Building Global Workflow From The Scratch

An Approach Based On Integration of Heterogenic Workflows by Mediators

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Abstract. In a fast changing environment, enterprises need to constantly refine their processes in order to effectively meet the requirements needed for achieving on-demand collaboration in order to win new opportunities as a result of market evolution. This paper introduces the global and common Workflow for cross-enterprises collaboration. A problem that stems from the global Workflow is the need to integrate running ad hoc processes whose descriptions unpredictably change to accommodate the business agility. Through this paper, we propose an approach based on synchronization points between processes of two or more enterprises. These points act as mediators to interface ad hoc processes without considering their definitions at the design time neither their evolution during the execution. A case study, relating to e-procurement, will illustrate the introduced concepts.

Keywords. B2B e-commerce, inter-enterprise Business Process, Workflow, ad hoc Workflow, Mediator.

1 Context

Nowadays enterprises have to deal with global competition, reduce the cost of productions, and rapidly develop new services and products. As a result, they must constantly reconsider and optimize the way they do business and adapt their information systems to support flexible Business Processes. Such dynamic process organization involves managing different process maturity levels depending on the reached structuring level (Ruiz et al. 2002). Workflow technology deals with these requirements by offering methodologies and software tools to support Business

Process modeling and cross-enterprises collaboration. Current Workflow products focus on two extremes: completely *unstructured processes* and highly *structured processes*. On the one hand, the groupware products that typically aim at supporting unstructured processes are completely unaware of the Business Process, where cases are handled according to a fixed definition of the tasks to be performed and their order. This kind of Business Process is characterized by a high frequency and a high level of standardization (i.e., Lotus Notes (Ginsburg et al. 1997)). On the other hand, the traditional Workflows are aware of the Business Process (i.e. Staffware, MQSeries Workflow (Aalst 2002)). In fact, they typically support highly structured Business Processes defined at the design time.

In the daily work of the real world of business collaboration between enterprises, most Business Processes are in-between the two extremes sketched above. They are known as *ad hoc Workflows* which are not based on *process templates*. These ad hoc Workflows provide the procedural backbone that can be filled in and varied upon to accommodate the requirements of individual cases. Each individual case can be modified to meet specific needs. The templates do not prescribe in detail how cases are to be handled, but allow a certain degree of flexibility(Wombacher et al. 2002).

In a fast changing environment, enterprises need to constantly refine their ad hoc processes in order to effectively meet the opportunities proposed by new market requirements and on-demand collaboration. Dealing with ad-hoc processes in an adequate way is important to improve the cross-enterprise Workflow between two or more enterprises. One of the challenging issues in ad hoc Workflows is the integration of running processes whose descriptions are modified and varied without prediction or any prior knowledge(Wombacher et al. 2002). Although the information and communication technologies facilitate the exchange of cases and information between information systems, the dynamic integration of local ad hoc Workflows into a global Workflow becomes one of the most challenging problems.

We propose in this paper a solution for the problem of ad hoc and formal Workflows integration into one coherent global Workflow maintained by different cyber-partners. We propose an approach based on Mediators between heterogeneous Workflow. The Mediator acts as an interface between distributed Workflows taking into account their dynamic definitions and their evolution during the execution.

The remainder of this paper is organized as follows. First we discuss the process of inter-enterprise Business Process orchestration together with ad hoc Workflows and the integration of heterogeneous Workflows. In section 3, we introduce the notion of Mediator and its composition as the basic item in our approach. A case study of e-procurement is illustrated about the integration of heterogeneous Workflows. Finally, we summarize the main conclusions and give an outlook on our future work (section 4).

2 Orchestration of inter-enterprise Business Processes

In the domain of B2B e-commerce, common BP can be seen as an interconnection of different enterprises local Workflows, orchestrated according to the goal to achieve (Figure 1).

