

Untitled

Selected abstracts

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Document Control

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Draft	0.3	xx May 2024	Created separate PDF index
Draft	0.2	22 May 2024	Changed zotero export from bibtex to biblatex
Draft	0.1	16 May 2024	Split corpus for rendering to html

Preface

Acknowledgements

There are a lot of people working with quarto and working on improving quarto. My primary reference is the excellent quarto documentation. Yet, some concepts only make sense having seen them applied in practice. I have taken inspiration from:

- Forbo7 / Salman Naqvi for the use of the metadata-files option in the format:html section. Indeed breaking up `_quarto.yml` is a good idea.
- nasa openscape is where I copied the navbar code from to distinguish About, SLR, Abstracts and Script.

1 Aa2017

Title

Comparing Textual Descriptions to Process Models – The Automatic Detection of Inconsistencies (van der Aa, Leopold, and Reijers (2017))

Abstract

Many organizations maintain textual process descriptions alongside graphical process models. The purpose is to make process information accessible to various stakeholders, including those who are not familiar with reading and interpreting the complex execution logic of process models. Despite this merit, there is a clear risk that model and text become misaligned when changes are not applied to both descriptions consistently. For organizations with hundreds of different processes, the effort required to identify and clear up such conflicts is considerable. To support organizations in keeping their process descriptions consistent, we present an approach to automatically identify inconsistencies between a process model and a corresponding textual description. Our approach detects cases where the two process representations describe activities in different orders and detect process model activities not contained in the textual description. A quantitative evaluation with 53 real-life model-text pairs demonstrates that our approach accurately identifies inconsistencies between model and text.

Keywords

Business process management, Business process modeling, Compliance checking, Inconsistency detection, Matching, Natural language processing

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Reference

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2 Amantea2022

Title

Business Process Modelling in Healthcare and Compliance Management: A Logical Framework (Amantea et al. (2022))

Abstract

This work describes a methodological approach to investigate Compliance Management in healthcare based on a BPM perspective, exploring an application in an innovative hospital service. Firstly, we present a business process analysis by modeling the process with the adoption of a standard language. Secondly, we encode a set of rules in LegalRuleML, an XML formalism designed to be a standard for representing the semantic and logical content of legal documents. The rules represent some provisions of the General Data Protection Regulation (GDPR) that are involved in the health process analyzed. Moreover, in order to perform the regulatory compliance check automatically, we converted the set of rules into Defeasible Deontic Logic format (DDL), readable by the Regorous compliance checker developed at CSIRO. Overall, the paper shows a methodology to automate regulatory compliance checking of a real hospital process with actual regulations and norms. The codes in the LegalRuleML and DDL formats used in the work are available online.

Keywords

No keywords available

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Reference

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3 BernardoJunior2023

Title

Toward Agile Business Process Management: Description of Concepts and a Proposed Definition (Bernardo Junior and De Padua (2023))

Abstract

Business Process Management (BPM) needs to be adjusted quickly and flexibly to cope with the dynamics of the business environment, so the demand for the incorporation of agility has reached BPM. To contribute to the theoretical consolidation of Agile BPM, it is necessary to develop a conceptualization for the term, that is, to describe the essential attributes for its understanding. Communicating the meaning of the concept in reduced words occurs through the definition, so the main objective of this study is to develop a scientific definition for Agile BPM. This study was performed in three phases. First, a systematic literature review was conducted to investigate how the scientific literature has addressed Agile BPM. Next, a deductive analysis was performed to conceptualize Agile BPM. In the third phase, a consultation with experts was conducted to refine the conceptual view and critique a tentative definition, preceded by judges' analysis to consolidate the definition. As a result, the concept of Agile BPM was elaborated, and based on the reduction of this conceptualization, a scientific definition was presented which describes that Agile BPM is "the promotion of BPM in which practitioners stimulate change quickly and flexibly in order to meet organizational demands with compliance and provide a better customer experience". There is a pioneering spirit in the present study regarding the deliberate conceptualization of Agile BPM, which provides the basis for discussion of the topic, and helps scientific dissemination through a definition, contributing to the development of a theory of Agile BPM.

