Improve Performance Management in Flexible Business Processes*

Extended Abstract

Bedilia Estrada-Torres
Depto. de Lenguajes y Sistemas Informáticos, Universidad de Sevilla
Av. Reina Mercedes s/n
Sevilla, Spain 41012
iestrada@us.es

ABSTRACT

The performance of business processes is evaluated and monitored with the aim of identifying whether strategic and operational goals are being achieved. Most approaches about performance measurement have been defined over traditional highly repetitive and well-structured processes. However, current organizational and business needs have encouraged the appearance of *customizable processes* to manage collections of process variants derived from a process, and *loosely specified processes* to manage non-repeatable and unpredictable processes. However, current techniques of performance measurement have not evolved to the same pace that business processes, thus generating a gap between processes and the measurement of their performance. The thesis introduced in this paper, is focused on enhancing the performance measurement of business processes by means of the improvement of existing techniques for the definition of process performance indicators and their applicability to different types of processes. With this purpose a set of artifacts, including a metamodel, notations, tools and methodologies will be developed. They will be validated by means of case studies based on real scenarios.

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KEYWORDS

Business process management, performance indicators, flexible processes

INTRODUCTION

Current organizational needs have motivated the appearance of the so called *flexible processes*, which are processes that may undergo frequent changes or represent a large number of alternatives that should be managed, cannot be completely predefined or can be knowledge-intensive and highly dynamic processes [14]. Those flexible processes can be one of two types: *customizable processes*, to manage the variability in business processes and *loosely specified processes* to represent knowledge-intensive processes (KIPs) [14].

The former type, *customizable processes*, comprises a collection of process-model variants in a way that the individual variants can be derived via transformations, such as adding or deleting process fragments [15]. The latter, *loosely specified processes*, concerns the management of performance in KIPs [14], which are processes characterized by their complex, non-repeatable, unpredictable and emergent nature, for which only their goal is known a priori [10, 14] and whose behavior and execution are dependent on knowledge workers [5].

The performance of business processes is evaluated and monitored with the aim of identifying whether strategic and operational goals are being achieved. Over time, different techniques have been developed with the aim of managing the performance perspective of business processes. Most of them are based on the modeling of performance indica-tors [2, 13, 17]. Process performance indicators (PPIs) are quantifiable metrics that allow the evaluation of efficiency and effectiveness of business processes taking and using data that is generated within the process flow [2]. Usually these techniques focused on measuring process performance are described on the basis of well-structured and highly repetitive processes whose behavior can be fully prespecified.

Although business process modeling and management have changed to adapt to flexibility needs, these techniques have

not been extended to the field of the performance measurement. There are not approaches able to adapt current proposals of performance measurement to meet flexibility aspects of the business processes.

For the performance measurement of *customizable processes* it is necessary to identify how PPI management is influenced by variability, which includes determining, among other things: What can be variability points in PPI definitions, what business process elements can provide information for the computation of PPI values or how can this PPI values actually be computed. Only one approach about variability and performance measurement has been found [11]; however, this is not focused on the variations of business processes, but in changes than can occur in the PPI. This proposal is limited, because does not provide a solid structure to define and calculate PPIs, does not provide fixed attributes to be used in PPI definitions, which could generate ambiguous PPI definitions; and it is not possible to implement traceability between PPIs and the business processes where they are defined.

On the other hand, to measure performance of *loosely specified processes* there is a lack of a generic proposal that allows the measurement of the different concepts related to knowledge, identifies their influence and synergy upon traditional measures and, in turn, evaluates the overall performance of KIPs. Only preliminary works exist when it turns to evaluate performance of KIPs. For example in [18], a classification of performance indexes to evaluate processes is exposed, where a subset of these indexes are dedicated to KIPs. Although those indexes are sub classified depending on their orientation —time, value, quantity and quality— this proposal does not describe how each index should be materialized, defined or modeled, and how they can be integrated in a real scenario.

On the basis of previous statements, we plan to propose a mechanism that facilitates the modeling and management of PPIs considering current features used over repetitive and well-structured processes, but that also improves the management of PPIs from the point of view of their definitions and applicability in different types of processes. Several artifacts are being developed to materialize the proposal: a metamodel that meets all restrictions to measure traditional and flexible processes, notations for modeling PPIs taking into account restrictions described in the metamodel, methodologies for the application of PPIs in flexible processes to achieve business goals and supporting tools to validate and implement the proposal.

For that purpose, several case studies are being analyzed. First, to identify real difficulties in the management of PPIs caused by limitations in current mechanisms of PPI definitions and management; and second, to analyze different scenarios where the performance can be the object of interest. To carry out this measurement, new requirements derived from flexible processes must be covered with current or new performance measures and indicators.

This proposal of improvement will be validated by means of its application in real scenarios and the modeling of real measures and PPIs on flexible processes. Formal definitions and their implementation in software applications will also be used as evaluation mechanisms.

The rest of this proposal is organized as follows. Section 2 introduces the research questions that guide this thesis. Section 3 explains the research method used in the course of this research. Section 4 describes preliminary results. Finally, Section 5 outlines the structure of the thesis and provides a work plan.