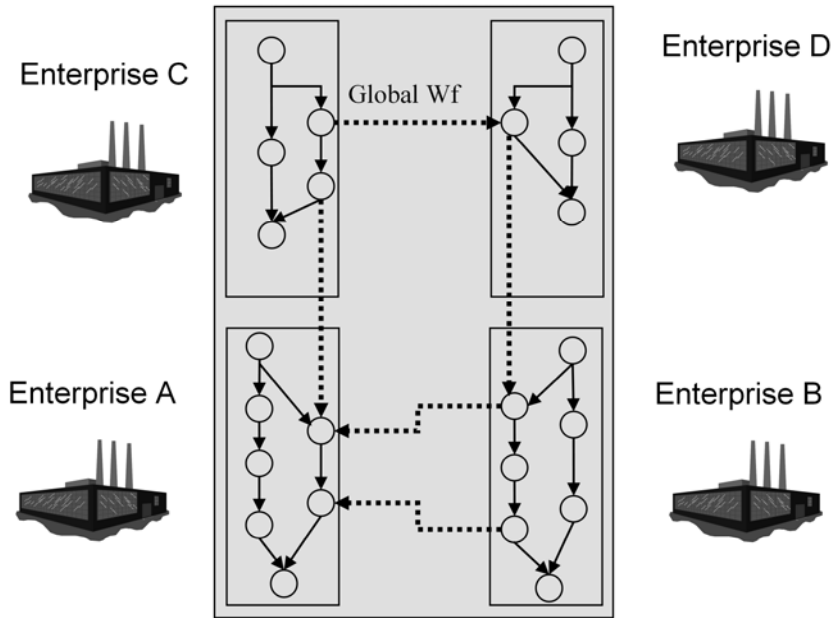

Fig. 1. Global Workflow

Common BPs are modeled as an ordered set of tasks achieved either by human or machinery actors. Consequently, they can be turned into a global Workflow oriented system(Jaber et al. 2005). In order to automate the interconnection among business entities, local Workflows should be merged so that information can be shared between partners and coordination abilities are improved.

A Workflow is a collection of activities and data that defines the paths that can be taken to complete a task within a process (Chiu et al. 2004; DiCaterino et al. 1997). A B2B Workflow based approach can be derived from traditional EDI (Electronic Data Exchange) or C-Business environment. For this purpose, Aalst (van der Aalst W. 2002) proposes multiple descriptions of shared Business Process: public and private Workflows are defined concurrently and the global consistency is achieved thanks to well-defined information exchange format (Bussler 2002). By this way collaborative business processes are defined as a set of interconnected private parts (black boxes for which only the interfaces (inputs and outputs) are known) and public parts (white boxes including precise process descriptions).

Depending on the process maturity level, different process organization can be set: either informal processes are used (in this case they can be modeled as ad hoc Workflow) or they are well defined and allow a formal Workflow implementation.

As far as inter-enterprise processes are concerned, the extended EDI based on ebXML can be used to provide an open and reactive framework to support inter-enterprise co-operation and provide heterogeneous systems interconnection abilities. According to these requirements, core components (i.e. message formats coupled to e-Business Process description) are defined as re-usable and exchangeable

information units (Oasis 2001). Moreover, such e-service infrastructure can be stored in registries so that binding services can set a dynamic Workflow. Nevertheless, these approaches lack of interconnection abilities needed for the integration of heterogeneous Workflows. The next paragraph focuses on the notions of ad hoc and formal Workflows before we proceed to the integration of these heterogeneous Workflows into a global Workflow.

2.1 Ad hoc Workflow vs. formal Workflow

Traditional Workflow products support production, administrative and collaborative processes, where the cases are instantiated conforming to formal and rigid templates. The problem with global Workflow in the domain of B2B is that inter-enterprise processes could not be instantiated form a predefined process templates, rather they are modeled as ad hoc Workflow (Figure 2). In contrast with formal Workflow, the cases in the ad hoc Workflows are derived from generic templates and can be modified to meet specific needs in order to support flexibility (Dittrich et al. 1999).
An ad hoc Workflow can be viewed as an informal orchestration of different activities (sub-processes) gathered in order to achieve a predefined objective (Weber et al. 2005). Another aspect of the ad hoc Workflow is related to the nature of its sub-processes. In deed, the adjacent tasks of an ad hoc Workflow are built depending on real world models and not by using rigid templates (Ivins et al. 2004). This fact leads to a manual integration in order to connect different and distributed Workflows within a global Workflow.