Keywords

Agility, bpm governance, Business And Economics–Management, Business process management, challenges, Communication, critical success factors, Customer satisfaction, implementation capabilities, intuition, knowledge systems, Literature reviews, operations strategy, organization, Systematic review

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4 Bevilacqua2012

Title

Business Process Reengineering of Emergency Management Procedures: A Case Study (Bevilacqua, Ciarapica, and Paciarotti (2012))

Abstract

The production and storage of dangerous substances in an industrial establishment creates risks for man, environment and properties in the surrounding area. Safety regulations require the establishment of a preventive information campaign regarding industrial risks and self-defence measures to adopt in an emergency situation. In the case of a major accident, people must be promptly made aware of the appropriate self-defence actions and behaviours to adopt. This strategic activity can reduce the panic effect, make citizens more cooperative and guarantee the effectiveness of any emergency plan. In this paper, the information chain is studied as an industrial process modelled by the IDEF0 language. Through this method, each link in the chain has been deeply analysed. For each function of the process, the inputs, outputs and necessary controls and resources have been identified. Starting from a clear view of the current state, the process of re-engineering has been implemented to minimise or eliminate downtime, deficiencies and illnesses and, thus, consequent time losses. The main contribution of the IDEF0 application in emergency management is to provide a clear view of the whole system, a communication system between emergency actors, a rich information source and a structured base for the re-engineering process.

Keywords

Emergency management, IDEF0, Information supply, Information system, Public, Risk information, Safety management

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5 Corsius2021

Title

RegelSpraak: A CNL for Executable Tax Rules Specification (Corsius et al. ([2021](#)))

Abstract

RegelSpraak is a CNL developed at the Dutch Tax Administration (DTA) over the last decade. Keeping up with frequently changing tax rules poses a formidable challenge to the DTA IT department. RegelSpraak is a central asset in ongoing efforts of the DTA to attune their tax IT systems to automatic execution of tax law. RegelSpraak now is part of the operational process of rule specification and execution. In this practice-oriented paper, we present the history of RegelSpraak, its properties and the context of its use, emphasizing its double functionality as a language readable by non-technical tax experts but also directly interpretable in a software generating setup.

Keywords

CNL

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Reference

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6 Elgammal2014

Title

Business Process Compliance Management: An Integrated Proactive Approach (Elgammal et al. (2014))

Abstract

Today's enterprises demand a high degree of compliance of business processes to meet regulations, such as Sarbanes-Oxley and Basel I-III. To ensure continuous guaranteed compliance, compliance management should be considered during all phases of the business process life-cycle; from the analysis and design to deployment, monitoring and evaluation. This paper introduces an integrated business process compliance management framework that incorporates design-time verification and runtime monitoring approaches. The nutshell of the approach is the Compliance Request Language (CRL), which is a high-level pattern-based language for the abstract specification of compliance requirements. From CRL expressions, formal compliance rules can be automatically generated, thereby eliminating the need for business and compliance experts to learn and use complex low-level formal languages. Formalized compliance rules enable automated approaches to be used for the static verification and dynamic monitoring of business processes. An integrated prototypical tool-suite is developed as a proof-of-concept to help validating the applicability of the approaches, and validated by experiment with two real-life case studies.

Keywords

Compliance Patterns, Design-time Compliance Management, Regulatory Compliance, Runtime Compliance Monitoring

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Reference

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7 Hadasch2016

Title

The Influence of Directive Explanations on Users' Business Process Compliance Performance (Hadasch, Maedche, and Gregor ([2016](#)))

Abstract

Purpose – In organizations, individual user's compliance with business processes is important from a regulatory and efficiency point of view. The restriction of users' choices by implementing a restrictive information system is a typical approach in many organizations. However, restrictions and mandated compliance may affect employees' performance negatively. Especially when users need a certain degree of flexibility in completing their work activity. The purpose of this paper is to introduce the concept of directive explanations (DEs). DEs provide context-dependent feedback to users, but do not force users to comply.

