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Challenges To Support A PPI Management Lifecycle*

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Abstract

An important aspect in the business process lifecycle is the evaluation of business processes performance, since it helps organisations to define and measure progress towards their goals. Performance requirements on business processes can be specified by means of Process Performance Indicators (PPIs), as suggested in many methodologies and frameworks like, for instance, COBIT, ITIL or EFQM. As a consequence, it is convenient to integrate the management of PPIs into the whole business process lifecycle from its design to its evaluation, enabling thus a more effective an efficient automated support to extract information from such indicators. In this paper, we analyse some approaches related to this issue and identify the challenges that need to be faced.

1 Introduction

It is increasingly important to evaluate the performance of business processes. A key instrument to carry out this evaluation is by means of Process Performance Indicators (PPIs). A PPI is a measure that reflects the critical success factors of a business process defined within an organisation, in which its target value must be reached in a certain period and reflects the objectives pursued by the organisation with that business process. Note that we use PPI as a kind of Key Performance

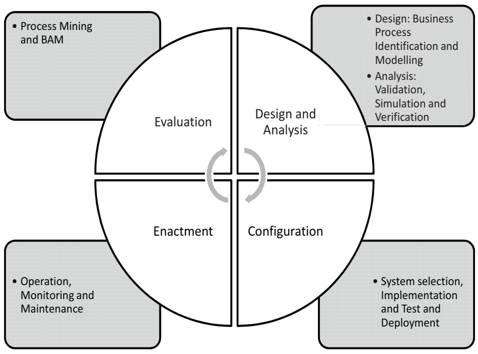

Figure 1: Business Process Lifecycle as described in [4]

Indicator (KPI) that focuses exclusively on the indicators defined on the business processes. Nowadays, many methodologies and frameworks like, for instance, COBIT, ITIL or the EFQM excellence model [1, 2, 3], confirm this importance by including the definition of these PPIs within their recommendations as a means to evaluate the performance of the existing business processes. In order to make this evaluation of business processes easier, it is convenient to integrate the management of PPIs into the whole business process lifecycle. In [4], the four-phase business process lifecycle of Figure 1 is proposed. This lifecycle starts with the Design and analysis phase, in which business processes are identified, modelled using a particular notation, validated to check whether all valid process instances are reflected by its corresponding business process model, simulated to detect possible undesired

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execution sequences, and verified. Once the business process model is designed and verified, it needs to be implemented. This is done during the configuration phase, where, in case a dedicated software system is needed, it must be selected and configured in order to take into account the interactions of the employees with the system and the integration with existing software systems. Then, the implementation of business process needs to be tested and finally deployed in its target environment. Next phase is the enactment, that encompasses the run time of the business process. On the one hand, a correct orchestration is necessary for the business activities to be performed according to the business process's execution constraints. On the other hand, process monitoring is a good mechanism for providing information about the status of business process instances. Finally, the evaluation phase uses information available to evaluate and improve business process models and their implementations. Note that there not exists a strict temporal ordering in which these phases need to be executed; incremental and evolutionary approaches involving concurrent activities in multiple phases are, thus, common. In this paper, we are interested in describing what has been done in the literature regarding the integration of PPIs as first-class citizens in this business process lifecycle, and in outlining the open challenges this issue presents.

The remainder of this paper is organised as follows. In Section 2 we explain how to integrate PPIs into the business process management lifecycle and analyse how different approaches deal with this issue. From this section, a number of open research questions are identified and presented in Section 3. Finally, Section 4 draws the conclusions from our work, summarizes the paper and outlines our future work.

2 Integrating PPIs Into The Business Process Management Lifecycle

In order to make the evaluation of the performance of business processes easier, it is convenient to integrate the management of PPIs into the whole business process lifecycle. In this section, we take the business process lifecycle presented by Weske in [4, 5] as a reference and we describe how management of PPIs can be integrated into this lifecycle. Furthermore, we also report on several proposals that can be used to support this integration.

2.1 Design and Analysis

In the design and analysis phase, PPIs should be modelled together with the business process. Furthermore, this model of PPIs should also enable their analysis by detecting the dependencies amongst them at design time and also using them as part of the business process analysis, for instance in business process simulation techniques.

With respect to this phase, several authors have presented some approaches: Pedrinaci et al. present in [9] a metric ontology to allow the definition and computation of metrics. Popova et al. [13] present a framework for modeling performance indicators within a general organisation modeling framework. They define indicators by assigning values to a set of attributes. In [23], they point out the way these indicators are calculated and define relations between PPIs and the processes. Relationships between PPIs (causality, correlation and aggregation) are briefly introduced in [13] and explained in detail in [23]. They also define temporal properties over PPIs (called PI expressions) in [24]. Wetzstein et al. describe in [20] a KPI ontology using WSML to specify KPIs over semantic business processes. In [15] Mayerl et al. discuss how to derive metric dependency definitions from functional dependencies by applying dependency patterns. Castellanos et al. present in [18] the IBOM platform, that allows, among other things, to define business measures. The user can define business measures (through a GUI) to measure characteristics of process instances, processes, resources or of the overall business operations. Specifically, they characterize metrics through four attributes: name (unique), target entity (objet to be measured), data type (numeric, boolean, taxonomy or SLA) and desirable metric values. This approach is not focused on business processes but on the whole organisation.

2.2 Configuration

During the configuration phase, the instrumentation of the processes that are necessary to take the measures must be defined.

Momm et al. present in [19] a meta-model for the specification of the PPI monitoring along with an extension of the BPMN meta-model for modeling the required instrumentation for the monitoring and an outline of methodology for an automated generation of this instrumentation.This approach explains how to define a KPI and how to take the measures.

