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Towards Improving Business Processes based on preconfigured KPI target values, Process Mining and Redesign Patterns

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Abstract

The Business Process Management (BPM) lifecycle includes a redesign phase, which is an important step for stakeholders while working on the improvement of their Business Processes. Some research approaches on process improvement involve Key Performance Indicators and Process Mining, but essentially using the latter to verify if improvement efforts have been successful. In this paper, we propose a different approach for process improvement by first defining and configuring, process KPI target values, and second using Process Mining techniques to discover and analyze deviations from those values. Then, for each deviation we propose improvement solutions based on Business Process redesign patterns. Since this encompasses also an improvement cycle, we present our approach as an extension of the well-known BPM cycle. With this approach, process stakeholders will be able to quickly identify process KPI deviations based on quality, cost, time and flexibility, and resolve them by automatically applying proven redesign patterns.

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1. Introduction

Business Process Management (BPM) is a discipline in which people use various methods to discover, model, analyze, measure, improve, optimize, and automate business processes along their lifecycle [1]. BPM is commonly used for Business Process Improvement (BPI), which allows for business processes to adapt to nowadays' complex, changing and competitive business environments. Although many BPI approaches exist, they tend to be hard to implement by process participants or even process engineers without enough knowledge in BPM [8].

Regarding the BPM landscape, business strategy and derived business goals are often well understood by collaborators, as they end up being commonly expressed by Key Performance Indicators (KPIs). For instance, regarding a health facility, in a patient-centered approach (strategy), the administration board could decide on reducing the waiting time in medical appointments (goal) by 10% (quantitative KPI) [14].

When mapping strategy, business goals and KPIs to business processes, collaborators find it difficult to correlate. For instance, authors in [15] propose the use of Enterprise Architecture concepts to perform a longitudinal mapping from business goals to business processes, registering the associated KPIs. In [16], the authors optimize a business process using a specific scheduling IT tool and realize that not every aspect of the process was improved. This led us to conclude that BPI is often guided by perceptions, without little knowledge on process data or even proven improvement patterns.

In this paper, we propose an approach to BPI based on KPIs target values, Process Mining (PM) techniques and process redesign patterns. For this, we extend the BPM lifecycle and propose a set of additional activities for each of its (Re) Design, Configuration, Enactment and Evaluation phases. The approach foresees that process engineers can easily set KPI target values associated with processes, to then analyze and compare them with registered values, using PM.

After analyzing the (possible) occurred deviations/violations, and depending on the type of process elements involved and improvement desired (related to time, cost, quality and/or flexibility), the process engineer should be guided to select the suitable pattern(s) to redesign the business process.

The remainder of this paper is organized as follows: in section 2 we provide related work, and in section 3 we detail our proposed approach. Finally, in section 4 we conclude the paper and provide future directions.

2. Related work

Each organization relies on a specific strategy to its activity in order to achieve certain goals. This strategy should be tightly associated to business processes, in order for the organization to be able to adapt to external and internal changes and ensure a coherent running of its operations. BPM and business strategy combined with KPIs lead to more efficient and effective business processes, since KPIs represent metrics that help companies in measuring the performances of their businesses and discovering whether they are achieving their goals or not. In this context, in [2] the authors proposed a method based on using KPIs to measure the level of compliance of the business processes with authoritative rules and to identify the processes that tend to be non-compliant and need to be improved. Also, in [3] the authors suggested a flexible framework for monitoring BP execution independently from any specific process model and execution engine and allowing the definition and evaluation of user specific KPI measures.

In [4] the authors suggested a method to integrate the description of KPIs within the general process modeling. This method allows flexible management of KPIs in an enterprise having multiple business units.

In another work [5] the authors proposed a solution to increase the automation of measuring KPIs and to minimize the intervention of the IT team by relying on the semantic BPM. The work presented in [6] suggests a graphical notation for KPI definition, aiming to fill the gap between BP and KPIs and to automate KPI management.