Keywords

Business Process Compliance, Explanations, Organizational Processes, Process, User-system cooperation

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Reference

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8 Hashmi2017

Title

Norms Modeling Constructs of Business Process Compliance Management Frameworks: A Conceptual Evaluation (Hashmi and Governatori ([2017](#)))

Abstract

The effectiveness of a compliance management framework (CMF) can be guaranteed only if the framework is based on sound conceptual and formal foundations. In particular, the formal language used in the CMF is able to expressively represent the specifications of normative requirements (hereafter, norms) that impose constraints on various activities of a business process. However, if the language used lacks expressiveness and the modelling constructs proposed in the CMF are not able to properly represent different types of norms, it can significantly impede the reliability of the compliance results produced by the CMF. This paper investigates whether existing CMFs are able to provide reasoning and modeling support for various types of normative requirements by evaluating the conceptual foundations of the modeling constructs that existing CMFs use to represent a specific type of norm. The evaluation results portray somewhat a bleak picture of the state-of-the-affairs when it comes to represent norms as none of the existing CMFs is able to provide a comprehensive reasoning and modeling support. Also, it points to the shortcomings of the CMFs and emphasises exigent need of new modeling languages with sound theoretical and formal foundations for representing legal norms.

Keywords

Business Processes, Compliance, Compliance Management Frameworks, Modelling Constructs, Modelling Languages, Norms

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9 Hashmi2018

Title

Legal Compliance Through Design: Preliminary Results of a Literature Survey (Hashmi, Casanovas, and de Koker ([2018](#)))

Abstract

In this paper we present the preliminary results of a literature survey conducted in the context of a larger research project on legal compliance by design (LCbD) and legal compliance through design (LCtD). Even though a rich set of approaches and frameworks are available, our analysis shows that there is less focus on legal compliance in general, and LCbD and LCtD in particular. The technical literature on compliance has been concentrated on specific aspects of the law, i.e. mainly on those related to corporate and administrative management (including those of law firms and government). Other legal dimensions such as public law, case law, constitutional, virtual ethics etc., have been put aside.

Keywords

law and regulations, legal compliance by design, legal compliance through design, legal dimensions, literature review, regulatory compliance

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10 Holzmüller-Laue2014

Title

Improved Compliance by BPM-Driven Workflow Automation (Holzmüller-Laue et al. (2014))

Abstract

Using methods and technologies of business process management (BPM) for the laboratory automation has important benefits (i.e., the agility of high-level automation processes, rapid interdisciplinary prototyping and implementation of laboratory tasks and procedures, and efficient real-time process documentation). A principal goal of the model-driven development is the improved transparency of processes and the alignment of process diagrams and technical code. First experiences of using the business process model and notation (BPMN) show that easy-to-read graphical process models can achieve and provide standardization of laboratory workflows. The model-based development allows one to change processes quickly and an easy adaption to changing requirements. The process models are able to host work procedures and their scheduling in compliance with predefined guidelines and policies. Finally, the process-controlled documentation of complex workflow results addresses modern laboratory needs of quality assurance. BPMN 2.0 as an automation language to control every kind of activity or subprocess is directed to complete workflows in end-to-end relationships. BPMN is applicable as a system-independent and cross-disciplinary graphical language to document all methods in laboratories (i.e., screening procedures or analytical processes). That means, with the BPM standard, a communication method of sharing process knowledge of laboratories is also available.

Keywords

BPMN, end-to-end workflow, laboratory automation, model-based application development, systems integration

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11 Kir2021

Title

A Knowledge-Intensive Adaptive Business Process Management Framework (Kir and Erdogan (2021))

Abstract

Business process management has been the driving force of optimization and operational efficiency for companies until now, but the digitalization era we have been experiencing requires businesses to be agile and responsive as well. In order to be a part of this digital transformation, delivering new levels of automation-fueled agility through digitalization of BPM itself is required. However, the automation of BPM cannot be achieved by solely focusing on process space and classical planning techniques. It requires a holistic approach that also captures the social aspects of the business environment, such as corporate strategies, organization policies, negotiations, and cooperation. For this purpose, we combine BPM, knowledge-intensive systems and intelligent agent technologies, and yield one consolidated intelligent business process management framework, namely agileBPM, that governs the entire BPM life-cycle. Accordingly, agileBPM proposes a modeling methodology to semantically capture the business interests, enterprise environment and process space in accordance with the agent-oriented software engineering paradigm. The proposed agent-based process execution environment provides cognitive capabilities (such as goal-driven planning, norm compliance, knowledge-driven actions, and dynamic cooperation) on top of the developed business models to support knowledge workers' multi-criteria decision making tasks. The context awareness and exception handling capabilities of the proposed approach have been presented with experimental studies. Through comparative evaluations, it is shown that agileBPM is the most comprehensive knowledge-intensive process management solution.

