A conceptual business process entity with lifecycle and compliance alignment

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Abstract. This paper proposes a conceptual model that incorporates: (a) a business process entity, (b) a business process lifecycle aligned with the proposed entity, and (c) a compliance framework that focuses on the degree of process compliance to imposed regulatory standards. The pursuing objective is to systematize business processes through a conceptual entity applicable to Business Process Management (BPM) practices and compliance-checking. The applied methodology involves the review, interpretation and comparison of business process definitions, structural elements and their interrelations, acknowledged BPM lifecycles and compliance rules. The initial findings lead to the proposal of a contextual business process structure that sets the boundaries of business process as a clearly defined entity. The business process entity encompasses continuous modification of its design based on the feedback it generates. Additionally, a comparative analysis of prominent BPM lifecycles resulted in a proposed 'business process lifecycle' that allows for a better alignment of the included cycle steps. The proposed business process entity is also related with process compliance practices to produce compliance-aware business processes. The introduced conceptual model can assist professionals in apprehending core business process features, focusing on process flexibility and redesign. It can also serve as a preliminary prototype for checking the degree of compliance between a business process and the applicable compliance rules.

Keywords: Business Process, Business Process Management, BPM lifecycle, Business Process Lifecycle, Business Process Compliance.

1 Introduction

Business processes are conceived as a set of related activities, orderly performed for actualizing a business objective. Through maintaining an orientation towards business processes, organizations orchestrate and achieve continuous improvements of their activities on time and within specified resource constraints, in an effort to gain

competitive superiority [1]. One of the fields dealing with the induced challenges is BPM that has emerged as an area of high interest among scholars, professionals and practitioners [2]. BPM typically consists of a sequence of discrete activities for the continual improvement of business processes, carried out within an iterative life cycle [3]. The continuous research on BPM resulted in a plethora of methods, techniques, and tools to support the design, enactment, management, and analysis of operational business processes [4]. Although the practical relevance of BPM has proved undisputed, debates still accrue and persist, regarding the identity, quality and maturity of the BPM field [5].

The authors aim to address the ambiguity of business process as a concept and the resulting approaches in BPM lifecycles. This is achieved by proposing a contextual business process structure that ratifies business process as a unique entity, that encompasses continuous modification and evolution of its design, based on the feedback it generates. The authors also propose a lifecycle model aligned to the business process entity. The lifecycle should be attributed to a business process and the various stages it evolves through; not BPM as an entity. Treating the lifecycle as a process itself will reveal a closer and more detailed interaction of the various cycle steps and will provide a clearer perspective of how a business process progresses and what tools and technologies are better suited for each of its stages. Lastly, compliance-checking in the proposed lifecycle can generate business processes applying a novel 'compliance-by-design and redesign' approach. The conceptual model discussed in this paper embodies three main notions:

- a *business process entity* that sets the boundaries of a business process as a clearly defined entity. The proposed structure portrays the business process entity as continuously evolving and adapting its design based on the execution feedback that it generates. The specific approach towards design modification (whether it is redesign, improvement, restructuring, or formal optimization) is left open to different disciplines and methodologies.
- a *business process lifecycle* aligned to the business process structure that emphasizes the value of adaptability. The various cycle steps are extracted from critically reviewing the existing BPM lifecycles and they are unified in the proposed structured to better highlight that a clearly defined concept of business process also reflects the stages that it is flowing through.
- a *compliance-aware framework* that addresses the need for organizational business processes to comply to various internally and externally imposed regulatory frameworks. The authors reviewed existing approaches and propose a combination of a priori and a posteriori compliance approaches and also highlight where these connect to the proposed business process entity.

2 Related work

The increased popularity of business process has resulted in a variety of interdisciplinary approaches [6], a fact that also underpins the ambivalent nature of the business process scope. Völkner and Werners [7] believe that there is no generally accepted

business process definition due to the fact that the concept has been engaged by a number of different disciplines. Moreover, Lindsay et al. [8] underline that business process definitions are based on machine metaphor type explorations of a process, suggesting that most of them are limited in depth, leading to constrained corresponding models.