2 RESEARCH QUESTIONS

This study seeks to improve the management of performance in business processes. Throughout the course of this research, two questions should be answered:

(RQ1) "*How can the management of performance be improved in flexible processes?*".

(RQ2) "*Is it possible to consider flexibility in performance indicators management?*"

To answer these questions, we based on the following assumption: *the performance measurement of business processes is carried out by means of PPIs, then to improve this measurement of performance it is necessary to improve the management of PPIs.*

On the basis of this assumption and the issues identified and presented in Section 1, **RQ1** should be addressed from the point of view of the definitions and the context of application of PPIs, from which two sub research questions are derived.

(RQ1.1) "*How can PPI definitions be improved concerning flexible processes?*"

(RQ1.2) "*How does the performance measurement vary depending on the type of flexible process being measured?*"

In this sense, it is necessary to identify the business process elements derived from flexible processes that can be measured, which conditions should be met to realize the measurement, what characteristics of current measurement techniques can be applied in flexible processes and what changes should be included in current proposals of measurement.

RQ2 is related to the possibility of implementing reusable PPI definitions that can be applied in different processes. A PPI can be defined in different processes, in this case there is a variation in the process or process variant where the PPI is defined, but not in the characteristics of the PPI. In other cases, slight changes are applied to a PPI to facilitate the reuse of its definition in a different process or process variants. If changes are applied to the PPI, Can we talk about PPI variants? This is an open discussion that should be answered at the end of this research.

3 RESEARCH METHODOLOGY AND APPROACH

In this thesis, the *design science research methodology* (DSRM) [12] is being followed. DSRM defines six activities, which are described in the context of this research below.

(1) *Problem identification and motivation* is addressed by means of both a literature review used to analyze the state of the art of process performance

measurement and flexible processes, and the study of several cases from which difficulties and drawbacks about the current management of performance may be identified.

(2) The *objective for a solution* is to provide tools and techniques to improve the current performance management of business processes by means of the improvement of PPI definitions and their management.

(3) The *design and development* of artifacts include: a metamodel that implements features to improve PPI definitions and facilitates its application in flexible processes; notations or extensions of existing ones to facilitate the modeling of PPIs; software tools to implement and validate proposals; and methodologies that provide guidelines that conduct the implementation of flexible processes and PPIs for the fulfilling of performance goals.

(4) *Demonstration* involves artifacts in the development of applications or software tools to facilitate PPI management, their definitions and applicability in different types of business processes.

(5) *Evaluation* phase will be carried out by means of the use of the artifacts developed in real scenarios to compare and analyze their feasibility and real contributions. Some of those scenarios are based on the *SCOR model* [1], which is a process reference model for the supply chain management that enables users to address, improve, and communicate supply chain management practices within and between all interested parties in the enterprise; the *Andalusian Health Service*, by means of their processes and indicators to manage incidence; and a case study of a real organization in Brazil to manage the performance of an incident troubleshooting process within an Information and Communication Technology Outsourcing Company.

(6) Finally, in the *Communication* phase, the main target will be conferences and scientific journals related to business processes and process performance.

4 PRELIMINARY RESULTS

This research is focused on the development of artifacts that improve the performance measurement of business processes. Several case studies, described in Section 3, are being anayzed to determine how PPIs can be defined extending current limitations related to their definitions and range of applications. A literature review allowed the identification of business process techniques that can be applied to PPIs. The development of artifacts is an ongoing activity addressed to overcome the issues identified in the different scenarios analyzed.

One of the main artifacts resulting from this thesis consists of a metamodel that facilitates the management of PPIs, taking into account how the performance is measured over repetitive and well-structured processes, and how they can be adapted to the new requirements identified for the measurement of flexible processes. This proposal is not starting from scratch. The *PPINOT Metamodel* [2] is one of several proposals to manage PPIs. This was selected because the metamodel is independent of the language used to model business processes, allows traceability of PPIs with the process, facilitates definitions understandable by all users and also provides notations to PPI definitions [3, 4].

PPIs can be represented using different mechanisms. In this research formal definitions are used to describe the PPINOT metamodel, its extension and also is used to model PPIs. On the basis of [3, 4], a graphical notation and a representation based on templates and linguistic patterns are being extended to allow the definition of PPIs in flexible processes. Supporting tools allow us to validate proposals; for this reason, PPINOT Tool Suite is also being extended to facilitate the modeling and automatic calculation of PPIs.

Up to know, different works have been carried out to address the issues described in this paper to incorporate the new requirements of measurement of flexible processes. Different performance dimensions, time, cost or compliance for example, can be addressed using the PPINOT metamodel, because it provides a set of general measures (time, count, state and data), which by means of a set of particular conditions, allow to take data from business process elements, regardless of the type of measure defined. In the original proposal of PPINOT, business process elements can be elements of the control-flow such as activities or events, and other elements of the process such as data objects. Through this research, this set of elements is being extended to include other elements related to flexible processes. The details of these proposals are described below.

