



Defining the resource perspective in the development of processes-aware information systems



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ABSTRACT

Context: The resource perspective has impact on the performance of business processes. However, current Workflow Management Systems (WfMSs) provide disparate support to its implementation and business process modeling languages provide limited capabilities for its definition. Thus, it is difficult to specify requirements regarding this perspective and to select an appropriate WfMS to support them in order to obtain a technological solution aligned with the organizational needs.

Objective: To provide support to the definition, implementation, verification and validation of resource perspective requirements in the development of Process-Aware Information Systems (PAISs) based on WfMSs.

Method: The following activities were carried out: (i) identification of resource perspective aspects in executable workflow specifications, (ii) analysis of the elements provided by the BPMN modeling language to represent these aspects, (iii) development of a framework based on BPMN for defining and implementing these aspects by using the extension mechanism provided by this language, (iv) development of a model-driven development method that leverages the framework to develop PAISs, and (v) validation of the proposed framework and method through the development of a tool supporting them, a case study, and the evaluation against the Workflow Resource Patterns.

Results: A framework, a method and a tool that support the definition of the resource perspective in the development of PAISs.

Conclusion: By using the proposed framework and method, practitioners are able to: define the resource perspective requirements in conceptual process models, select a WfMS as implementation platform, and define the implementation of these requirements maintaining the consistency between the conceptual process models and the workflow specifications.

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1. Introduction

Process-Aware Information Systems (PAISs) are software systems that manage and execute operational processes involving people, applications, and information sources on the basis of process models [1]. A Workflow Management System (WfMS) is a general purpose system that constitutes the implementation platform for PAISs. WfMSs manage the execution of business processes based on executable workflow specifications defining the ordering of the process activities (control flow perspective), the information passed between them (data perspective), and the assignment of responsibilities to the organization's resources for their execution

(resource perspective) [2]. WfMSs were integrated over time together with Enterprise Application Integration Systems and Business Rule Management Systems into the so called Business Process Management Systems (BPMSs).

This paper is focused on the resource perspective, particularly on the involvement of human resources in the execution of business processes. The term Resource is used hereinafter to designate human resources.

The Workflow Resource Patterns [3] were defined as abstractions of recurrent requirements supported by WfMSs. These patterns have been used to evaluate the capabilities provided by multiple WfMSs to support the resource perspective [4,5]. The WfMSs evaluated at that time showed a disparate support to this perspective. This continues to be the case in the present. Different WfMSs work with base on different organizational metamodels and provide distinct concepts to specify the distribution of work

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among the resources. For example, Bizagi¹ provides a rich organizational metamodel including areas, positions, roles, skills, groups and properties. Also, it allows defining work distribution policies with base on allocation rules, assignation methods and preconditions. Instead, Bonita² provides a more generic organization metamodel which allows defining the membership of users to organizational groups by performing roles and handles work distribution through the assignment and filtering of actors. The Workflow Resource Patterns have also been used to evaluate high level business process modeling languages like BPMN or UML Activity Diagrams [6,7]. These evaluations showed a poor support of these languages to the representation of the resource perspective.

The limited capabilities offered by modeling languages to represent resource perspective requirements make it difficult to define these requirements in a platform independent way. Most of these requirements are defined directly in the implementation stage, when workflow specifications are created for the selected WfMS. Choosing a WfMS before defining the resource perspective requirements increases the chances of selecting an execution platform that does not support the organizational needs [8]. Another consequence is often an oversimplified definition of the resource perspective, which results in the PAIS being either inflexible or too liberal [9,10]. Inflexible systems have a negative impact on the process performance when the assigned resources are overloaded or unavailable. In such a case, these systems block the process until the assigned resources are able to fulfill the task even in case there are other suitable resources available to perform it. On the other hand, if the system is too liberal, the wrong people can be allowed to execute work, which may raise security issues.