Process Mining (PM) techniques have also been widely used to improve business processes. For instance in [7], the authors used them to analyze health processes and discover new insights that facilitated the improvement of existing care flows.

In [8] we can observe an application methodology for PM within the Physical Asset Management (PAM) environment to improve a supporting process. This is achieved by discovering real-world behavior and developing metrics which can be used to improve it. In this case, PM proved its efficiency as a remedy to quality data problems.

The use of patterns has been reported as beneficial, since they represent a general solution to a common issue [15-16], help reusing and documenting existing knowledge [15] and had proved to help saving time and effort. In [9] the authors provide an overview of heuristic rules that can support practitioners to develop a business process redesign. They define a framework with 29 patterns, and a qualitative evaluation of their impact on the cost, quality, flexibility and time dimensions of a business process.

Also in [10] the author provides a framework for identifying patterns to support the act of redesigning business processes.

In the same context, [11] presented an evaluation for the usefulness of patterns as a means of improving business processes. The evaluation is based on a simulation, as in [12], the author presented the results regarding the effectiveness and efficiency of a pattern-based approach for process improvement. They both conclude positively on the use of patterns for this matter.

As mentioned above, in this paper we focus on the correlation of three main concepts: business process Key Performance Indicators (KPIs), Process Mining (PM) and Business Process Improvement (BPI) (including redesign and improvement patterns). In Table 1, we summarize the related works found on these concepts.

Table 1. – Summary of the mentioned related works, and correlation with business process KPIs, improvement and Process Mining.

Article	KPIs	BP Improvement	Process Mining
[2]	X		
[3]	X		X
[4]	X		X
[5]	X		X
[6]			
[7]			
[8]	X		
[9]		X	
[10]		X	
[11]		X	
[12]		X	

As observed in Table 1, we could not find from the mentioned related works, any research correlating the use of KPIs, Process Mining and improvement through the use of redesign patterns. We describe, in the next section, our approach for process improvement based on these three concepts.

3. TheKPI4BPI approach

The BPM lifecycle involves four phases: (Re) Design, Configuration, Enactment and Evaluation. Our KPI4BPIapproach makes use of this BPM cycle, adding for each phase the activities and techniques used to improve business processes based on KPI target values, PM and redesign patterns.

In Figure 1, we identify (in white) the generic activities from the BPM lifecycle, and (in light orange) the ones we propose in our improvement approach.