First, with regard to *"customizable processes"*.

- A proposal about *variability* is presented in [7]. It describes how a PPI can vary depending on whether it is defined for all process variants or not, and depending on attributes required to define it, which also may change depending on the process variant in which the PPI is defined. The PPINOT metamodel was extended and expressed by means of a formal definition, to reflect the relationship between PPIs and process variants and to indicate how PPI attributes (target to be reach, scope, human resources involved and measure definitions that defines the PPI) integrate variability in its definitions. Examples using the formal definition of the PPINOT metamodel extended and another example represented by means of a graphical notation are available on the Web[1].
- The customization of a process includes the possibility of reusing some parts of its definition to reduce effort and time during its design and maintenance. In the context of PPIs, *reuse* and *abstraction* are used in [6] as two techniques to improve PPI definitions as a particular type of customization. A new proposal to improve the management of performance

[1]Examples available on PPINOT-Variability - http://www.isa.us.es/ppinot/variability-bpm2016/

focused on the way in which PPIs are defined is currently being developed. In it, a set of similar PPIs definitions are conceived as PPI variants. Reuse and hierarchical levels are materialized by means of a tool that allows us to define a PPI and reuse it in several business processes. Templates and linguistic patterns are also used to define PPIs and are also extended to allow the reuse of PPI definitions.

- With the aim of improving PPI definitions in the context of process variants, [9] proposes the use of change patterns, usually used to model business process variants, to model and manage PPIs. This proposal introduces a set of change patterns based on operations identified in the management of PPIs, they are aimed at reducing the number of operations required to specify PPIs and ensuring current PPI definitions after their constructions and modifications.

In addition, with regard to *"loosely specified processes"*.

- A proposal for the integration of PPINOT with the Knowledge-Intensive Process Ontology (KIPO) [16] has been submitted and currently it is under review for the ACM-ToIT Journal. Here, the range of application of PPINOT is extended to the field of KIPs. A set of measures and indicators are reused to be applied to KIPO elements. New measures are also required and have been included in the metamodel. In addition, a methodology based on PPINOT and KIPO, and on the concepts of lead and lag indicators was proposed to provide process participants with actionable guidelines that help them conduct the KIP in a way that fulfills a set of performance goals.
- Another approach deals with the possibility of measuring performance over CMMN cases, which can be considered as flexible processes because they are highly dynamic, cannot be fully prespecified and require loosely processes to be modeled. In this proposal, the feasibility of PPINOT to be applied in CMMN elements to measure performance of CMMN cases is evaluated. To do this, CMMN elements and PPINOT elements are analyzed to identify where is the point of union between them (measures, business process elements and other PPINOT attributes) that allow the performance measurement. Preliminary results are included in [8] and will be presented in the Spanish Conference JCIS-2017[2].

5 WORK PLAN

The structure of this thesis will be divided in several parts.

- First, it will begin with a brief *introduction* to describe its context and motivation, and to establish its goals and contributions.
- Next section, the *background*, will explain concepts in which the thesis is based. Most relevant proposals about each topic will be included to ensure their veracity and the importance of the topic. Business processes, process performance, flexibility and flexible processes are some concepts that will be described in this section.
- To explain the contribution of the thesis, one section will be included for each artifact developed: the extended PPINOT metamodel, notations, supporting tools and methodologies. For each one, a description, the context of application, importance, the solution proposed and how each artifact is validated, are issues that should be explained.
- Finally, a section of conclusions and future work will describe conclusions of this research, limitations identified and future work.

In Section 4, preliminary results are listed. Some of them are the basis of future proposals and publications. Below, future plan is described.

- The proposal about variability [7] is being extended to include other considerations about management of variability. More examples using templates and formal definitions for the representation of PPIs are being included. A supporting tool based on the PPINOT Tool Suite is being developed, which facilitates the application of restrictions included in the PPINOT metamodel to real scenarios. New case studies will allow us to validate the proposal. This proposal shall be submitted to a scientific journal.
- We plan to finish the proposal about the reuse and abstraction as alternatives to improve the management of PPIs, next month. This proposal includes the extension of the PPINOT metamodel, the use of templates and linguistic patterns to define PPIs, examples and case studies, and the use of a supporting tool to define PPIs taking into account the reuse and abstraction of PPI definitions. We expect to start the publication process of this paper in the following months. For that reason, at the end of 2017 or at the beginning of 2018, we expect to have this paper published in a scientific journal.
- According to the paper about measuring performance in KIPs, we expect to receive feedback from the journal about our submission in the following weeks and we hope this paper can be published before the end of the year.
- Also related to the KIP paper, we plan to do a new research stay in collaboration with the research group of UNIRIO [3] that propose the KIP-Ontology[16] to extend the proposal about measuring performance in KIPO with the measuring of performance in CMMN cases.

In addition to these publications in scientific journals, I plan to participate in national and international conferences related to business processes.

[2] JCIS-2017 - https://fg.ull.es/sistedes2017/jcis/

[3] Federal University of the State of Rio de Janeiro, Brazil. http://www.unirio.br/

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