Keywords

Agent-based business process management, Agile business process management, Business process management, Knowledge-intensive processes, Process adaptation, Process modeling and execution

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Reference

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12 Koncevics2017

Title

Comparative Analysis of Business Process Modelling Tools for Compliance Management Support (Koncevics et al. (2017))

Abstract

The paper presents results of the comparative analysis of business process modelling tools for supporting automated compliance management in organisations. By **compliance** in the paper we mean compliance to legislation, **regulations** of municipalities, external regulatory requirements and also internal organisational policies. The goal of the research is (1) to identify main attributes of business process modelling tools relevant in compliance management, and (2) to use the identified attributes for analysis of the tools to better understand the scope of their capability to support compliance management. The attributes of the tools have been derived from the related research. The analysis of the tools has been performed by installing each tool and evaluating it against a set of the identified attributes. The obtained results are useful in choosing the tools for compliance management in general and for open source solutions to develop new compliance management tools in particular.

Keywords

Business process compliance, compliance management, compliance management tools, open source business process modelling tools

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Reference

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13 Lohmann2013

Title

Compliance by Design for Artifact-Centric Business Processes (Lohmann ([2013](#)))

Abstract

Compliance to legal regulations, internal policies, or best practices is becoming a more and more important aspect in business processes management. Compliance requirements are usually formulated in a set of rules that can be checked during or after the execution of the business process, called compliance by detection. If noncompliant behavior is detected, the business process needs to be redesigned. Alternatively, the rules can be already taken into account while modeling the business process to result in a business process that is compliant by design. This technique has the advantage that a subsequent verification of compliance is not required.

Keywords

Artifact-centric business processes, Compliance by design, Compliance management, Process synthesis

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Reference

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14 Loreti2018

Title

A Distributed Approach to Compliance Monitoring of Business Process Event Streams (Loreti et al. (2018))

Abstract

In recent years, the significant advantages brought to business processes by process mining account for its evolution as a major concern in both industrial and academic research. In particular, increasing attention has been turned to compliance monitoring as a way to identify when a sequence of events deviates from the expected behaviour. As we are entering the IoT era, an increasing variety of smart objects can be introduced in business processes (e.g., tags to track products in a plant, smartphones and badge swiping to draw the activities of customers and employees in a shopping centre, etc.). All these objects produce large volumes of log data in the form of streams, which need to be run-time analysed to extract further knowledge about the underlying business process and to identify unexpected, non-conforming events. Albeit rather straightforward on a small log file, compliance verification techniques may show poor performances when dealing with big data and streams, thus calling for scalable approaches. This work investigates the possibility of spreading the compliance monitoring task over a network of computing nodes, achieving the desired scalability. The monitor is realised through the existing SCIFF framework for compliance checking, which provides a high level logic-based language for expressing the properties to be monitored and nicely supports the partitioning of the monitoring task. The distributed computation is achieved through a MapReduce approach and the adoption of an existing general engine for large scale stream processing. Experimental results show the feasibility of the approach as well as the advantages in performance brought to the compliance monitoring task.

Keywords

Business process management, Distributed compliance monitoring, MapReduce, Stream processing

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Reference

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15 Mendling2018

Title

Blockchains for Business Process Management-Challenges and Opportunities (Mendling et al. (2018))

Abstract

Blockchain technology promises a sizable potential for executing inter-organizational business processes without requiring a central party serving as a single point of trust (and failure). This paper analyzes its impact on business process management (BPM). We structure the discussion using two BPM frameworks, namely the six BPM core capabilities and the BPM lifecycle. This paper provides research directions for investigating the application of blockchain technology to BPM.