2.3 Enactment

During the business process enactment, when valuable execution data is gathered, the PPIs' values have to be calculated and the monitoring of these PPIs should be carried out. For instance, this can be done based on execution logs that store information about the process such as the start or the end of activities.

To overcome this issue, Pedrinaci et al. present in [9] a Semantic Business Process Monitoring Tool called SENTINEL. This tool can support automated reasoning. Popova et al. propose in [23] formal techniques for analysis of executions of organizational scenarios. Wetzstein et al. introduce in [20] a framework for BAM as part of the semantic business process management, where PPI models are automatically converted to IT-level event-based models and used for real-time monitoring using reasoning technology. In this framework, there is a monitor model that specifies how events are processed to calculate KPIs, whose values are then published in dashboards

2.4 Evaluation

Finally, during the evaluation phase, the monitoring information obtained in the previous phase will help to identify correlations and predict future behaviour.

Castellanos et al. [18] address this issue, since their IBOM platform also allows to perform intelligent analysis on business measures to understand causes of undesired values and predict future values.

3 Challenges

As can be deduced from Section 2, business process lifecycle can benefit from the definition of PPIs over processes and from a set of analysis operations of them, enabling a more effective and efficient automated support to extract information from such indicators.

In order to obtain such benefit, there exists a number of research questions that are not answered yet. In the following we state some of them:

- **Which information is necessary in order to define Process Performance Indicators over business processes? How do these PPIs relate to the business processes for which they were defined?**

  An appropriate definition of PPIs is key to enable the automated support of the aforementioned PPIs lifecycle. Moreover, in order to be able to get information, not only from the indicators, but also from the business processes they were defined for, it is important to define an explicit connection between indicators and the process elements they are measuring.

  There are several research proposals to define PPIs, as presented in Section 2, but none of them are well-suited because either there are commonly used PPIs that cannot be defined with them or they are not ready to enable a design-time analysis of PPIs. In Pedrinati et al.'s approach [9] it is not clear whether the defined metrics are explicitly connected with the elements of a business process. Popova et al. [13] do not consider derived measures when defining indicators. Wetzstein et al. [20] do not take into account indicators related to data. Mayerl et al. [15] do not delve into the definition of measures, they only set the semantics of some elements to consider when defining measures based on concepts of the CIM metrics model [16] (e.g. UnitOfWork, which relates metrics with functional entities) and the QoS UML profile described in [17]. Momm et al.'s metamodel for the specification of PPIs [19] lacks some properties identified like, for instance, the analysis period of the PPI). Finally, Castellanos et al. [18], as far as we can deduce from the paper, do not take into account during the definition of metrics some aspects such as the analysis period, the unit of measure or the dimension to be measured.

- **Which analysis operations can be applied to PPIs in order to get relevant information about them? Which information can be gathered from these PPIs' definition?**

  Making queries and extracting information from PPIs may be useful when defining dashboards to monitor processes. Furthermore, the analysis of these PPIs at design-time can help to assure the definition of achievable goals or even identify conflicting goals. E.g. It could be detected if two PPIs inversely dependent are being tried to be optimised. Another benefit resulting from this analysis is the possibility to find out how certain activity influences PPIs or vice versa.

  With respect to this challenge, there exist some approaches [9, 23, 20, 18] that address the analysis of PPIs, but they do it in runtime, losing the aforementioned benefits of this design-time analysis.

- **Which are the issues to consider when developing a suitable tool to support this automatic analysis of process performance indicators?**

  Explicit business process models expressed in a graphical notation (such as, for instance, BPMN) ease communication about these processes, so that stakeholders can communicate efficiently, and refine and improve them. In the same way, it is convenient to develop a graphical notation to depict these PPIs together with the corresponding business process models. Thus, it is necessary to develop a tool to support such a graphical notation of PPIs, as well as to enable their automated analysis. Furthermore, it would be very useful to integrate such a tool with an editor of business process diagrams.

  To the best of our knowledge, there not exists such a graphical notation nor the described tool.

4 Conclusions and Future Work

In this paper, we argue the importance of integrating the management of PPIs into the whole business process lifecycle. Specifically, in the design and analysis phase, PPIs must be modelled together with the business process. This model should enable (at design-time) an automated or semi-automated analysis to, for instance, detect the dependencies and potential conflicts amongst them or to use them together with other business process analysis techniques such as simulation techniques. We have analysed how different approaches address this issue and their shortcomings. We have also identified the challenges that need to be faced to this respect.

Our future work focuses on finding answers to the open research questions presented in Section 3. In order to do so we have already started by defining an ontology for the definition of PPIs (described in a paper submitted to the 18th International Conference on Cooperative Information Systems-CoopIS 2010), whose main benefits can be summarised as follows:

1. The relation between PPIs and the business process is explicitly established.

2. It supports the definition of a wide variety of PPIs, including those associated with data objects. It also supports the definition of an expressive analysis period of a PPI

3. Dependencies between measures can be automatically obtained from the ontology, which enables the analysis of PPIs at design time. Furthermore, since the ontology has been defined in OWL DL, automated reasoners can be used to make queries about the PPI model

Moreover, we are extending this ontological definition with a textual language as closer to the natural language as possible, in order to ease this definition.

With respect to the second point, we plan to define a mechanism to make queries on PPIs (PPI-Q) similar to the one presented in [21] to make queries on BPMN (BPMN-Q). We are also working on describing mechanisms to derive restrictions (taking advantage from Constraint Satisfaction Problems) between PPIs, in order to extract knowledge in an automatic way from the PPIs defined over a particular business process.

Finally, to overcome the third challenge, we are developing a graphical notation in order to depict these ontological concepts of PPIs over business processes and we are also integrating this notation into the web-based editor ORYX [22] as a result of a collaboration stay with the BPT group at the HPI Potsdam.

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