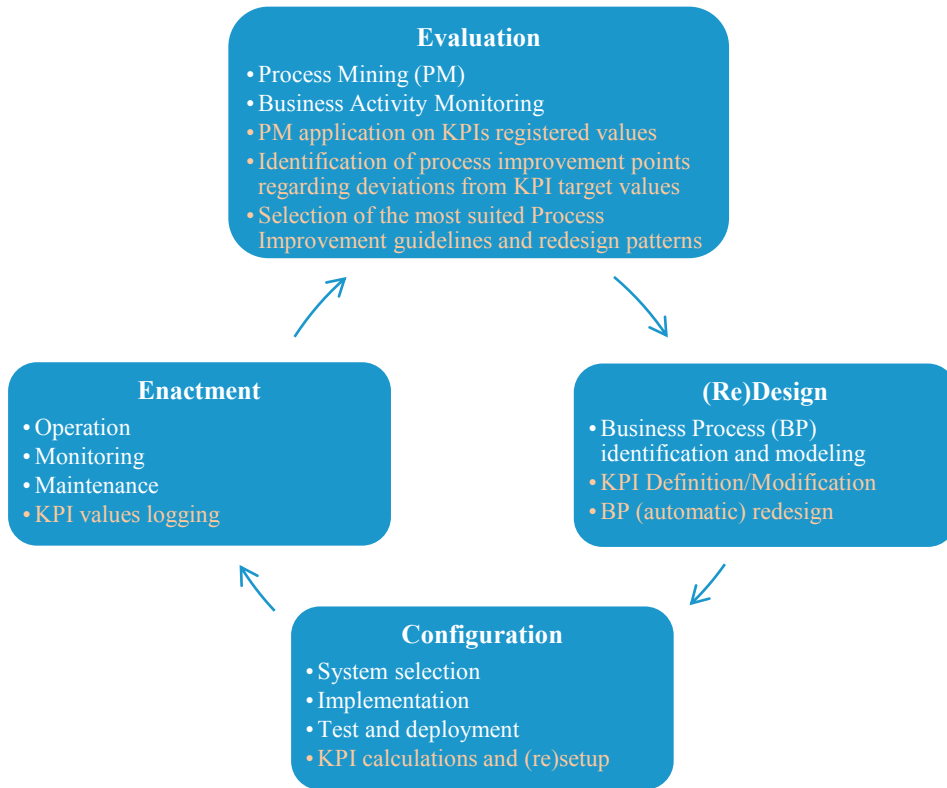


Fig 1 – BPM lifecycle [13] with the added steps from our approach.

For our approach, in the (Re) Design phase, KPI target values are defined within the process model. These values can be associated with the whole process, parts of a process or single process elements. For instance, time-related KPIs can assume a target value of 15 days maximum for a whole process instance, as well as a minimum time of 3 days between two process activity instances (e.g. in a patient discharge after surgery process). Each KPI should be simple, measurable, achievable and relevant to its corresponding goal.

The KPIs related with the pre-configured target values have then to be setup within the Configuration phase, either using the Business Process Management System (BPMS) in place, or any other system(s) supporting the business process. This is where KPI calculation formulas and measures have to be defined, and also where KPI value storage is defined, so that the system(s) can execute and store them within the context of a process instance.

During the Enactment phase, business process instances are executed and therefore calculated and measured KPI values are registered and stored.

During the Evaluation phase, Process Mining is applied in order to discover correlated KPIs for a certain process instance, and perform conformance analyses to detect KPI values' deviations from the pre-configured target values. With this, PM can also assist in identifying the parts of the process that should be improved.

Still in this Evaluation phase, the PM tool in place will also provide improvement guidelines and applicable redesign patterns for each deviation detected. These suggested guidelines and patterns should be closely related with the type of process elements where the deviation occurred.

Once back again to the (Re) Design phase, a process engineer should be able to observe/select/implement the suggested improvement guidelines and patterns, and proceed accordingly. In fact, some of these guidelines and patterns might even be automatically applied onto the process model, once they are not dependent on any constraint within the process, or bound to any decision of the process engineer. These applied improvement/redesign suggestions

can affect the way KPIs are calculated for the forthcoming process instances, and therefore, a (re)setup of these might be necessary in the Configuration phase.

4. Conclusion

Improving business processes is an ongoing activity that can be considered as complex and needing constant support. Although many approaches and solutions exist in the context of defining, modeling, monitoring, evaluating, analyzing and improving business processes. To the best of our knowledge, none of them had combined KPIs, PM and BPI guidelines and patterns.

Our KPI4BPI approach takes the BPM lifecycle as a solid base to propose a set of activities to be executed in each phase, in order to achieve a supported process improvement goal. It implies the use of modeling tools that support the definition of KPI target values, and the redesign of processes based on suggested guidelines and/or patterns. It also requires the use of systems where KPIs and their formulas can be configured, measured and stored.

The PM tool in place should also be able to associate deviations with process elements and recommended improvement guidelines and patterns (we cannot suggest a time-based improvement pattern such as a parallelism of sequenced activities on a deviation related with the cost of a certain process part).

We are actually focusing our future work in the implementation of this “intelligent” PM tool. We plan, for the proof of concept, to implement these recommendations on this tool based on the patterns and improvement framework identified in [9]. Here, patterns involving not only control-flow redesign but also resource optimizations and data quality are proposed under an improvement framework based on the cost, time, quality and flexibility dimensions. The PM tool should also support this redesign activity by proposing automatically redesigned (and improved) process models alternatives, to enhance the process engineer’s decisions.

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