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Toward a Conceptual Model for Cost-Effective Business Process Compliance

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Abstract: Owing to the constant rise in the number of regulatory requirements, checking and ensuring business process compliance (BPC) becomes increasingly complex and thus more costly. Although managing BPC in a cost-effective way is critical for organisations, it lacks a corresponding domain model. In response, the paper at hand introduces a theoretically grounded conceptual model including necessary domain-specific elements, attributes and methods for cost-effective BPC. The model maps the operating principle of cost-effectiveness calculations in a BPC environment.

Keywords: business process compliance, compliance, cost-effectiveness, conceptual model, domain model

1 Introduction

Business process compliance (BPC) can be characterised as the act of ensuring that the business processes of an enterprise conform to a set of requirements arising from regulations such as laws, directives, internal guidelines, etc. [RLD08, FZ14, Go16]. Various approaches to checking BPC seek to confirm business processes against formally expressed regulatory requirements or so-called formal compliance rules [LMX07]. Such approaches address a variety of checking scopes, including time, information, resources, control flows or location-based aspects [CRR10, FZ14] and consider compliance as a rather technical matter [Sc13]. However, checking and ensuring BPC is not purely a technical challenge. Due to the ever-increasing number of regulatory requirements, checking and ensuring BPC becomes exceptionally complex and thus a cost-intensive task [Sa11, SG15].

The authors of [Sa11], [Sc13] and [SG15] have pointed out that managing BPC in a cost-effective way is critical for organisations and the conceptualisation of a corresponding domain model is needed. A comprehensive conceptual model for cost-effective BPC could map the operating principle of cost-effectiveness calculations in a BPC environment, clarify the interrelations between necessary domain-specific model elements and serve as a conceptual foundation for deriving corresponding mathematical methods, such as domain-specific cost-effectiveness or cost-benefit ratios. Hence, the research objective of this paper is the construction of a conceptual model for cost-effective BPC. The design of the model builds upon a literature-based domain analysis and the methodological notes of March and Smith [MS95]. This contribution is part of a comprehensive research project

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[Kü17] resting upon the design science research (DSR) methodology, which describes a systematic structure for artefact development [GH13]. According to [GH13], a conceptual model for cost-effective BPC represents an artefact that contributes to the prescriptive knowledge base of DSR.

The remainder of this paper is structured as follows. Section 2 outlines related work and includes a literature-based analysis of the BPC domain. Since section 2 shows that existing work is lacking in the comprehensive consideration of domain-specific model elements for conceptualising cost-effectiveness, section 3 introduces a novel conceptual model for cost-effective BPC. The paper closes with a conclusion and an outlook for further research in section 4.

2 Related Work and Domain Analysis

Cost-effectiveness refers to the assessment of measures according to both their costs and their effects with regard to creating outcome [LM01]. As discussed below, the conceptualisation of cost-effectiveness for BPC is accompanied by a number of requirements. The subsequent review of related work is done under consideration of these requirements.

Cost-effectiveness is also known as economic efficiency and refers to the economic principle, which describes the relation between a result (or so-called output) and required means (or so-called input) [KBS09, In15]. This general characterisation can be specified in terms of different means and objectives for various domains, including BPC. The first requirement for the conceptualisation of cost-effectiveness is mapping the input and output of BPC by a *domain-specific input element* (DIE) and a *domain-specific output element* (DOE). The DIE maps particular measures for ensuring compliance and the DOE is the element associated with the results of those measures. Since the cost-effectiveness refers to the assessment of measures [LM01], the second requirement is the presence of a *domain-specific assessment element* (DAE). The DAE serves to contrast DIE and DOE mathematically and thus has to provide methods to calculate the cost-effectiveness of BPC. Such calculations can only be performed if DIE and DOE are measurable [LM01, Be01]. Therefore, the last requirement refers to the representation of DIE and DOE by *attributes* with quantitative (at best, monetary) expressions, such as the cost of compliance measures.

In the following, it is examined whether the cost-effectiveness and its conceptual requirements are considered in related work on conceptual models of the BPC domain. The search for related work was conducted according to the methodological notes on documenting the literature search process of Vom Brocke et al. [Vo09]. It was performed using the following four databases: IEEE Xplore digital library, electronic library of the Association for Information Systems (AISel), Science Direct and SpringerLink. The use of various databases ensures that a broad range of relevant literature can be found and the search results are not restricted to specific publishers [FZ14]. In the first step, the databases were searched for publications whose titles contain the keywords *business process* and *compliance*. The search string *(business process) AND compliance* was used in all four databases, resulting in a total of 67 hits. In the second step, the 67 contributions found were searched for domain models, meta-models and conceptual models, resulting in seven relevant articles. Those were reviewed with regard to the requirements for the conceptualisation of cost-effectiveness, in particular the existence of adequate DIE, DOE, DAE and corresponding attributes. The outcome is shown in Table 1 and discussed below.