Keywords

Blockchain, Business Process Management, Research Challenges

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16 Ramezani2011

Title

Separating Compliance Management and Business Process Management (Ramezani et al. (2011))

Abstract

No abstract available

Keywords

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Reference

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17 Raucci2020

Title

BPM Perspectives to Support ICSs: Exploiting the Integration of Formal Verifications into Investment Service Provision Processes (Raucci et al. (2020))

Abstract

Purpose This paper investigates the criteria for a selective integration, in the multidisciplinary business process management (BPM) areas, between information technologies tools and the company's internal control systems (ICSs) aimed at directing organizational behaviours. Adopting a process-based perspective, the authors propose a formal methodology to increase ICSs aims, related to the segregation of duties (SoDs) models, efficiently and effectively. **Design/methodology/approach** The authors examine the applicability of formal verifications to validate a banking process of providing investment services, which is mapped through the workflow management system. To mitigate the state explosion problem of formal methods, the authors propose an efficient methodology that has been proved on the SoDs models in the bank ICSs, as a case study. **Findings** The authors' investigations suggest that in the BPM domain, the banking ICSs aims can benefit from the aforesaid methodologies, originating from the formal methods area, to increase the reliability and correctness in the design, modelling and implementation of the SoDs models. **Originality/value** The proposed methodology is quite general and can be efficiently applied to large-scale systems in different business contexts or areas of the BPM. Its application to the bank's SoD prevents or detects significant weaknesses, operational risks, excessive risk appetite and other undesirable behaviours in the investment services provision processes. This guarantees that the investment ordered/offered is "suitable and appropriate" with the client's risk profile, especially non-professional, required by the MiFID II Directive.

Keywords

Banking Processes, Business Process Management, Formal Methods, Internal Control Systems, Investment Services, Segregation of Duties

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Reference

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18 Sackmann2018

Title

Using Business Process Compliance Approaches for Compliance Management with Regard to Digitization: Evidence from a Systematic Literature Review (Sackmann, Kühnel, and Seyffarth (2018))

Abstract

Business Process Compliance (BPC) means ensuring that business processes are in accordance with relevant compliance requirements. Thus, BPC is an essential part of both business process management (BPM) and compliance management (CM). Digitization has also been referred to as a “digital revolution” that describes a technological change that has extended to many organizational areas and tasks, including compliance. Current efforts to digitize, e.g., by realizing cyber-physical systems, rely on the automation and interoperability of systems. In order for CM not to hamper these efforts, it becomes an increasingly relevant issue to digitize compliance as well. The managerial perspective of compliance comprises several phases, which together represent a CM life-cycle. Efforts to digitize compliance require bundling interoperable BPC technologies, methods, and tools supporting this life-cycle in a consolidated manner. Several approaches addressing the field of BPC have already been developed and explored. Based on a systematic literature review, we examined these approaches in terms of their suitability for supporting the CM life-cycle phases in support of the digitization of compliance. The results of our literature review show which CM life-cycle phases are supported by BPC approaches and which phases are the focus of research. Moreover, the results show that a purely sequential clustering, as specified in a CM life-cycle, is not always suitable for the bundling of BPC approaches in support of the digitization of compliance. Consequently, we propose a novel, task-oriented clustering of BPC approaches that is particularly oriented toward interoperability.

Keywords

Business process compliance, Compliance management life-cycle, Digitization

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Reference

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19 VanDerAalst2018

Title

Spreadsheets for Business Process Management: Using Process Mining to Deal with “Events” Rather than “Numbers”? (Van Der Aalst ([2018](#)))

Abstract

Purpose – Process mining provides a generic collection of techniques to turn event data into valuable insights, improvement ideas, predictions, and recommendations. This paper uses spreadsheets as a metaphor to introduce process mining as an essential tool for data scientists and business analysts. The purpose of this paper is to illustrate that process mining can do with events what spreadsheets can do with numbers.

Keywords

Business Process Management, Data Science, Process Mining, Spreadsheets

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Reference

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20 Vanderfeesten2011

Title

Product-Based Workflow Support (Vanderfeesten, Reijers, and Van Der Aalst ([2011](#)))

Abstract

Despite the industrial need for the improvement of information-intensive business processes, few scientifically grounded approaches exist to support such initiatives. In this paper, we propose a new approach that builds on concepts that are part of a product-oriented view on process optimization. Essentially, this approach allows end users to flexibly decide on the best possible way to create an informational product within the limits that are imposed by regulations and logical dependencies. We argue that this provides various benefits in comparison to earlier work. To support the end user in making sensible decisions, we describe two alternative approaches to provide her with recommendations to this end. We formalize these alternatives and discuss their relative strengths and weaknesses. The feasibility of the overall approach, which we refer to as Product-Based Workflow Support, is demonstrated by a workflow system realized using ProM and DECLARE.

