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Enhancing the Management of Resource-Aware Business Processes

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The resource perspective has received much less attention than other business process (BP) perspectives, e.g., control flow. This thesis focuses on human resource management in BPs, and addresses challenges related to resource specification and resource analysis by introducing novel techniques for resource specification that rely on a new resource selection language called RAL, and providing automated support for a set of analysis operations at design time and at run time based on the formal semantics of RAL defined in description logics (DLs), leveraging existing DL reasoners. All the contributions have been validated.

Keywords: analysis operation, business process management, description logics, RAL, resource specification, resource analysis

1. Motivation

Providing support for Business Process Management (BPM) requires taking into account several perspectives throughout the entire BPM lifecycle. The BP resource perspective has received lees attention than others such as control flow, while resources are a key element in the correct execution of BP activities. This thesis [1] focuses on *human resource*[1] management in BPs, specifically on resource specification, and on design-time (DT) and run-time (RT) resource analysis. *Resource specification in BPs* refers to the assignment of people to activities in which they can be involved, and *resource analysis in BPs* copes with reasoning on *resource-aware BP models* (i.e., BP models with information about resources) to infer information from them in order to understand how resources are involved in them.

[1]In the following, *resource* for the sake of brevity.

The solutions for resource specification must be *traceable* to the concepts defined in the organisational model of the company; *expressive*, to define a wide variety of resource selection conditions; and *flexible*, to allow the user to decide how the resource specification is going to be *bound* to a resource-unaware BP model. The study of twenty-one approaches showed that, despite most of them are traceable, more than 50% do not exceed a medium level of expressiveness, and evidence about binding flexibility was not found in any approach.

Regarding analysis, seven analysis operations related to the relation between people and activities (a.k.a. *person-activity operations*), and 4 analysis operations related to the permissions people have to access the information handled in BPs (a.k.a. *person-data operations*), were identified. The study of seven proposals considering resource analysis concluded that only one person-activity operation is supported in all cases, but only one approach offers support at DT (i.e., considering only static information modelled in the BP diagram) and at RT (i.e., considering also dynamic execution information). Another person-activity operation has often been addressed at DT. Support for the rest of operations is missing.

Therefore, the goal of this work was to develop traceable, expressive and flexible techniques to assign resources to BPs, and to develop mechanisms for the automation of the eleven analysis operations at DT and at RT.

2. Contributions

The approach developed to address the previous goals is depicted in Fig. 1 and summarized below.

The first contribution (C1) is the development of a new language called Resource Assignment Language (RAL) [3], which enables defining resource selection conditions in the context of BPM. Its

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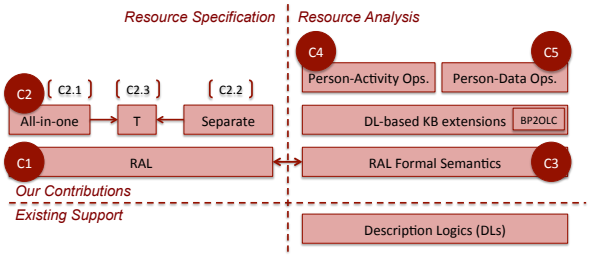

Fig. 1. Overview of the contributions

design is grounded on an existing organisational metamodel [5]. Thus, RAL expressions are *traceable* to the organisational model of the company, as long as it considers concepts defined in it. Furthermore, RAL is *very expressive*, according to the same criteria used to evaluate similar approaches on resource specification from literature.

The second contribution (C2) pursues *flexibility* and introduces a technique to use RAL as an extension of Business Process Model and Notation (BPMN) (C2.1), giving rise to *RAL-aware BP models*; and a technique to use RAL in combination with RASCI matrices (C2.2). Furthermore, a procedure to automatically shift from the RASCI-based approach to the BPMN-based approach in a seamless way, has been developed (C2.3).

The third contribution (C3) defines formal semantics for RAL based on Description Logics (DLs) [2]. This provides the RAL expressions with precise meaning, and eases the automated extraction of information from RAL-aware BP models.

Next, relying on RAL semantics, an approach to automatically analyse how resources are managed in a BP is introduced, specifically automated support for the eleven analysis operations identified. The resolution of the person-activity operations (C4) enables answering questions such as "who can be involved in activity *Sign Authorisation*?", "can anybody in the company take part in all the activities of the *Trip Management* process"?, or "is there any person indispensable for the completion of that BP?", in an automatic way. The resolution of the person-data operations (C5) provides automatic answer to questions such as "who can read the *Authorisation Form*?", or "who is allowed to update the *User Properties* file?". As an intermediate step, some procedures and extensions of the DL-based knowledge base created to define RAL semantics were developed in order to prepare it for automated operation resolution. It implied considering perspectives such as control flow (e.g., behavioural relationships between activities) and data flow (e.g., data states and transitions) for the automation of certain operations. Then, a reference implementation based on DLs was developed to enable the execution of all the operations at DT and at RT, by expressing the analysis operations in terms of standard DL reasoning operations, which are implemented by existing DL reasoners.

Support for all the contributions was implemented in CRISTAL [4], and some results were also validated in the scope of a project with a multinational organisation, in which the applicability of the automated analysis to check conformance with business rules was proven.

3. Conclusions

The outcome of this work is a set of traceable, expressive and flexible techniques to assign resources to BPs, and DL-based mechanisms to automate a number of resource analysis operations at DT and at RT. This bridges the gaps found in current approaches.

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