer to compare service offers regarding their adverse business impact and, thus, to select the cost-optimal solution of its optimization problem – in case of constant *and* non-constant marginal business cost functions.

Having put forward our approach, we are fully aware of a number of limitations and challenges: First, we assumed providers to be able to determine the frequencies for certain combinations of sequential service incidents to occur when using specific service delivery environments. In order to collect this information, we are currently working on a data mining approach using monitoring data. Observed evolution in IT service standardization and delivery (e.g. cloud computing) already seems to support that research objective. Second, we assumed the customer to be able to determine its business cost functions for all service incident classes. We are conscious that a precise determination of business cost functions might be difficult to achieve. Nevertheless, we argue that an economically well-founded investment decision about the service offer to purchase has to be made based on information about business cost. Even a good estimate of business cost functions might already significantly improve a decision with regard to total customer cost. Third, we assumed providers to be risk-neutral and, thus, to “simply” add up business cost measures and the service price when defining service offers, i.e. without adding risk premiums. In addition, we assumed providers to accept for non-mission-critical yet non-commodity services a “1:1 penalty rule”. This penalty rule ensures that business cost information contained in business cost measures is not distorted when service prices are defined. The penalty rule will be accepted by providers, since they can add all business cost measures to the service price. In future works we will analyze the influence of different penalty rules and provider risk-attitudes on the solution of the customer optimization problem, as well. Finally, we assumed the customer to reveal its business cost functions, which indicates the negative criticality of the service for business. The competition among providers, which participate in the procurement auction, prevents them from taking advantage of this information.

We are convinced that our approach, which enables customers to compare different service offers and to select the cost-optimal solution, provides valuable insights for both, service providers and their customers. It will help both parties to address the challenge of business/IT alignment in a different way. At the same time, the limitations mentioned above leave a broad field for further research.

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