Economic Assessment and Analysis of Business Process Compliance: An Approach based on Basic Control Flow Patterns and Extensible Event Streams (Extended Abstract)

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Abstract. In many industries, ensuring compliance in business processes has become a cost-intensive task due to intensive regulation. For companies to operate profitably despite current regulatory developments, approaches to the economic assessment and analysis of process-based compliance measures are needed. The dissertation entitled "Economic Assessment and Analysis of Business Process Compliance: An Approach based on Basic Control Flow Patterns and Extensible Event Streams" addresses that need by designing, implementing, and evaluating: 1) a mathematical method for the economic assessment of BPC drawing on patterns of basic control flows, and 2) an information technology-based method for the economic analysis and selection of compliance measures drawing on eXtensible Event Streams. This paper is an extended abstract of the dissertation, which briefly presents the two methods. Its conclusion discusses the implementation of a software artifact and the results of a summative evaluation.

Keywords: Business Process Compliance, Economic Assessment, Compliance Cost, Design Science Research, Software Artifact, EconBPC

1 Introduction

In business contexts, the term "compliance" refers to the adherence to rules, i.e., corporate actions in accordance with applicable regulations originating from various sources, such as laws, standards, contracts, internal organizational provisions, etc. [1]. Business Process Compliance (BPC) describes and addresses the adherence to business-related requirements when designing and executing business processes [1, 2]. Against the background of a growing number of compliance requirements, ensuring BPC has not only become a complex technical challenge, but also a cost-intensive task [3–5]. In this context, BPC is even described as a "heavy cost driver" [6]. Therefore, the need for approaches that also address non-technical economic dimensions in securing BPC was

communicated in science and practice. The principle of economic efficiency is essentially based on an input–output relation, which can be specified by quantitative parameters for various domains, including BPC [7]. The investigation of process-based compliance measures in regard to this relation, i.e., the investigation of compliance activities and activity sequences in business processes, is a procedure called economic analysis of BPC [8]. This analysis requires an economic assessment of process-based compliance measures to identify inefficiencies and stimulate process improvements [8].

The literature already provides approaches addressing the economic assessment and analysis of compliance controls [9–11]. While these approaches allow for the determination of an adequate control intensity from an economic point of view, they neglect the assessment of process-based compliance measures in business processes, which is a fundamental prerequisite for the economic analysis of BPC.

Consequently, the cumulative dissertation entitled "Economic Assessment and Analysis of Business Process Compliance: An Approach based on Basic Control Flow Patterns and Extensible Event Streams" [2] conceptualized, implemented, and evaluated methods for the economic assessment and analysis of BPC. For the realization of the research project, a multi-cyclical design science research approach was applied, resulting in four core papers of the cumulative dissertation and two methods for the economic assessment and analysis of BPC. The first method draws on the well-known Basic Control Flow Patterns of van der Aalst et al. [12], the second method builds on the standard for eXtensible Event Streams (XES) [13].

This extended abstract briefly presents both methods in Sections 2 and 3. Section 4 closes this article by discussing both the implementation of a corresponding software artifact and the results of a summative evaluation.

2 Economic Assessment of Business Process Compliance with Basic Control Flow Patterns

The first method comprises three steps (see Fig. 1) and enables the assessment of process-based compliance measures drawing on the Basic Control Flow Patterns [12].

1. ***Complexity reduction.*** Since the economic assessment of BPC is focused on compliance activities, other activities of a business process can be neglected. The application of complexity reduction mechanisms allows one to derive a (reduced) compliance process [7] that merely contains activities relevant to the assessment of BPC.
2. ***Assessment and pattern matching.*** A compliance process is subsequently broken down into assessable sub-processes/process fragments matching the well-known

Basic Control Flow Patterns [12]. Calculation rules have been developed for these patterns, which can be used to calculate economic parameters of compliance activities and activity sequences, considering control flows [14].

3. ***Assessment aggregation.*** The calculation rules of [14] can be used to determine economic benefits for well-formed combinations of compliance activities at different levels of abstraction (respectively aggregation). Thus, the complexity of (extensive) calculations can be resolved step by step, even for large-scale compliance processes.

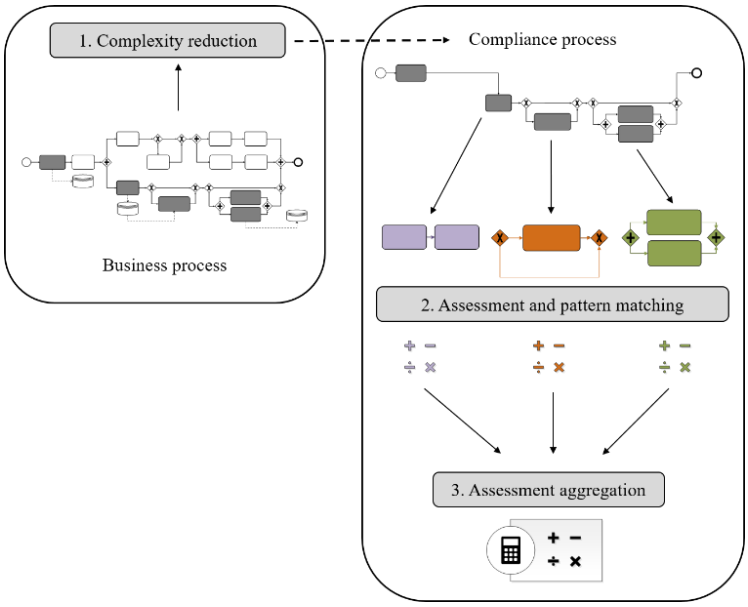

Fig. 1. Basic Control Flow Pattern-based method for the economic assessment of BPC