Authors such as Van Der Aalst et al. [4] and Dumas et al. [9], attempt to rationalize the ambiguity in generic business process definitions by deploying a set of components that structure a business process. The purpose of a business process is the processing of various cases (e.g. online orders, sales and calculation of travel expenses) that can be either too simplistic when restricted to a functional unit of an organization or more complex by cutting across several business partners [10]. According to Van der Aalst [11] there are two important elements for a business process to be defined: (a) the activities, that are usually a set of tasks in a specific order, and (b) the allocation of resources to these tasks. Similarly, Dumas et al. [9] indicate that a business process encompasses a number of events and activities, through illustrating a typical business process example. Other perceived components are: (i) process structure (i.e. control flow, data flow dependencies and business rules that cover execution constraints), (ii) process goals, and (iii) structural elements such as resources, input and output [12]. The combination of these components and their relationships construct a structure that attempts to formalize a business process and transfuse a much-desired uniqueness in terms of operations perspective. However, most of these approaches are not extensive on the components they employ [11], they result in either too simplistic [13] or too complex structures ([14], [15]) and undermine the capability for effectively redesigning a business process as they capture mostly static elements.

The comprehension of the different tools, techniques, terminologies and features of BPM allowed for the conceptualization of what is referred to as BPM lifecycle [16]. Business Process Management (BPM) encompasses a set of methods, techniques, and tools for handling business processes (i.e. modeling, execution and analysis) of an organization [3], which are organized in phases and steps, referred to as BPM lifecycle [9]. Advocates of the BPM lifecycles propagate schematic diagrams that systematize the methodology and steps of a BPM project, in an effort to manage effectively the organizational operations. BPM lifecycles are continuous [17] and composed of activities [18]. However, there are multiple variations and convergences throughout literature [19] regarding of what is actually included in such lifecycle. Researchers either propose simple sequential diagrams with rigid connections between the different lifecycle steps, or introduce illustrations with multi-faceted interfaces in an effort to achieve specific objectives. A comparative survey of the established BPM lifecycles [20] demonstrates the abundance of existing approaches. Further investigation of these lifecycle models reveals a unique orientation for each e.g., how to incorporate external factors into BPM [21], or how to analyze whether BPM systems actually support the different phases of the lifecycle [22]. This variety of approaches underlines the absence of a unanimous point of view in the academic and business community, which results in limited and fragmented benefits.

Moreover, organizations face many different sets of regulations they have to comply with, from high-level regulations and frameworks (e.g., CMMI, ITIL, COBIT and ISO rules) to low-level specific business rules. An instance of non-compliance can result in

severe penalties such as financial or reputation loss stressing the importance of the semantically correct and error-free execution of business processes. The proper executability of a process model has been based on semantic constraints [23]. These Semantic Constraints or Compliance Rules stem from standards, regulations, guidelines, corporate policies and laws and reflect whether a process complies with them.
Over the last decades, the global discipline of BPM academics, practitioners and professionals have incrementally improved established BPM lifecycle models. For BPM to remain relevant, the community has to reconsider its overall aim and make a shift from the economy of corporations to a digitally empowered economy of people [24]. This entails that the current perception of business processes, i.e. rigid rule-based execution of pre-defined activities has to evolve into dynamically evolving processes based on real-time customer needs and comprised of context-sensitive activities. This paper intends to highlight the need for a conceptual model tailored to current and emerging requirements. This context-aware model focuses on constant adaptation and applies for both business process lifecycle and compliance checking.

3 Business Process as an Entity: A Conceptual Model

Given the diversity of both theoretical (definitions, design) and functional (lifecycle, compliance) aspects of BPM, the authors propose a contextual business process structure (Fig. 1) that perceives business process as a unique entity and supports continuous modification and evolution of its design, based on the feedback it generates. The inspiration for the proposed approach is based on the description introduced in [8]: *"Sustainable business processes carried out by human operators are a balancing act between learning from the past and experimenting with and adapting to the future, and between rules and constraints versus freedom and flexibility".* The proposed entity is separated in three distinct sets of components: (i) the prerequisite components, (ii) the process and contextual components, and (iii) the goal components.