Source	**DIE**	**DOE**	**DAE**	**Attributes**
[SGN07]	Internal Control	Control Objective	-	-
[NS07]	Control	Control Objective	Risk Assessment	-
[Sc10]	Compliance Fragment	Compliance Target	-	-
[Tu11]	Control	Compliance Target	BPC Assessment	-
[Sc13]	Process-integrated Control Mean	Control Objective	Process Assessment	DIE Effectiveness
[ET15]	Control	Compliance Target	BPC Assessment	-
[St16]	Compliance Rule	Compliance Goal	-	-

Tab. 1: Outcome of the analysis of the business process compliance domain

In the models of [SGN07, NS07, Tu11, Sc13, ET15], the DIEs of BPC are control, internal control or process-integrated control mean. Essentially, these DIEs merely differ in wording since they all rest upon the definition of a control as a measure to check, verify or enforce compliance. In a proper sense, a control is defined as a target-performance comparison that ensures compliance provided that the execution of a control is directly requested by a requirement. However, compliance requirements can also constitute obligatory activities, such as reporting duties of the banking sector (see, for example, Section 14 (1) of the German Banking Act (KWG)) which controls as such do not cover. Under these circumstances, the specification of a control as DIE is insufficient for a comprehensive assessment of cost-effectiveness. The DIEs of the models of [St16] and [Sc10] allow covering both kinds of compliance duties, i.e., control activities and obligatory activities. In the model of [St16], an executable formal compliance rule is the DIE of BPC. Formal compliance rules are logical expressions of compliance requirements which are difficult to measure in terms of cost-effectiveness. In the model of [Sc10], the DIE is a compliance fragment representing a process structure that is integrated into a business process in order to ensure compliance. By appropriate quantitative specification of the underlying activities, such process structures are suitable for assessment. However, this specification is not included in [Sc10].

The authors of the related work specify utmost similar elements as DOE of BPC. Control objectives [SGN07, NS07, Sc13], compliance goals [St16] and compliance targets [Sc10, ET15] are derived from requirements and indicate what needs to be done in order to comply. This specification of DOE is insufficient for a comprehensive assessment of cost-effectiveness, as it merely describes a procedure for achieving a desired state, which is difficult to measure. Besides, the aim of BPC approaches is commonly described as the detection and prevention of impending compliance violations, which corresponds to the hedging of compliance risks [KSS17]. Compliance risks can be represented mathematically [Sc10, ET15, Tu11, Sc13] and thus can be considered as measurable ODEs. In the domain of BPC, a compliance risk is characterised as the potential failure to meet requirements [Sc10] or, more generally, the potential occurrence of an undesired state. Thus, compliance risks are merely perceived as threats [Sc13, ET15, Tu11], which corresponds to a downside risk view [La17, Ma07]. Although [SGN07, NS07, Sc10, Tu11, Sc13, ET15] consider a downside risk as a domain-specific element, it does not represent the DOE in their conceptual models, since they do not characterise the protection against downside risks (or rather violations) as the goal of compliance. Moreover, the focus on downside risks is insufficient for a comprehensive assessment of cost-effectiveness, since it does not correspond to a holistic risk view. The downside risk view solely focuses on uncertain negative consequences [La17, Ma07]. Thus, it neglects the upside risk perspective which refers to uncertain positive consequences, such as increasing sales through positive image effects [Am08].

In the model of [NS07], risk assessment is specified as DAE, which rates the risk of not being compliant. However, [NS07] do not specifically describe what constitutes a risk or how it is measured or assessed. In the models of [Tu11, Sc13, ET15], the DAE is process assessment/BPC assessment. These elements assess the extent to which the DIEs ensure compliance. The models of [SGN07, Sc10, St16] do not contain any DAEs. To put it in a nutshell, extant models do not yet consider DAEs aimed at assessing the cost-effectiveness of BPC. Hence, it is hardly surprising that the attributes of corresponding calculations, such as compliance costs (of DIE), likelihoods or monetary impacts of uncertain consequences (of DOE) are largely lacking. Merely [Sc13] defines the effectiveness as an attribute for specifying the DOE. However, this single attribute is insufficient for a comprehensive assessment of cost-effectiveness.

The domain analysis has shown that related work is lacking in a comprehensive consideration of domain-specific elements and attributes for conceptualising cost-effectiveness. To close this gap, a novel conceptual model for cost-effective BPC is proposed in section 3.