Keywords

Business Process Modelling, Product Data Model, Workflow Management

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Reference

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21 Viriyasitavat2020

Title

Blockchain-Based Business Process Management (BPM) Framework for Service Composition in Industry 4.0 (Viriyasitavat (2020))

Abstract

Business process management (BPM) aims to optimize business processes to achieve better system performance such as higher profit, quicker response, and better services. BPM systems in Industry 4.0 are required to digitize and automate business process workflows and support the transparent interoperations of service vendors. The critical bottleneck to advance BPM systems is the evaluation, verification, and transformation of trustworthiness and digitized assets. Most of BPM systems rely heavily on domain experts or third parties to deal with trustworthiness. In this paper, an automated BPM solution is investigated to select and compose services in open business environment, Blockchain technology (BCT) is explored and proposed to transfer and verify the trustiness of businesses and partners, and a BPM framework is developed to illustrate how BCT can be integrated to support prompt, reliable, and cost-effective evaluation and transferring of Quality of Services in the workflow composition and management.

Keywords

Block-chain technology (BCT), Business process management (BPM), Industry 4.0, Internet of Things (IoT), Quality of Service (QoS), Service selection and composition, Smart contracts, Trustworthiness

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Reference

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22 Viriyasitavat2023

Title

Blockchain-as-a-Service for Business Process Management: Survey and Challenges (Viriyasitavat et al. (2023))

Abstract

Blockchain technology (BCT) has brought a paradigm shift to Business Process Management (BPM). BCT provides a trusted decentralized infrastructure to secure data and process executions using distributed ledgers and smart contract to manage complex business processes. Numerous efforts have been made to exploit BCT in supporting dynamic and trusted collaborations of business processes. This paper aims to understand recent BCT development for its BPM applications and identify the limitations and challenges for further development via a systematic literature review (SLR). It is found that numerous works have reported using BCT as technical solutions to fulfill some traditional BPM functions. This paper is distinguished from existing works, especially several relevant surveys in the sense that (1) the impact of using BCT in BPM is thoroughly explored to identify new constraints and challenges explicitly brought by blockchains; (2) the requirements for Business Process Compliance (BPC) are firstly analyzed in detail. Note that BPC is to assure the adherence of business processes to pre-defined policies, standards, specifications, regulations, and laws when business processes are executed. To fill the gaps of BCT applications in these two aspects, Blockchain-as-aService (BCaaS) is adopted in business process architecture, and the trends of BCT developments are identified accordingly.

Keywords

Blockchain Technology, Blockchain-as-a-services, Business Process Compliance, Business Process Management, Business Processes, Smart Contracts, Systematic Literature Review

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Reference

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23 Zasada2023

Title

Evaluation of Compliance Rule Languages for Modelling Regulatory Compliance Requirements (Zasada et al. (2023))