We argue that for designing a business process, the prerequisite components are essential in determining the scope and the outcome: (a) who is the recipient of the outcome? The customer (external or internal to the organization) is the initiator of a particular business process instance and -in most cases- the recipient of its outcome. (b) What is the expected outcome of the process (i.e. product, service or a combination)? The desired outcome(s) of the process should be explicitly documented including the cases that they fail to be produced. Designing a business process without clear indication of what it produces or when it concludes is a recipe for disaster [25]. (c) What are the required resources and conditions for the outcome to be produced and the customer to be satisfied? This prerequisite is about specifying the necessary resources and conditions for the process to run smoothly and document the effect of their absence to a process instance. Completing the specification of the first set of components, the process designer has a clear idea on the business process: who is intended for, what is the outcome and what is required for its enactment.

The second set of components includes the construction of the process design along with the contextual elements. Examples of how context is incorporated in the business

process specification include frameworks that describe context factors with relevance to BPM projects based on their settings [26], and select methods and mechanisms to work together for supporting context-aware BPM [27]. Relevant research is still at an early stage which provides the opportunity of formally incorporating context awareness into BPM. The other component is business process design that includes: (i) the business objectives (qualitative or quantitative) over which the process is evaluated; (ii) the particular arrangement of its structural elements (e.g., activities and other artifacts); and (iii) the data flows, i.e. the circulation of data throughout the process execution [28].

The business process instance is a specific enactment and implementation of the business process design, depending on the particular process inputs [29]. During a single execution, specific decisions are taken, following the actual events that lead to the performance of explicit activities. The combination of these elements produces each time a unique blueprint based on the initial design. It is important to acknowledge the static nature of a business process design, no matter how accurately describes an operation, and the dynamic knowledge-intensive nature of its generated instances that can provide a better understanding of the flexibility that a business process can demonstrate.

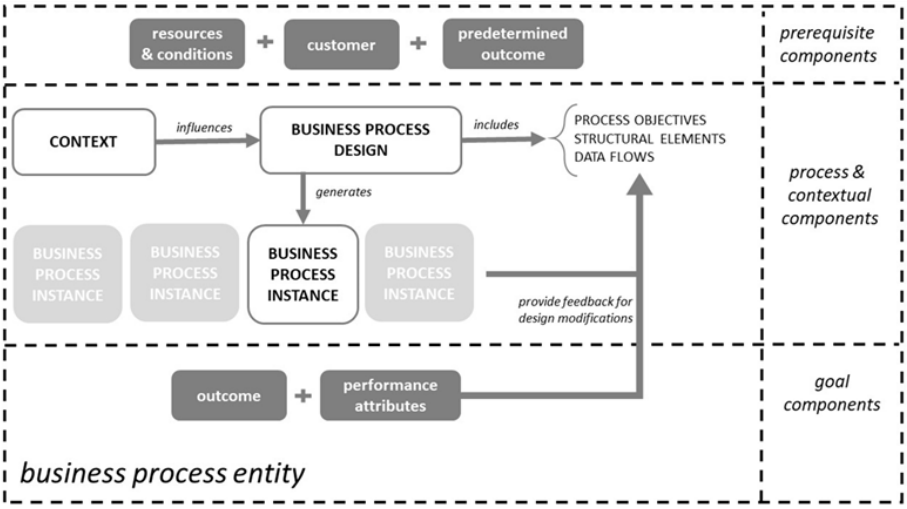

Fig. 1. Proposed structure of the business process entity

The goal components include: (i) the final outcome; complete or incomplete in relation to the predetermined one, and (ii) the performance attributes; multiple factors and key performance indicators, such as process efficiency, effectiveness and flexibility, policy adherence and traceability [30]. These attributes assess each process instance and provide feedback for the process performance. Based on the proposed entity, the process design is continuously modified based on the feedback of the goal components. Regarding design modification, we avoided using the words 'improvement, 'optimization' and 'redesign' as they require specific criteria, objectives and techniques. The aim of the proposed structure is to portray that the business process entity should encompass a continuous modification and evolution of its design based on the feedback

it generates. The specific approach towards design modification (whether it is redesign, improvement, restructuring, optimization) is open to different disciplines and methodologies. The main novelties of the proposed structure of the business process entity are: (1) The business process entity has clear boundaries and interrelated components; (2) Context awareness in the design adds flexibility and highlights the subjective nature of each instance; (3) A predetermined outcome, specific performance attributes and the potential of design modification enable the capability for continuous process improvement and the application of various approaches towards modifying/improving the business process. The main rationale is that metadata, new insights and any kind of feedback generated during past executions can be leveraged to enhance the design of processes.

