Inter-operability of Workflow Applications: 
Local Criteria for Global Soundness

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Abstract. Automatic analysis techniques for business processes are crucial for today’s workflow applications. Since business processes are rapidly changing, only fully automatic techniques can detect processes which might cause deadlocks or congestion.

Analyzing a complete workflow application, however, is much too complex to be performed fully automatically. Therefore, techniques for analyzing single processes in isolation and corresponding soundness criteria have been proposed. Though these techniques may detect errors such as deadlocks or congestion, problems arising from an incorrect inter-operation with other processes are completely ignored. The situation becomes even worse for cross-organizational workflow applications, where some processes are not even available for analysis due to confidentiality reasons.

We propose a technique which allows to detect but a few errors of workflow applications which arise from incorrect inter-operation of workflows. To this end, the dynamics of the inter-operation of different workflows must be specified by the help of sequence diagrams. Then, each single workflow can be checked for local soundness with respect to this specification. If each single workflow is locally sound, a composition theorem guarantees global soundness of the complete workflow application. This way, each organization can check its own workflows without knowing the workflows of other organizations—still global soundness is guaranteed.

Introduction

Automatic analysis techniques for business processes are crucial for today’s workflow applications. Since business processes are rapidly changing (sometimes even at runtime), only automatic techniques can detect processes which might cause deadlocks or congestion.

Van der Aalst [8, 9] has proposed simple but powerful soundness criteria for a single workflow. These criteria can be checked fully automatically. In [10], these criteria have been extended to global soundness of a system of loosely coupled workflows. To check global soundness, one needs a model of the complete workflow application. This model, however, is often not available for cross-organizational workflow applications because organizations are not willing to
disclose their workflows. Therefore we need a technique which allows to argue
locally on global soundness.

This paper is a first step towards such a technique. We present a local critique
for single workflows which can be checked without knowing the other work-
flows. Of course, we need some information on the interaction with the other
workflows, which will be captured by scenarios. The local criterion consists of
two parts: Local correctness guarantees that the interactions of the workflow
under consideration is allowed by a scenario; local soundness guarantees proper-
termination of the workflow. According to our main theorem a workflow appli-
cation is globally sound if each involved workflow is locally sound and locally
correct.

As mentioned above, we use scenarios for specifying the interaction between
different workflows. A single scenario shows one possible interaction between the
workflows by sending and receiving messages; a scenario abstracts from internal
behavior of each workflow. A set of scenarios specifies all legal interactions.
Syntactically, a possibly infinite set of scenarios can be represented by high-level
Message Sequence Charts [3] or Sequence Diagrams in UML [7]. In this paper
we concentrate on the semantical foundations and, therefore, we do not fix a
particular representation of scenarios.

The paper is structured as follows: In Sect. 1 we present the basic concepts and
the basic idea by the help of an example. In Sect. 2 we give formal definitions. In
Sect. 3 we present the local conditions for global soundness. At last, we indicate
how the techniques presented in this paper can be mechanized—which is subject
to further research.

1 Example

In this section, we introduce the basic concepts by the help of an example.

1.1 Scenarios

We choose a simple workflow application as an example. The workflow applica-
tion consists of three workflows concerning three different parties (resp. organi-
zations): A Customer, a Support department, and a Production department. The
Customer may ask the Support department a question (e.g. about a particular
product). Then, the Support department either answers the question directly and
terminates, or the Support department requests some more detailed information
from the Production department. In order to make matters more interesting,
we allow the Support department may request more details several times. The
Support department eventually acknowledges the receipt of all details to the
Production department and compiles an answer which is sent to the Customer.

The interaction defined above is formally represented by the scenarios shown
in Fig. 1. Figure 1(a) shows the scenario where the Production department is
not involved at all; Fig. 1(b) represents all other scenarios. In fact, Fig. 1(b)