Abstract

Compliance in business processes has become a fundamental requirement given the constant rise in regulatory requirements and competitive pressures that have emerged in recent decades. While in other areas of business process modelling and execution, considerable progress towards automation has been made (e.g., process discovery, executable process models), the interpretation and implementation of compliance requirements is still a highly complex task requiring human effort and time. To increase the level of “mechanization” when implementing regulations in business processes, compliance research seeks to formalize compliance requirements. Formal representations of compliance requirements should, then, be leveraged to design correct process models and, ideally, would also serve for the automated detection of violations. To formally specify compliance requirements, however, multiple process perspectives, such as control flow, data, time and resources, have to be considered. This leads to the challenge of representing such complex constraints which affect different process perspectives. To this end, current approaches in business process compliance make use of a varied set of languages. However, every approach has been devised based on different assumptions and motivating scenarios. In addition, these languages and their presentation usually abstract from real-world requirements which often would imply introducing a substantial amount of domain knowledge and interpretation, thus hampering the evaluation of their expressiveness. This is a serious problem, since comparisons of different formal languages based on real-world compliance requirements are lacking, meaning that users of such languages are not able to make informed decisions about which language to choose. To close this gap and to establish a uniform evaluation basis, we introduce a running example for evaluating the expressiveness and complexity of compliance rule languages. For language selection, we conducted a literature review. Next, we briefly introduce and demonstrate the languages’ grammars and vocabularies based on the representation of a number of legal requirements. In doing so, we pay attention to semantic subtleties which we evaluate by adopting a normative classification framework which differentiates between different deontic assignments. Finally, on top of that, we apply Halstead’s well-known metrics for calculating the relevant characteristics of the different languages in our comparison, such as the volume, difficulty and effort for each language. With this, we are finally able to better understand the lexical complexity of the languages in relation to their expressiveness. In sum, we provide a systematic comparison of different compliance rule languages based on real-world compliance requirements which may inform future users and developers of these

languages. Finally, we advocate for a more user-aware development of compliance languages which should consider a trade off between expressiveness, complexity and usability.

Keywords

business processes, compliance rules modelling, conceptual modelling, expressiveness, language complexity, regulatory compliance

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Reference

:::

- Aa, Han van der, Henrik Leopold, and Hajo A. Reijers. 2017. "Comparing Textual Descriptions to Process Models – The Automatic Detection of Inconsistencies." *Information Systems* 64 (March): 447–60. <https://doi.org/10.1016/j.is.2016.07.010>.
- Amantea, Ilaria Angela, Livio Robaldo, Emilio Sulis, Guido Governatori, and Guido Boella. 2022. "Business Process Modelling in Healthcare and Compliance Management: A Logical Framework." *FLAP* 9 (4): 1131–54. <https://collegepublications.co.uk/ifcolog/?00056>.
- Bernardo Junior, Ronaldo, and Silvia Ines Dallavalle De Padua. 2023. "Toward Agile Business Process Management: Description of Concepts and a Proposed Definition." *Knowl Process Manag* 30 (1): 14–32. <https://doi.org/10.1002/kpm.1737>.
- Bevilacqua, M., F. E. Ciarapica, and C. Paciarotti. 2012. "Business Process Reengineering of Emergency Management Procedures: A Case Study." *Safety Science* 50 (5): 1368–76. <https://doi.org/10.1016/j.ssci.2012.01.002>.
- Corsius, Mischa, Stijn Hoppenbrouwers, Mariette Lokin, Elian Baars, Gertrude Sangers-Van Cappellen, and Ilona Wilmont. 2021. "RegelSpraak: A CNL for Executable Tax Rules Specification." In *Proceedings of the Seventh International Workshop on Controlled Natural Language (CNL 2020/21)*.
- Elgammal, A, S Sebahi, O Turetken, MS Hacid, MP Papazoglou, and WJ van den Heuvel. 2014. "Business Process Compliance Management: An Integrated Proactive Approach." In, edited by KS Soliman, 764–81.
- Hadasch, Frank, Alexander Maedche, and Shirley Gregor. 2016. "The Influence of Directive Explanations on Users' Business Process Compliance Performance." *Business Process Management Journal* 22 (3): 458–83. <https://doi.org/10.1108/BPMJ-05-2015-0067>.
- Hashmi, Mustafa, Pompeu Casanovas, and Louis de Koker. 2018. "Legal Compliance Through Design: Preliminary Results of a Literature Survey." In *Technologies for Regulatory Compliance*. Groningen. [CEUR-WS.org/Vol-2309/06.pdf](https://www.ceur-ws.org/Vol-2309/06.pdf).
- Hashmi, Mustafa, and Guido Governatori. 2017. "Norms Modeling Constructs of Business Process Compliance Management Frameworks: A Conceptual Evaluation." *Artificial Intelligence and Law* 26 (September): 251–305. <https://doi.org/10.1007/s10506-017-9215-8>.
- Holzmüller-Laue, Silke, Bernd Göde, Heidi Fleischer, and Kerstin Thurow. 2014. "Improved Compliance by BPM-Driven Workflow Automation." *SLAS Technology* 19 (6): 528–45. <https://doi.org/10.1177/2211068214549626>.