4 A Business Process Lifecycle based on the proposed entity

The notion of BPM and the abundance of proposed lifecycles create ambiguity on structuring and managing an organization's business processes [31]. The authors propose that lifecycle should be attributed to a business process and the various stages (e.g., elicitation, modelling, enactment, redesign) it evolves through; not BPM as an entity. It is far easier to conceive and manage such perspective: an organization designs business processes by explicitly specifying the lifecycle, span and stages they evolve by utilizing the appropriate tools and methods in each phase. Many of the existing BPM lifecycles discussed in [20] make more sense under this perspective. Based on the most commonly used lifecycles in BPM, the authors suggest a comprehensive set of steps that compose the *business process lifecycle*:

1. *Specification:* This first step encompasses the specification of scope, i.e. the predetermined outcome the customer intends for, along with the identification of explicit conditions and resources needed to be in place for a continual process execution. This step also serves as a primary conformance check that inspects the organizational capacity required for the next step.
2. *Design and modelling:* This step determines the artifacts, business objectives and data flows. Design refers to aligning the scope of the process to specific business operations, departments and tasks, whereas modelling refers to capturing the process using structured techniques with formal syntax. At this step, the particular organizational goals are specifically determined.
3. *Contextualization* (or configuration): A step that involves system selection and testing through selecting the subjective elements that influence the business process in a particular context. This phase takes place before the actual business process implementation and once it is completed, the system is launched in its context where the design is fine-tuned in accordance to the environment that the process will be enacted [3].
4. *Implementation, Execution and Monitoring:* The selected design is translated to an actual workflow taking place in the organization with the assistance of a Business Process Management System (BPMS). A process is enacted each time in the form of a unique process instance containing additional run-time information that can

provide feedback for the evaluation of performance. This step also encompasses the capability of switching variants during runtime to adapt to context changes [32].

5. *Performance analysis and evaluation:* The execution data collected from the various process instances in the previous step, are collected in log file and evaluated based on specific criteria that can be qualitative or quantitative. The competence of the execution environment is also analyzed for providing an assessment of contextual features.
6. *Redesign:* This step occurs through the application of various techniques and approaches that result in modifying the process design based on the feedback for the process run-time and/or the performance attributes e.g., to adapt to current conditions or optimize according to a given objective function. This stage can result in both high- and low-level design modifications, or complete overhaul of the business process depending on the technique utilized.

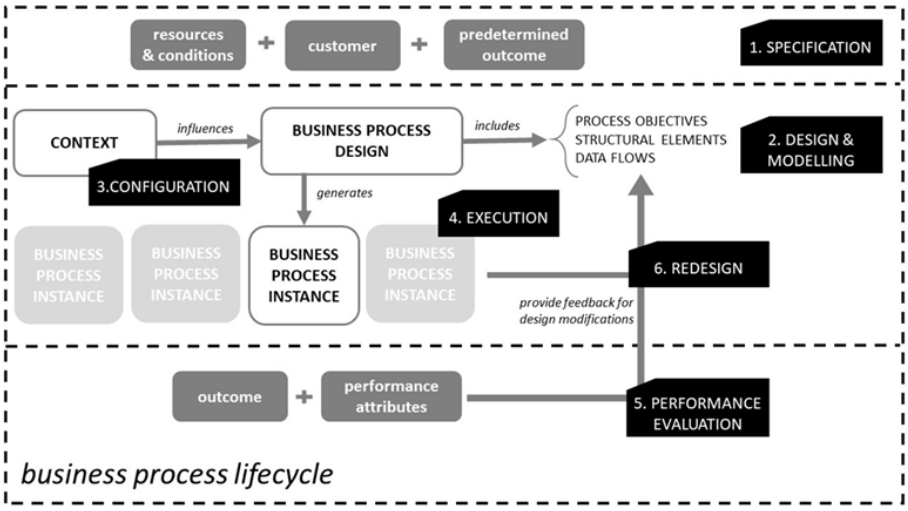

Fig. 2. Proposed business process lifecycle projected on the business process entity

The selection of steps for the proposed business process lifecycle comprises an inclusive collection in comparison to the existing lifecycles. It should be highlighted that the steps selected are first class citizens in all models presented in [20], despite the fact that they are incorporated into these models in different ways. Fig. 2 extends the proposed business process entity by projecting the proposed lifecycle steps with the business process elements identified in the previous section. This further showcases that a concise definition and structure of what consists a business process encompasses the various cycle steps it evolves through its lifecycle alleviating the need to define processes and BPM lifecycles separately. The business process lifecycle adds on the proposed conceptual model by aligning its encompassing steps on the proposed entity thus bridging the gap between business process blueprints and existing BPM lifecycle models.