3 A Conceptual Model for Cost-Effective BPC

The proposed conceptual model for cost-effective BPC was constructed in consideration of the methodological notes on models of March and Smith [MS95]. Conceptual models can be used to represent new theories or phenomena through domain-specific elements and their associations and can be constructed based on domain knowledge [MS95]. According to [MS95], the concern of such models is utility, not truth. Correspondingly, a new conceptual model for assessing the cost-effectiveness of BPC is proposed below. The model is based on the previous domain analysis, takes into account the requirements for conceptualising the cost-effectiveness as discussed in section 2, and was constructed under use of the Unified Modelling Language (UML). Since the UML allows modelling class diagrams at different abstraction levels, it also allows building conceptual models focussing on domain concepts rather than software entities [FG03]. Figure 1 shows a UML class diagram mapping key elements for cost-effective BPC as classes and their relationships as associations.

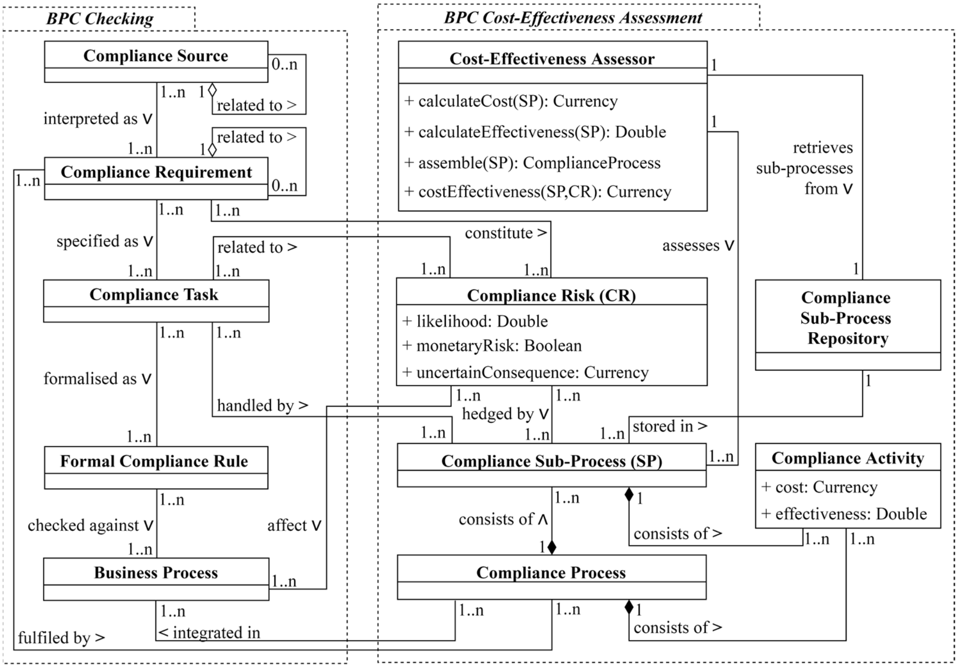

Fig. 1: Conceptual model for cost-effective business process compliance

According to the contributions of [SGN07, NS07, Sc10, Tu11, Sc13, ET15, St16], checking BPC is essentially based on the domain-specific elements as depicted in the UML package *BPC Checking*. These are defined as follows. A *Compliance Requirement* is a condition, obligation or constraint that describes desired results or binding duties. Compliance requirements stem from the interpretation of rather general and mostly textual *Compliance Sources*, such as laws, regulations, internal provisions, contracts, standards, (best practice) frameworks, etc. [Tu11, Sc10]. A compliance source, moreover, defines the origin of compliance requirements [Tu11]. Further specification of each requirement results in one or several operative and organisation-specific *Compliance Tasks*, which serve as activity descriptions. Compliance tasks can be mapped as machine-readable *Formal Compliance Rules*, formalised by logical languages such as Linear Temporal Logic (LTL), Computational Tree Logic (CTL), etc. [Tu11, Sc10]. A *Business Process* is a collection of work items that takes one or more kinds of input and transforms it into a valuable output [HC03]. Business processes are checked against formal compliance rules by using, for example, process verification tools that aim at inspecting compliant process design [Sc10].

The UML Package *BPC Cost-Effectiveness Assessment* extends the conceptual structure of checking BPC to the perspective of cost-effectiveness, taking into account the requirements discussed in section 2 and corresponding domain-specific elements. These elements are defined as follows. A *Compliance Risk* represents the DOE of cost-effective BPC and describes the possibility of occurrence of an uncertain consequence that can affect a business process. Uncertain consequences can affect business processes both positively in terms of upside risks, such as increasing sales through positive image effects, and negatively in terms of downside risks, such as fines due to compliance violations. Since a compliance risk is represented mathematically as multiplication of the likelihood of occurrence by the extent of an uncertain positive or negative consequence [La17], it is specified by means of the appropriate attributes *likelihood* and *uncertainConsequence*. The additional attribute *monetaryRisk* represents a logical value that indicates whether the attribute uncertainConsequence can be expressed in monetary terms (i.e., in a currency), which is required for subsequent calculations. However, uncertain consequences can also be non-monetary and thus difficult or even impossible to measure in economic terms, such as prison sentences.