3 Economic Assessment of Business Process Compliance with eXtensible Event Streams

The second method comprises four steps (see Fig. 2) and enables the assessment of process-based compliance measures drawing on XES [13].

1. Annotation and complexity reduction. The flexible character of the XES standard opens up the opportunity to annotate log files, i.e., to enrich events with data relevant to BPC assessment, such as costs. The XES-based method also starts by reducing complexity, whereby all events that are not of the type „compliance“ are removed from the log file [2]. This increases the method's computing efficiency. The reduced log file is referred to as a *compliance log file*. Although no graphical process reconstruction is required for this assessment method, the compliance process can be reconstructed and visualized from the compliance log file [8].

2. ***Identification of compliance process patterns.*** Based on the compliance log file, the event sequences of all compliance traces are analyzed. Subsequently, a list of all differing sequences with their relative frequency of occurrence is created. Each entry in the list is a unique tuple that represents one of a finite number of path sequences through a compliance process and is referred to as a *compliance process pattern*.
3. ***Assessment of compliance process patterns.*** Using the calculation rules of the pattern-based method (cf. Section 2), economic parameters for compliance process patterns are determined. Since the compliance process patterns are derived from the traces of a business process, and a trace always has either a parallel or a sequential character, only the calculation rules for sequence, parallel split, and synchronization patterns have to be considered for economic assessment and analysis.
4. ***Assessment aggregation.*** Considering the occurrence probabilities of the compliance process patterns determined in Step 2, the method of [14] can be used to calculate the expected economic benefit of a compliance process (i.e., for aggregation purposes). In contrast to the pattern-based method, the XES-based method is not limited to well-formed processes.

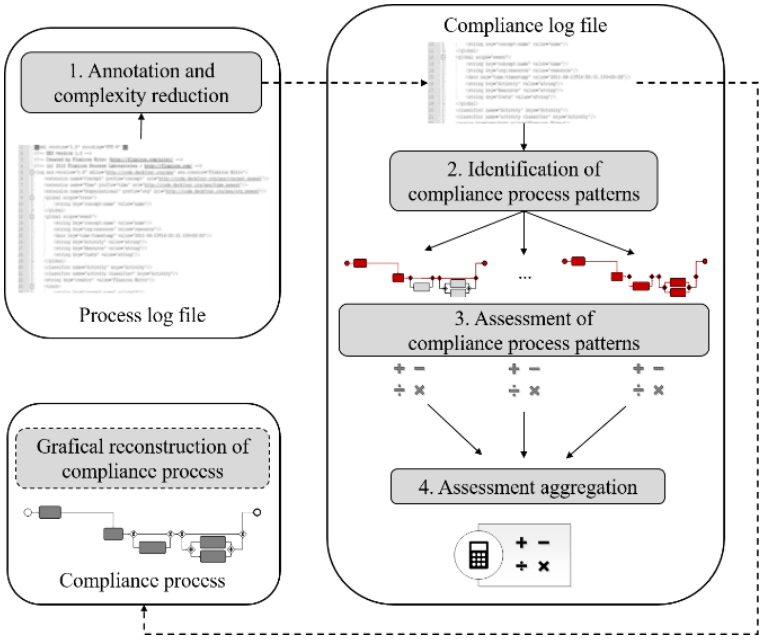

Fig. 2. eXtensible Event Stream-based method for the economic assessment of BPC

4 Implementation, Evaluation, and Conclusion

To instantiate the methods, five design principles and an architecture model were developed. On their basis, the software artifact *EconBPC* was implemented in R as a web application (see [8]). EconBPC was qualitatively evaluated by means of think-aloud

sessions. The evaluation results show that the handling of EconBPC is intuitive and that the automatic assessment of compliance activities/processes is perceived as cognitive relief [8]. Furthermore, it was found that the comprehensible presentation of calculation results and inefficient compliance activities in the user interface of EconBPC is useful for decision support. In a subsequent survey with experts, the design principles were evaluated as comprehensible, traceable, useful, and practicable [8]. The methods developed and the software artifact EconBPC offer practical application potentials both for an assessment and analysis of BPC and for decision support in selection decisions on alternative compliance measures. Furthermore, the design principles underlying the XES-based method can be adapted by scientists and practitioners for new application contexts and used as a starting point for the development of further software artifacts.

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