5 Multi-Stage Compliance Framework

The final view of the conceptual model focuses on the topic of business process compliance. Governatori and Rotolo [33] define Business Process Compliance (BPC) as the relationship between two sets of specifications: (a) the specification for the processes adopted by a business to achieve its goal (i.e. the formal representation of a process model), and, (b) the specifications corresponding to the regulations relevant for a business (i.e. the formal representation of a relevant regulation). The authors propose an aligned approach on how compliance rules can be incorporated in the different components of the business process entity.

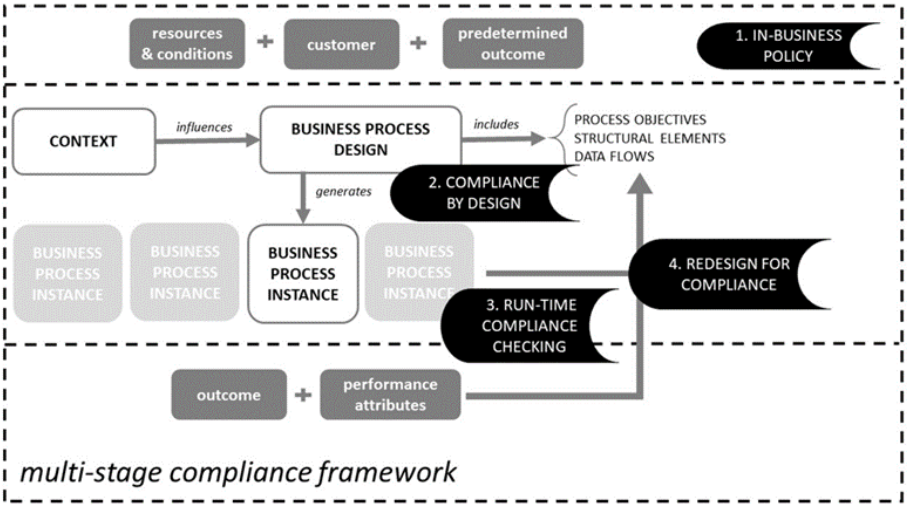

Fig. 3. Proposed compliance framework based on the business process entity.

According to Ghanavati et. al. [33], compliance in business process entails:

1. Identification of the compliance rules that are relevant to a particular business process,
2. Tracking of compliance rules relevant to the organization due to the dynamically changing of legislatures and compliance requirements,
3. Extracting relevant legal requirements from source documents (i.e., legal texts),
4. Identification of noncompliance instances and prioritization for resolution to prevent the occurrence of non-compliant situations,
5. Modification of the process instance behavior the during its execution,
6. Integration of relevant legal requirements to the business processes of the organization and optimization of the overall business strategy,
7. Updating all of the above in the face of ongoing evolution of regulations and the organization itself.

Much of the work discussed in relevant literature attempts to ensure compliance between business processes and regulations [35]. The majority of the compliance-checking approaches focus on a particular checking moment [36], [23] during the business process lifecycle:

- a priori, including Forward Compliance Checking (FCC) and Design-Time Compliance Checking (DTCC), and,
- a posteriori, including Backward Compliance Checking (BCC).

Based on the above, Fig. 3 extends the proposed business process structure through relating business process compliance practices with the business process elements identified in the previous section to produce compliance-aware business processes. In particular:

1. *In-business policy:* in this phase, the organization produces its policy. The company identifies and analyzes the compliance rules (e.g., regulations, laws, best practices, contracts) that integrate with its business and produce a deliberate system of principles to guide its processes and achieve business outcomes. An effective in-business policy does not guarantee continued compliance between processes and internal or external laws, because problems are inevitable to occur in the real world (e.g., computers break, people do not absorb their training, data gets corrupted) and as a result a business policy is not always adhered to. However, generating the in-business policy is essential to drive the design of compliant business processes.

