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# Workflow modeling for virtual processes: an order-preserving process-view approach<sup>☆</sup>

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## Abstract

Conducting workflow management allows virtual enterprises to collaboratively manage business processes. Given the diverse requirements of the participants involved in a business process, providing various participants with adequate process information is critical to effective workflow management. This work describes a novel process-view, i.e., an *abstracted process* which is derived from a *base process* to provide process abstraction, for modeling a *virtual workflow process*. The proposed process-view model enhances the conventional activity-based process models by providing different participants with various views of a process. Moreover, this work presents a novel order-preserving approach to derive a process-view from a base process. The approach proposed herein can preserve the original ordering of activities in the base process. Additionally, a formal model is presented to define an order-preserving process-view. Finally, an algorithm is proposed for automatically generating an order-preserving process-view. The proposed approach increases the flexibility and functionality of workflow management systems.

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*Keywords:* Workflow management; Process abstraction; Virtual workflow; Process modeling

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## 1. Introduction

Workflow management via workflow management systems (WfMSs) not only facilitates electronic commerce, but also allows virtual enterprises to collaboratively manage business processes. As an effective process management tool, WfMSs allow businesses to analyze, simulate, design, enact, control and monitor their overall business processes [1,2]. The support of a WfMS allows

various participants to collaborate in effectively managing a workflow-controlled business processes. The participants represent particular positions in a company or particular companies in a supply chain. In practice, these participants possess different needs and levels of authority when obtaining information on business processes. To facilitate effective workflow management, a WfMS should provide various participants with adequate process information.

For example, a high-level manager may require aggregated information on a process, while a marketing manager may not have the authority or need to know each specific step of the production flow. These requirements create the

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need for a flexible process model capable of providing appropriate processes abstraction for various roles within an enterprise. Furthermore, interorganizational coordination via WfMSs has become a critical success factor for businesses in rapidly fluctuating and complex business environments. Besides the interoperability issues of heterogeneous WfMSs, in a WfMS-supported supply chain (or called multi-enterprise process [3]), each participatory organization wants to conceal its own processes from other organizations, and different organizations require different supply chain information. In sum, providing aggregated information or encapsulating sensitive data requires the development of a workflow model capable of offering adequate *abstracted processes* for different levels, units, and organizations.

Despite notational differences, activity-based methodologies are extensively used process modeling techniques, and have been extensively adopted for commercial products, research projects, and standards, e.g., MQSeries Workflow [4], Ultimus [5], METEOR [6], and workflow management coalition (WfMC) process definition meta-model [7]. A typical activity-based approach designs a workflow through a top-down decomposition procedure. This stepwise refinement allows a modeler to define a process more easily and completely than do one-step approaches.

However, resultant layered process definitions do not always fit into an organizational hierarchy, despite providing several different levels of hierarchical abstraction. Therefore, hierarchically decomposing a process may not provide each organizational level with an appropriate view of that process. Despite forcing a process modeler to follow an organizational hierarchy while decomposing a process, different organizational units (divisions/companies) may have difficulties in obtaining adequate abstractions of the process/supply chain they participate in. The activity-based approach cannot adequately provide different participants with varied abstracted processes.

The activity-based approach should be enhanced to provide different process abstractions. Several formal process modeling techniques, including process algebras and Petri Nets [8–11], can

provide process abstractions by renaming activities to silent activities that are not observable. Such abstraction is considered as *partial abstraction* since it provides partial observability of a process. Although useful in satisfying some of the needs of process abstractions, partial abstraction may be unable to adequately address the needs of managers or collaborative parties who require aggregated information on a process.

Based on the notion of views in database management systems (DBMSs), this work proposes a novel *virtual workflow process*, i.e., a *process-view*, in a WfMS. A process-view, i.e., an *abstracted process* derived from an implemented *base process*, is employed to provide *aggregate abstraction* of a process. During workflow build time, a process modeler does not need to be concerned with process abstraction, and can focus solely on process design, using a top-down decomposition procedure to define the process in detail. The modeler can then use a process-view definition tool to define multiple abstracted processes, i.e., process-views. During run time, creating a process instance initiates its corresponding process-view instances. Each participant can retrieve and monitor appropriate process information via the related process-view instance. Therefore, coordination within an organization or across multiple organizations can be improved.

Although process design is a specialized and top-down procedure, process-view design is a generalized and bottom-up procedure. Process-views allow a WfMS to provide various aggregated views of a process for different levels or departments in an organization or for different organizations in a supply chain. Several approaches can be adopted to construct a process-view. This work describes a novel order-preserving approach in which the constructed process-view can preserve the original ordering of activities in the base process. A formal model is also presented to define an order-preserving process-view. Theoretical analysis is performed herein, indicating that the defined process-view satisfies the order-preserving property. Moreover, an algorithm is proposed to automatically generate an order-preserving process-view.

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