The objective of this work is to provide an approach that enables organizations to define the resource perspective along the development of PAISs with base on WfMSs. For this purpose, a framework is proposed based on the well-known business process modeling language BPMN [11] in order to allow defining resource perspective requirements in both platform-independent and platform-specific models, and describing the support provided by WfMSs to the resource perspective. A method based on the principles of model-driven development that makes use of the framework is also proposed to support: the definition of resource perspective requirements in a platform-independent way, the selection of a WfMS that supports the identified requirements, the implementation of these requirements with base on the selected WfMS, the verification and validation of the resulting technological solution against the WfMS and the defined requirements, and the generation of executable workflow specifications for the target WfMS.

The remainder of this paper is structured as follows: Section 2 presents the background. Section 3 presents the framework to define the resource perspective of business processes. Section 4 describes a model-driven development method based on that framework. Section 5 presents the tool developed to support the proposed framework and method. Section 6 evaluates the framework and method through the Workflow Resource Patterns and a case study. Section 7 discusses related work. Finally, Section 8 presents the conclusions and future work.

2. Background

2.1. Resource perspective in the development of PAISs

Different types of requirements regarding the resource perspective need to be supported by PAISs. These requirements were

addressed in the literature through different approaches. In a previous work [12], these requirements were identified and organized in terms of three aspects of this perspective: Resource Structure, Work Distribution and Authorization. These aspects express the behavior of three general purpose components that are present in well-known reference models and architectures of WfMSs, such as the proposed by Workflow Management Coalition [13], Pesic et al. [14] or WS-HumanTask [15]. These components are: Organizational Repository, Work Distribution and Worklist Handler. These components enable WfMSs to present the work of tasks to the resources in the form of work items.

The Resource Structure aspect refers to the representation of information about the resources required to support the distribution of work items. This is defined through the characterization and classification of resources. The characterization consists in describing the attributes of the resources. The classification is the association of resources with a concept. It allows referencing groups of resources and to assign them common sets of properties. Resources can be classified by using different criteria based on organizational or technological concepts [16]. Examples of such criteria include functional classification (often represented through roles), or organizational classification (represented through organizational units or positions) [2]. The definition of this aspect results in a resource model or resource schema stored and managed by an Organizational Repository.

The Work Distribution aspect is concerned with the advertisement and binding of work items to the resources for their execution [3]. There are two basic types of work distribution strategy: pull and push. Pull strategies advertise work items to one or more resources who can voluntarily undertake the responsibility for their execution. Push strategies assign work items to typically a single resource who has the responsibility to fulfill them.

A work distribution strategy includes a resource assignment or allocation definition that specifies the set of resources allowed to handle the work items of a task [17]. Resource assignments are typically defined as a query to the information defined in a resource schema stored in an Organizational Repository, or as an expression evaluating data available in the scope of the process instance. Constraints such as binding or separation of duties can also be defined for resource assignments [18,19]. These constraints, also referred to as resolution constraints, are often used when specifying push work distribution strategies in order to ensure that each work item is assigned to a single resource for its execution. These constraints can be either hard or soft. The former are always enforced by the system, the latter define desirable restrictions that can be violated under certain conditions [20].

More advanced work distribution requirements comprise changes in the distribution of work items upon the occurrence of events or as consequence of an operation executed by a resource. The so called detour resource patterns [3] identify recurrent requirements of this type. An escalation designates a detour performed by the WfMS upon the occurrence of an event triggered in the scope of the work item. Examples of such events are the *startDeadline* and *completionDeadline* defined by WS-HumanTask [15]. Escalations are often defined in order to reduce the completion time of work items by changing their distribution when a deadline is not met [21]. Detours triggered by human resources such as delegation [22] give some degree of freedom to the resources for changing the assignment of work items.

Resources access and complete the work items distributed to them through the Worklist Handler. This component allows executing two kinds of operations. Worklist operations enable resources to organize the work items distributed to them. Work item operations allow resources to modify the state of a work item by setting its outcome or changing its distribution.

¹ <http://www.bizagi.com/>.

² <http://www.bonitasoft.com/>.

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