2. *Compliance by design or Compliance modeling:* the goal of this phase to model business processes with respect to the in-business policy also considering the final goal of the process and the services it has to provide to the organization. While considering compliance (as defined in the previous step) in the business process modeling, it is important not limit the potential of the business process imposing severe restrictions. Compliance modelling should also benefit process design by incorporating checking mechanisms to control compliant execution of the business processes. The aim of this stage is to achieve compliance by design [37]. The outcome of this compliance stage is a structured collection of mechanisms and other parameters that encompass business rules checked at run time.

3. *Run-time compliance checking:* this phase starts when the compliant processes are executed using a configured system (e.g., a WFMS). Run-Time Compliance Checking (RTCC) techniques such as Compliance alerts and Recovery actions ensure compliance of business processes with regulations and business rules on time to avoid ending in a non-compliant result. Such checking mechanisms find a non-compliant factor while running the process and allow process engineers to both control and monitor compliance rules during the generation of process instances [36]. This phase also calculates the degree of compliance of an executed compliant business process instance. During process execution, relevant data are collected and analyzed to determine how well the process is complying with respect to in-business policy and other compliance parameters. Namely, the data logged by the information

system are used to diagnose the operational process bottlenecks and recurrent errors or deviations. Consequently, corrective actions are can be undertaken.

4. *Process Redesign for Compliance:* the goal of this phase is to monitor the aforementioned changes, analyze and apply them to a process model with increased in-business policy compliance and alignment with the organizational performance objectives. Redesign for compliance aims at a redesigned process with increased degree of compliance which serves as a basis for the next iteration.

Also, it is important to highlight the need for an external consultant (e.g., a financial auditor) to certify business compliance. This external actor physically visits the company and checks (i) whether the company has correctly interpreted the existing legislation, (ii) whether business processes have been correctly implemented, and, finally, (iii) whether they are correctly executed [38]. The system must be prepared to allow the execution of internal audits aimed at performing routine controls by the organization, and external audits carried out by compliance experts unconnected with the organization and responsible for checking whether the organization complies with the rules [35].

The proposed compliance conceptual framework provides full-coverage of the business process lifecycle to fulfill the need for automated compliance support. This is achieved by combining before-the-fact, run time and after-the-fact compliance checking approaches. More particular, in-business policy is a preventative step to avoid non-compliant situations at the modeling phase. It's a mechanism (i.e., a collection of legal norms relevant to our organization or originating from the government, standardization bodies, customers and the like) guaranteeing that a future process design will be compliant. Compliance by design or Compliance modeling is a subsequent verification of compliance while modeling the business process to result in a business process that is compliant by design. In the following phase (i.e., run-time compliance checking) the execution of business process (i.e., when process and event definitions are consumed) is covered by checking compliance step by step (after each task is executed). Finally, the compliance-aware framework goes a step forward by proposing the stage of Process Redesign for Compliance which provides a means of evaluating the impact of aforementioned compliance control phases, detect and analyze compliance violations on executed process models, and, provide feedback for process (re)design.

6 Discussion and Conclusions

The authors put forward a three-fold conceptual model to: (i) clearly define the boundaries and components of business processes, (ii) align and better manage its lifecycle by matching specific cycle steps to corresponding elements, and (iii) generate business processes applying a novel 'compliance-by-design and redesign' approach. The proposal addresses current limitations and is amenable to further extensions. More specifically, the authors examined core aspects of business processes; their definitions and structure, the elements of a business process lifecycle and their interrelations. By examining existing definitions and structures of business processes, the authors proposed an entity that is more contemporary in the sense that includes contextual elements and

focuses on continuous and adaptive process modification. A next step would be to develop a mechanism of recording and generating business process paradigms based on the proposed structure. In addition, a known issue in evaluating qualitative and quantitative approaches is the lack of a library of comparable business process problems. An established library of theoretical problems is common in many disciplines in testing the performance and consistency of new algorithms and techniques. Having a mechanism to capture and generate business process paradigms will assist in better evaluating the various modelling and improvement approaches put forward by researchers and practitioners in providing comparable results. Currently, the authors investigate business process paradigms used in literature as motivational examples, to compose a cumulative library that can initially serve to test and validate the conceptual framework. Thereafter, the proposed business process structure can be a starting point for creating test cases of business process designs that can then be utilized in specific domains.