- Kir, Huseyin, and Nadia Erdogan. 2021. “A Knowledge-Intensive Adaptive Business Process Management Framework.” *Information Systems* 95 (January): 101639. <https://doi.org/10.1016/j.is.2020.101639>.
- Koncevics, Rolands, Ludmila Penicina, Andrejs Gaidukovs, Maris Dargis, Rita Burbo, and Ainars Auzins. 2017. “Comparative Analysis of Business Process Modelling Tools for Compliance Management Support.” *Appl. Comput. Syst.* 21 (1): 22–27. <https://doi.org/10.1515/ACSS-2017-0003>.
- Lohmann, Niels. 2013. “Compliance by Design for Artifact-Centric Business Processes.” *Information Systems* 38 (4): 606–18. <https://doi.org/10.1016/j.is.2012.07.003>.
- Loreti, Daniela, Federico Chesani, Anna Ciampolini, and Paola Mello. 2018. “A Distributed Approach to Compliance Monitoring of Business Process Event Streams.” *Future Generation Computer Systems* 82 (May): 104–18. <https://doi.org/10.1016/j.future.2017.12.043>.
- Mendling, Jan, Ingo Weber, Wil Van Der Aalst, Jan Vom Brocke, Cristina Cabanillas, Florian Daniel, Søren Debois, Claudio Di Ciccio, Marlon Dumas, and Schahram Dustdar. 2018. “Blockchains for Business Process Management-Challenges and Opportunities.” *ACM Transactions on Management Information Systems (TMIS)* 9 (1): 1–16.
- Ramezani, Elham, Dirk Fahland, Jan Martijn van der Werf, and Peter Mattheis. 2011. “Separating Compliance Management and Business Process Management.” In *International Conference on Business Process Management*, 459–64. Springer.
- Rauci, Domenico, Antonella Santone, Francesco Mercaldo, and Tomasz Dyczkowski. 2020. “BPM Perspectives to Support ICSs: Exploiting the Integration of Formal Verifications into Investment Service Provision Processes.” *Industrial Management & Data Systems* 120 (7): 1383–1400. <https://doi.org/10.1108/IMDS-11-2019-0593>.
- Sackmann, Stefan, Stephan Kühnel, and Tobias Seyffarth. 2018. “Using Business Process Compliance Approaches for Compliance Management with Regard to Digitization: Evidence from a Systematic Literature Review.” In *Business Process Management - 16th International Conference, BPM 2018, Sydney, NSW, Australia, September 9-14, 2018, Proceedings*, edited by Mathias Weske, Marco Montali, Ingo Weber, and Jan vom Brocke, 11080:409–25. Lecture Notes in Computer Science. Springer. https://doi.org/10.1007/978-3-319-98648-7/_24.
- Van Der Aalst, Wil. 2018. “Spreadsheets for Business Process Management: Using Process Mining to Deal with ‘Events’ Rather Than ‘Numbers’?” *BPMJ* 24 (1): 105–27. <https://doi.org/10.1108/BPMJ-10-2016-0190>.
- Vanderfeesten, Irene, Hajo A. Reijers, and Wil M. P. Van Der Aalst. 2011. “Product-Based Workflow Support.” *Information Systems* 36 (2): 517–35. <https://doi.org/10.1016/j.is.2010.09.008>.
- Viriyasitavat, Wattana. 2020. “Blockchain-Based Business Process Management (BPM) Framework for Service Composition in Industry 4.0.” *Journal of Intelligent Manufacturing*.
- Viriyasitavat, Wattana, Li Da Xu, Gaurav Dhiman, and Zhuming Bi. 2023. “Blockchain-as-a-Service for Business Process Management: Survey and Challenges.” *IEEE Trans. Serv. Comput.* 16 (3): 2299–2314. <https://doi.org/10.1109/TSC.2022.3199232>.
- Zasada, Andrea, Mustafa Hashmi, Michael Fellmann, and David Knuplesch. 2023. “Evaluation of Compliance Rule Languages for Modelling Regulatory Compliance Requirements.” *Software* 2 (1): 71–120. <https://doi.org/10.3390/software2010004>.