The analysis of related work has shown that existing DIEs differ in terms of duties that can be addressed. Hence, the *Compliance Activity* is introduced as an abstract DIE that serves the fulfilment of a specific compliance task and can address both types of compliance duties, i.e., controls and obligatory activities. Compliance activities are specified by the attributes *cost* (for example, the cost of implementation or execution) and e*ffectiveness* of task fulfilment. Both compliance processes and compliance sub-processes consist of such activities. A *Compliance Sub-Processes* represents an elementary process section that can be integrated into a business process in order to ensure compliance with a specific requirement. Moreover, it serves the fulfilment of multiple compliance tasks in order to hedge a specific compliance risk. Following the idea of reusability [NS07, Sc10], such sub-processes can be used to hedge the same risks in diverse business processes. For this purpose, compliance sub-processes are stored in a *Compliance Sub-Process Repository*. A *Compliance Process* is a composite sequence of compliance sub-processes that can be integrated into a business process. It hedges all risks that could affect a specific business process by complying with the set of corresponding requirements.

The *Cost-Effectiveness Assessor* is the DAE of this model. It enables assessing the cost-effectiveness of BPC by contrasting DIE and DOE. Since a compliance sub-process hedges a compliance risk (DOE), the method *costEffectiveness(SP,CR)* contrasts the cost of a specific sub-process (i.e., the monetary input) with the economic benefit of this sub-process resulting from risk hedging (i.e., the monetary output), given the attribute value of monetaryRisk is TRUE. The methods *calculateCost(SP)* and *calculateEffectiveness(SP)* allow calculating cost and effectiveness of compliance sub-processes based on the attribute values of the underlying compliance activities (DIEs). In case of a downside risk, the effectiveness of a compliance sub-process corresponds to the likelihood with which a negative uncertainConsequence is prevented. In case of an upside risk, the effectiveness of a compliance sub-process corresponds to the likelihood with which a positive uncertainConsequence can be realised. The economic benefit of a compliance sub-process is calculated by multiplying the attribute value of uncertainConsequence by the effectiveness of the corresponding sub-process. The calculated values of monetary input and output can be contrasted and used to determine domain-specific ratios as well as cost-effective compliance sub-processes. Finally, the method *assemble(SP)* composes a compliance process from cost-effective compliance sub-processes which hedge all risks arising from relevant requirements.

The conceptual model proposed in this section includes essential DIE, DOE, DAE as well as corresponding attributes and methods for cost-effective BPC, which are summarised in Table 2. Thus, the model meets the requirements that are associated with the conceptualisation of cost-effectiveness, as discussed in section 2.

	DIE	**DOE**	**DAE**
Name	Compliance Activity	Compliance Risk	Cost-Effectiveness Assessor
Attributes/ Methods	cost, effectiveness	likelihood, monetaryRisk, uncertainConsequence	calculateCost(SP), calculateEffectiveness(SP), assemble(SP), costEffectiveness(SP,CR)

Tab. 2: Domain-specific elements, attributes and methods of the conceptual model

However, the cost-effectiveness assessor of this model is currently restricted to the monetary assessment of compliance measures, since it solely allows comparing both costs and effects when each is measured in monetary terms. Thus, the assessor reaches its limits given non-monetary uncertain consequences (i.e., the attribute value of monetaryRisk is FALSE). The subject of future research is the expansion of the DAE by methods for assessing non-monetary consequences.

4 Conclusion and Outlook

Although managing BPC in a cost-effective way is critical for organisations, a literature review has shown that a corresponding domain model is lacking. In response, this paper introduced a novel conceptual model that extends the conceptual structure of checking BPC to the perspective of cost-effectiveness. The model is grounded on a literature-based analysis of the BPC domain and clarifies the interrelations between necessary domain-specific model elements. Moreover, it maps the operating principle of cost-effectiveness calculations in a BPC environment, taking into account necessary methods and attributes. The model serves as the conceptual foundation for deriving corresponding mathematical methods, which is the consequent next step of research. Besides, there are further research opportunities. Since the model is theoretically grounded, it requires verification, for example, through empirical studies. In addition, a more detailed investigation of non-monetary uncertain consequences is necessary, as these are not yet readily accessible to an assessment of cost-effectiveness. These research opportunities are subject of prospective investigations.

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