This paper also examined the necessity for managing the lifecycle of business processes in a structured and coherent way. The authors proposed a lifecycle centered on the proposed business process entity. Most of the current approaches depict the cycle steps in a simple sequential manner failing to properly depict their complex interrelations. Our proposal matches the various lifecycle steps to specific components of the business process entity and aims for a more comprehensive approach in managing the process lifecycle. As a future direction, this approach will be further extended by modeling the interactions of the various steps through the lifecycle of a business process. Treating the BPM lifecycle as a process itself can potentially provide: (i) a closer and more detailed interaction of the various cycle steps, (ii) a clearer perspective of how a business process unfolds and (iii) the appropriate tools and techniques that are better suited for each stage.

Furthermore, the authors are currently focusing their efforts towards automated (or semi-automated) checking of the degree of compliance between a business process and the applicable compliance rules. The areas of focus, according to [34], [35]: (i) identification of particular protocols on compliance analysis (e.g., how to extract legal requirements, how to map them to business processes); (ii) construction of templates and samples to help organizations build compliant processes more easily; and (iii) formal extraction of compliance rules (i.e., in-business standard policy). A future extension of the proposed multi-stage compliance framework should address the above challenges.

References

1. Tsakalidis, G., Vergidis, K.: Towards a comprehensive business process optimization framework. In: Business Informatics (CBI), 2017 IEEE 19th Conference on. pp. 129–134. IEEE (2017).
2. Hassani, A., Ghannouchi, S.A.: Analysis of Massive E-learning Processes: An Approach Based on Big Association Rules Mining. In: International Conference on Parallel and Distributed Computing: Applications and Technologies. pp. 188–199. Springer (2018).
3. Weske, M.: Business Process Management: Concepts, Languages, Architectures. Springer-Verlag Berlin Heidelberg (2012).

4. Van Der Aalst, W.M., Ter Hofstede, A.H., Weske, M.: Business process management: a comprehensive survey. ISRN Software Engineering. 2013, (2013).
5. Recker, J., Mendling, J.: The state of the art of business process management research as published in the BPM conference. Business & Information Systems Engineering. 58, 55–72 (2016).
6. Georgoulakos, K., Vergidis, K., Tsakalidis, G., Samaras, N.: Evolutionary multi-objective optimization of business process designs with pre-processing. In: 2017 IEEE Congress on Evolutionary Computation (CEC). pp. 897–904. IEEE (2017).
7. Völkner, P., Werners, B.: A decision support system for business process planning. European Journal of Operational Research. 125, 633–647 (2000).
8. Lindsay, A., Downs, D., Lunn, K.: Business processes—attempts to find a definition. Information and software technology. 45, 1015–1019 (2003).
9. Dumas, M., Rosa, M.L., Mendling, J., Reijers, H.A.: Fundamentals of Business Process Management. Springer (2018).
10. Pourshahid, A., Amyot, D., Peyton, L., Ghanavati, S., Chen, P., Weiss, M., Forster, A.J.: Business process management with the user requirements notation. Electronic Commerce Research. 9, 269–316 (2009).
11. Van der Aalst, W.M.P.: A class of Petri net for modeling and analyzing business processes. Computing Science Reports. 95, 26 (1995).
12. Zur Muehlen, M., Ho, D.T.-Y.: Risk management in the BPM lifecycle. In: International Conference on Business Process Management. pp. 454–466. Springer (2005).
13. Caetano, A., Silva, A.R., Tribolet, J.: Using roles and business objects to model and understand business processes. In: Proceedings of the 2005 ACM symposium on Applied computing. pp. 1308–1313. ACM (2005).
14. Tyndale-Biscoe, S., Sims, O., Wood, B., Sluman, C.: Business modelling for component systems with UML. In: Enterprise Distributed Object Computing Conference, 2002. EDOC'02. Proceedings. Sixth International. pp. 120–131. IEEE (2002).
15. Born, M.: User guidance in business process modelling. Logos Verlag Berlin GmbH (2012).
16. Vom Brocke, J., Mendling, J.: Business process management cases. Digital Innovation and Business Transformation in Practice. Berlin et al.: Springer. (2018).
17. Ma, Z., Leymann, F.: A lifecycle model for using process fragment in business process modeling. In: Proceedings of the 9th Workshop on Business Process Modeling, Development, and Support (BPDMS 2008). pp. 1–9 (2008).
18. van der Aalst, W.M.: Business process management: a personal view. Business Process Management Journal. 10, (2004).
19. Ruževičius, J., Milinavičiūtė, I., Klimas, D.: Peculiarities of the business process management lifecycle at different maturity levels: The banking sector's case. Issues of business and law. 2029–1094 (2012).
20. Macedo de Morais, R., Kazan, S., Inês Dallavalle de Pádua, S., Lucirton Costa, A.: An analysis of BPM lifecycles: from a literature review to a framework proposal. Business Process Management Journal. 20, 412–432 (2014).
21. Bernardo, R., Galina, S.V.R., Pádua, S.I.D. de: The BPM lifecycle: How to incorporate a view external to the organization through dynamic capability. Business Process Management Journal. 23, 155–175 (2017).

