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Modeling languages for business processes and business rules: A representational analysis

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ABSTRACT

Process modeling and rule modeling languages are both used to document organizational policies and procedures. To date, their synergies and overlap are underresearched. Understanding the relationship between the two modeling types would allow organizations to maximize synergies, avoid content duplication, and thus reduce their overall modeling effort. In this paper, we use the Bunge–Wand–Weber (BWW) representation theory to compare the representation capabilities of process and rule modeling languages. We perform a representational analysis of four rule modeling specifications: The Simple Rule Markup Language (SRML), the Semantic Web Rules Language (SWRL), the Production Rule Representation (PRR), and the Semantics of Business Vocabulary and Business Rules (SBVR) specification. We compare their BWW representation capabilities with those of four popular conceptual process modeling languages. In our analysis, we focus on the aspects of maximum ontological completeness and minimum ontological overlap. The outcome of this study shows that no single language is internally complete with respect to the BWW representation model. We also show that a combination of two languages, in particular SRML and BPMN, appears to be better suited for combined process and rule modeling than any of these modeling languages used independently.

1. Introduction

The improvement of corporate processes has consistently been identified as a top priority of CIOs for the last few years [5]. Organizations are increasingly interested in understanding, managing and improving their process portfolio, and in identifying and quantifying processes with outsourcing potential. The collection of tools and methods to achieve these objectives is referred to as Business Process Management (BPM). The design of innovative processes is constrained by the rules and regulations an organization has to comply with. Business Rules Management (BRM) describes the identification, definition, and management of these rules using technology such as Business Rules Management Systems.

Both process modeling languages and rule modeling languages offer constructs to represent business operations and constraints, but they do so in different ways. While process modeling languages typically describe a procedural sequence of activities, including decisions and concurrency, rule modeling languages often rely on a declarative description of facts, conditions, and constraints. This situation presents a selection dilemma for organizations, and little guidance exists as to which modeling approach is preferable in a particular situation. Despite a significant focus on the evaluation of the representational capability of process modeling languages

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[29], the comparative evaluation of rule modeling languages has received considerably less attention. This situation is a concern because an increasing number of organizations are deploying both BPM and BRM solutions (see [30]). In addition, a number of – partially overlapping – efforts are underway to specify standard representations for business rules. Comparing and contrasting these approaches will help organizations select the most appropriate representation for their purposes.

Recent empirical research has identified representational weaknesses in process modeling languages [27]. This research has led to speculation that business rule modeling languages might be suitable to fill these weak spots. It is an open question whether the two language types should be used in combination, i.e. whether the integrated use of business rules and business process modeling languages allows organizations to better understand, represent, and improve their operations. Accordingly, there is a need for a rigorous analysis of the two types of languages in order to identify their potential synergies and conflicts.

The main *goal* of the work we present in this paper is to investigate the representation capability of four rule modeling specifications. The four specifications selected for analysis are the Simple Rule Markup Language (SRML) [34], the Semantic Web Rules Language (SWRL) [10], the Production Rule Representation (PRR) [23], and the Semantics of Business Vocabulary and Business Rules (SBVR) specification [22]. We place this evaluation in the context of previous evaluations of conceptual process modeling languages by using the same evaluation framework and measurement techniques. Our evaluation is based on the well-established Bunge–Wand–Weber (BWW) representation theory [38], which allows us to gauge the degree to which each specification is capable of representing fundamental elements of the real world. In line with these goals, our two *research questions* are as follows:

RQ1: What are the representational capabilities, with respect to the BWW representation theory, of SRML, SWRL, PRR, and SBVR?

RQ2: Are the representational capabilities of SRML, SWRL, PRR, and SBVR complementary or substitutive to those of process modeling languages?

To answer the first question we will map the elements of the four business rule specifications against the constructs of the BWW representation model. To answer the second question we will compare these mappings to the BWW mappings of process modeling languages. The degree to which the mappings overlap and/or diverge will allow us to infer representational capabilities of each specification independently, and in combination with other specifications.

The remainder of this paper is structured as follows. In the next section, we present a brief review of business rules and business processes. The section also provides a review of related work on the integration of the two approaches and discusses studies that identify representational deficiencies in process modeling languages. Section 3 presents the justification for the use of the BWW representation theory as a suitable benchmark for the analysis of representation capabilities of process and rule modeling languages. Section 4 describes the research methodology adopted in this work and provides a justification for the selection of languages under consideration. In Section 5, we present a summary of the results of the BWW-based representation analysis of SRML, SWRL, PRR, and SBVR and discuss the results of the analysis in light of combined representation capabilities of process and rule modeling languages. We conclude the paper in Section 6 with a discussion of limitations and future work directions in this area.

2. Background

While, to the best of our knowledge, no representational evaluation of rule modeling languages has been carried out, some attempts at the integration of rule- and process-based modeling approaches have been made, different approaches to specify business rules have been surveyed in the existing literature, and the strengths and weaknesses of process modeling languages have been explored in some studies. These works inform our research.

2.1. Business rules

A business rule is a statement that aims to influence or guide behavior and information in an organization [33]. According to their structure, different types of business rules can be distinguished [37]:

- *Integrity rules* express constraints. These rules typically define the acceptable relationship between data elements. For example, each project must have one and only one project manager.
- *Derivation rules* express conditions that result in conclusions. These rules define the validity of facts and can be used to infer new facts based on known facts. For example, platinum customers receive a 5% discount. John Doe is a platinum customer. As a conclusion, John Doe receives a 5% discount.
- *Reaction rules* (also known as Event-Condition-Action (ECA) rules, alternative-action rules, or post-conditions) specify a trigger that activates the evaluation of the rule, a condition that is evaluated, and a subsequent activity that will be carried out if the specified condition is met; for example, the evaluation of a reaction rule is triggered as soon as a new invoice is received. If the invoice amount is more than $1000 then a supervisor review is initiated.
- *Production rules* (also known as condition, action rules) are similar to reaction rules, but do not specify a particular circumstance in which the evaluation takes place; For example, if there are no defects in the last 10 widgets, the entire batch is quality approved.
- *Transformation rules* restrict the state changes of objects; for example, an employee's age can change from 30 to 31, but not from 31 to 30.