

InDiA: a framework for workflow interoperability support by means of multi-agent systems

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Abstract

Inter-organisational business processes are by no means rare. On the contrary, a business can only thrive if it cooperates with other businesses, like service providers, wholesalers, shipping companies, insurances, banks, etc. However, there is a major barrier here for automating such processes: the IT infrastructure of the trading partners, or more specifically their variety and independence. Owing to these problems, even if both organisations have automated support for their parts of the whole inter-organisational process, the activities responsible for cross-organisational messaging or document passing are often done manually by post or email. This paper concentrates on the problem of providing support for workflow interoperability, which would allow for linking business partners without the necessity of a major redesign of their workflows. A framework for interoperability between heterogeneous workflow systems is presented, which uses a layer of agents to enforce the correct execution of coordination dialogues between the business partners. Further, the framework is discussed and conclusions are given.

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1. Introduction

Autonomic computing is described as the ability of an IT infrastructure to sense, respond and ultimately adapt to change in accordance with business policies and objectives. The aim is to free IT professionals to focus on higher-value tasks by making technology work smarter, with business rules guiding systems to be self-configuring, self healing, self-optimising, and self-protecting (IBM 2001; Kephart and Chess, 2003). As such autonomic computing presents a grand challenge which may only be solved by combined efforts of researchers from disparate domains.

One domain which can both contribute and greatly benefit from autonomic computing is the domain of workflow technology. Over the past three decades

workflow technology has become established as one of the backbone IT infrastructures of many large organisations. Early work concentrated on supporting the flow of work within small organisational units. It has then gradually expanded its reach to the departmental, and later, to the corporate level.

In the current economic climate, with the emergence of businesses having world-wide presence, with companies merging, being taken-over, forming alliances, etc., the integration of business processes plays a crucial role. While some may use standardised workflow products, many still use non-standard or in-house solutions. This situation has prompted a shift in workflow research, encouraging researchers to start looking into ways of applying workflow technologies to cross-organisational processes. Providing interoperability solutions brings a number of benefits to the organisations. They include: savings on costs of development/implementation of new workflow processes, savings on time spent on staff training, and

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respect for work culture (existing users are not deprived of using well-known, pre-existing tools).

Recognition of the importance of workflow has led to the formation of several non-commercial bodies that have endeavoured to standardise workflow systems. The founding of the workflow management coalition (WfMC) in 1993 started the process of developing workflow standards beginning with the workflow reference model and its five interfaces (WfMC, 1995). Later other organisations looked into workflow-related issues: it is worth mentioning the work done by the object management coalition (OMG) on adapting WfMCs workflow facility to the object-oriented context.

The standards cover a wide range of workflow issues starting from process definition, through its execution, monitoring, and interoperation with other standard workflow systems. The problem is that the standards cover simple workflow interoperability models, mainly chained or nested sub-process execution. However in many cases cooperating companies require more complicated, parallel-synchronised workflow execution. This is usually implemented on a case by case basis. Two organisations first agree on a specific exchange of data and/or messages, and then each one of them builds their workflow independently. This approach has a large potential for errors. When each organisation builds their workflow separately, problems frequently occur when systems are connected, much time is spent on testing, and very large-scale linking interfaces may become unmanageable. Work done in the Kanagawa Institute (Kanagawa Institute, 1999) aimed to rectify some of the problems by first allowing the semi-automatic generation of workflows from an agreed upon inter-workflow definition. The next stage is to let the companies fine-tune the generated workflows by adding the internal details of their operation.

This framework was a step in the right direction. The meta-definition of workflow could be considered a cooperation scenario between two partners, which might be reapplied in similar situations. However, this solution has several disadvantages. If companies have already invested in the development of their workflows it will not be financially viable to build them again from the beginning. If a change is needed in the inter-workflow definition both workflows would be wholly re-generated. Finally, the framework has to be able to create process definitions understood by the workflow systems of various vendors, which is a problem with all frameworks aiming to be generic and is usually rectified by using vendor-specific plug-in components.

2. Approach

The Kanagawa Institute's approach addressed the issue of workflow interoperability, by building an inter-

operating workflow from scratch. While this is a valid approach, a straightforward alternative is trying to modify the existing workflows to cater for inter-organisational parallel-synchronised operation. This approach is taken here, concentrating on the following problem: how to provide for workflow interoperability, which links business partners without the necessity of a major redesign of their workflows, and yet is flexible enough to allow for reuse in similar cases? Another related problem is: how to ensure the correctness of the interoperating workflows, when neither of the two parties has control over the IT systems of the other?

One approach is to equip a workflow process definition with a process interface defining its input and output. Input specifies the data required for the process operation, while output defines the format of the process's final result (Biegus et al. 2002). Although yielding good reusability this solution effectively wraps the process in a black-box disallowing any communication with the process during its execution. Therefore this approach limits the interoperability to sub-process invocation, or chained execution, which is not enough to satisfy our requirements. However, if this idea taken further, it leads to two interfaces instead of one in the following way. Let's consider the two cooperating organisations as actors of a dialogue. A dialogue is understood as an exchange of messages. One side initiates it by sending the first message and waiting for a reply. The other side sends a response and waits for further messages—it is assumed that each message requires a response. The conversation ends with sending a message indicated as final. From now on the paper will refer to such an exchange of messages using the term: *coordination dialogue* (Biegus and Branki, 2003). The dialogue can be seen as a definition of two matching interfaces, which are implemented by workflows of the collaborating organisations.

Synchronisation is achieved through adding a capability of the workflow system to send and receive coordination messages: the event of a message arrival is used to trigger activities of the workflow. The idea of sending messages to synchronise activities is simple and obvious, however, instead of concentrating on synchronising all workflow actions through messages, the focus is placed here on the message interchange between the two organisations disregarding the details internal to them. As long as an organisation adheres to the coordination dialogue they are free to modify their workflow at any time.

Existing research into workflow interoperability approaches the issue of interoperability, generally, in two ways. The first one creates a definition of a cross organisational workflow which is then distributed to the

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