22. Netjes, M., Reijers, H.A., van der Aalst, W.M.: Supporting the BPM life-cycle with FileNet. In: Proceedings of the CAiSE. pp. 497–508. Citeseer (2006).
23. Reichert, M., Weber, B.: Enabling flexibility in process-aware information systems: challenges, methods, technologies. Springer Science & Business Media (2012).
24. Jesus, L., Rosemann, M.: The Future BPM: Seven Opportunities to Become the Butcher and not the Turkey. BPTrends, Feb. (2017).
25. Leth, S.A.: Critical success factors for reengineering business processes. National Productivity Review. 13, 557–568 (1994).
26. vom Brocke, J., Zelt, S., Schmiedel, T.: On the role of context in business process management. International Journal of Information Management. 36, 486–495 (2016).
27. Zhao, X., Mafuz, S.: Towards incorporating context awareness into business process management. World Academy of Science, Engineering and Technology, International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering. 9, 3890–3897 (2015).
28. Le Vie, D.S., Donald, S.: Understanding data flow diagrams. In: Annual Conference - Society for Technical Communication. pp. 396–401 (2000).
29. Edwards, C.A.: Business process integrity and enterprise resource planning systems: an analysis of workaround practices in a large public sector organisation, http://scholar.sun.ac.za/handle/10019.1/79845, (2013).
30. Draheim, D.: Semantics of Business Process Models. In: Business Process Technology. pp. 75–117. Springer (2010).
31. Bucher, T., Winter, R.: Taxonomy of business process management approaches. In: Handbook on Business Process Management 2. pp. 93–114. Springer (2010).
32. Hallerbach, A., Bauer, T., Reichert, M.: Managing Process Variants in the Process Lifecycle. (2008).
33. Governatori, G., Rotolo, A.: A conceptually rich model of business process compliance. In: Proceedings of the Seventh Asia-Pacific Conference on Conceptual Modelling-Volume 110. pp. 3–12. Australian Computer Society, Inc. (2010).
34. Ghanavati, S., Amyot, D., Peyton, L.: A systematic review of goal-oriented requirements management frameworks for business process compliance. In: Requirements Engineering and Law (RELAW), 2011 Fourth International Workshop on. pp. 25–34. IEEE (2011).
35. Cabanillas, C., Resinas, M., Ruiz-Cortés, A.: Exploring features of a full-coverage integrated solution for business process compliance. In: International Conference on Advanced Information Systems Engineering. pp. 218–227. Springer (2011).
36. Cabanillas Macías, C., Resinas Arias de Reyna, M., Ruiz Cortés, A.: Hints on how to face business process compliance. III Taller De Procesos De Negocio E Ingeniería De Servicios, PNIS2010, Valencia, España. (2010).
37. Sadiq, S., Governatori, G., Namiri, K.: Modeling control objectives for business process compliance. In: International conference on business process management. pp. 149–164. Springer (2007).
38. Daniel, F., Casati, F., D'Andrea, V., Mulo, E., Zdun, U., Dustdar, S., Strauch, S., Schumm, D., Leymann, F., Sebahi, S.: Business compliance governance in service-oriented architectures. In: International Conference on Advanced Information Networking and Applications, 2009 (AINA'09). pp. 113–120. IEEE (2009).