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Network-based social coordination of business processes

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ABSTRACT

This paper presents a social coordination approach that addresses the issue of conflicts over resources during business process execution. A business process consists of tasks that persons and/or machines execute. The resources, that business processes require at run-time, are sometimes limited and/or not-renewable. The approach uses a set of social relations that connect tasks/persons/machines together. These relations are the basis of developing specialized networks that capture the interactions during business process execution and are used to recommend corrective actions when conflicts over resources occur. These actions are dependent on the properties of tasks, persons and machines properties which referred to as transactional, activity, and operational, respectively. A system that demonstrates the approach is also discussed.

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1. Introduction

To achieve their missions and reach their objectives, organizations design, develop, and deploy Business Processes (BPs), which represent the know how of the organizations. BPs capture organizations' best practices when processing internal and/or external requests. Organizations are extremely keen to track the execution progress of BPs for the sake of assessing their effectiveness and re-engineering them, if necessary. Today's challenges (e.g., globalization and competition) are forcing organizations to be creative and/or innovative by embracing various technologies such as Web 2.0, *aka* social, [3]. In a previous work we proposed a novel approach for exposing social relations[1] in BPs [12]. These relations exist between a process's three components known as *task*, *person* and *machine*. Task is identified as a work unit which is associated with requirements, and person and machine are identified as potential task executors with their associated capacities (some use capability as the ability to achieve some goal [2]) that enable them to satisfy these requirements at run-time. Examples of social relations include delegation of work between persons, backup between machines, and interchange between tasks. We use social

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[1] We adopt "social" because of the relations in people's daily life (e.g., collaboration, friendship, and competition) that can be exemplified with

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relations to establish three categories of networks known as *configuration network of tasks*, *support network of machines*, and *social network of persons*. A configuration network of tasks permits for instance, to determine how straightforward a task's requirements are satisfied with respect to available executors' capacities. A support network of machines permits for instance, to determine how reliable a machine is when assigning critical tasks. Last but not least, a social network of persons permits for instance, to determine the engagement level of a person in helping others execute their tasks. In fact, the networks capture the previous interactions between tasks (t2t), between persons (p2p), and between machines (m2m), and how successful these interactions were. These networks provide various details such as how strong or weak the connection between tasks is, how reliable machines are, what machines are frequent backups, how available persons are, and what persons are frequent substitutes.

It is largely accepted by the R&D community that the correctness of a BP design (e.g., [27]) does not always guarantee that the BP can be successfully executed. A well-known reason that impedes this success is the lack of resources. Resources could be CPU time, power, and data and can vary from one domain to another (e.g., water in a power plant to paper reams in a publishing company). Because some resources do not last forever, are limited, and/or not shareable, tasks and persons/machines need to coordinate how to consume/use the available resources in order to avoid conflicts that could lead to delays and even failures. Resource allocation, *aka* coordination, has been recognized as an important topic in conflict resolution. However, most existing works on resource allocation (e.g., [11]) have not paid enough attention to the dependencies between tasks nor between persons/machines in terms of resource production and consumption/use. We propose a social coordination approach that uses the networks of tasks/persons/machines to recommend corrective actions in response to specific conflict patterns. Corrective actions could be when and how to regenerate a resource that is not renewable and when and how to share a resource that is not available all the time.

Our contributions are as follows: (i) identifying conflicts per type of component (i.e., *task*, *machine* and *person*) in a BP, (ii) analyzing the impact of these conflicts on BP execution progress, (iii) demonstrating the potential role of configuration, support and social networks in addressing these conflicts, and (iv) showcasing the solutions to conflicts through a system. The remainder of this paper is organized as follows. Section 2 is an overview of resource-conflict management techniques in business workflows, social coordination, and then social organization. The section also presents the rationale of our network-based coordination approach. Section 3 discusses business process design from a social perspective. Section 4 presents the realization of this approach in terms of resource categorization, conflict categorization, and strategies for conflict resolution. A system implementing the coordination approach is reported in Section 5 and concluding remarks are drawn in Section 6.

(*footnote continued*)
interactions between tasks, between machines, and between persons obviously in a business process.

2. Background

This section presents some resource-conflict management techniques in business workflows, discusses social coordination using a set of definitions and examples that illustrate the role of this coordination type in conflict resolution. Finally, the social organization that builds upon social coordination is also discussed.

2.1. Management of resource conflicts in business workflows

Several approaches of managing resource conflicts in business workflows have been presented in the literature. Han et al. [30] deal with the changes and rearrangement of individuals supporting workflow resources including modification and substitution of component interfaces of software systems. They classify resource-conflict situations into two broad categories. The first category focuses on organization-related situations where changes in organization-related structures and resources (e.g., personnel changes) can have direct impact on workflow process execution. The second category focuses on data-related situations where data that are not used by a workflow can be changed independently and accessed by other applications at the same time.

Li et al. [15] verify resource consistency during the specifications of timed workflows. Their approach focusses on the static analysis of workflows at design time without any consideration to the dynamic analysis aspect which may arise during workflow execution. Li and Yang [14] further enhanced this approach by proposing a dynamic checking mechanism of temporal constraints on concurrent workflows. Hsu and Wang [10] present an incremental method to analyze resource consistency and temporal constraints after each edit unit defined on a workflow specification. Zeng et al. [31] present a detection approach and some removal strategies for resource conflicts in workflows which are constrained by resources and non-determined duration based on Petri net.

Wang et al. [26,29] introduce a Workflows Intuitive Formal Approach (WIFA) where resources are considered as important decision factors when combined with control flow information. They focus on avoiding or reducing potential delays during a workflow execution by using an analysis technique that attempts to identify ways in which tasks can be executed in parallel and in the most efficient way. The approach supports the decision process by analyzing multiple criteria on behalf of the decision maker. In particular, the approach tracks resource availability, disables the paths that are not executable, and presents all executable paths for the decision maker to make more informed decisions and implement them more confidently. Azevedo et al. [2] present an ontological analysis of the enterprise architecture focusing in particular on the resource capability. The main aim of this analysis is to identify semantic issues in the proposed architecture and

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