Traditional Workflow overcomes the problem of interoperability when it comes to build the global Workflow based on their formal templates. In contrast, they stem from the lack of flexibility needed to deal with the frequent modifications of rules and conditions in the domain of business (Aalst 2000; Dittrich et al. 1999; Yan et al. 2001). However, in real world, both types of Workflows, i.e. ad hoc and formal Workflows coexist together and hence need to be integrated dynamically.

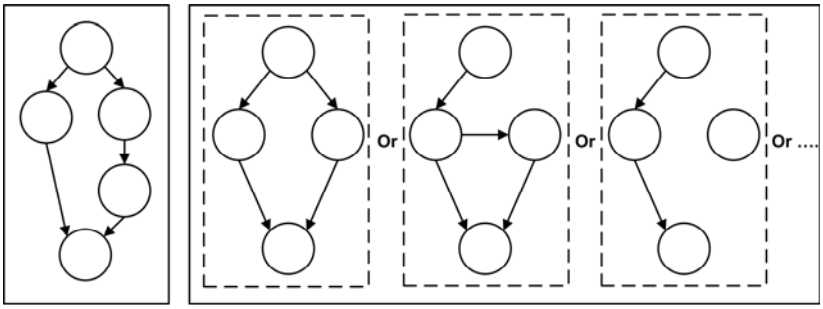

Fig. 2. (A) Formal Workflow – (B) Ad hoc Workflow

In the remainder of this paper, we handle the process of Distributed Workflow integration into a global Workflow.

2.2 Integration of heterogeneous Workflows

As mentioned previously, both types of Workflows, i.e. ad hoc and formal Workflows coexist together and need to be integrated without imposing the transformation of ad hoc Workflow into a formal one. In order to bring service agility and to support lean service integration, we propose to integrate the process life cycle in the service support system: first processes are designed in an exploratory way; they are implemented as ad hoc Workflows. Then, these ad hoc Workflows are integrated in a global Workflow to support efficiently the exploitation phase. Lastly, the Workflow is adapted in a re-engineering process by allowing ad hoc Workflow parts to fit the current evolution. Consequently, this lean organization support system involves to take into account both ad hoc and formal Workflows.

In this paper we propose a formal method, which permits the integration of several segments of separated Workflows regardless of theirs types. For that we propose to use a mediator between different parts of a global Workflow. The mediator grantees the interoperability between heterogeneous sub-Workflows even those which are not supported by software system.

3 The mediator

The basic aim of the mediator is to automate the process of global Workflow integration by offering standard connectors between the processes of a global Workflow.

The mediator is composed of Inbox and Outbox containers dedicated for conserving data related to processes being in treatment by an instance of the global Workflow (Figure1). In order to keep tracks of multiple instances, which might run concurrently, the mediator holds a Stack containing Process_ID, Process_Status, Process_Predecessor(s) and Process_Successor(s) for each process supervised by the global Workflow. The information gathered in the Stack is a significant resource to be analyzed and then employed as input data for the Process of Workflow reengineering.

As mentioned previously, human tasks still need to be integrated in an administrative Workflow. For that the mediator supports both types of communication ports API (Application Program Interface) and GUI (Graphical User Interface) as illustrated in figure 3.

The use of the Mediator as a connector offers a standard approach for building global formal Workflows combining both formal and ad hoc ones. On the one hand, using the mediator, global Workflows keep the flexibility needed for reconfiguring Business Process on the fly. On the other hand, the interconnection of heterogenic segments by means of formal Mediators offers a standard approach for reconfiguring and reengineering of service-based Workflows.

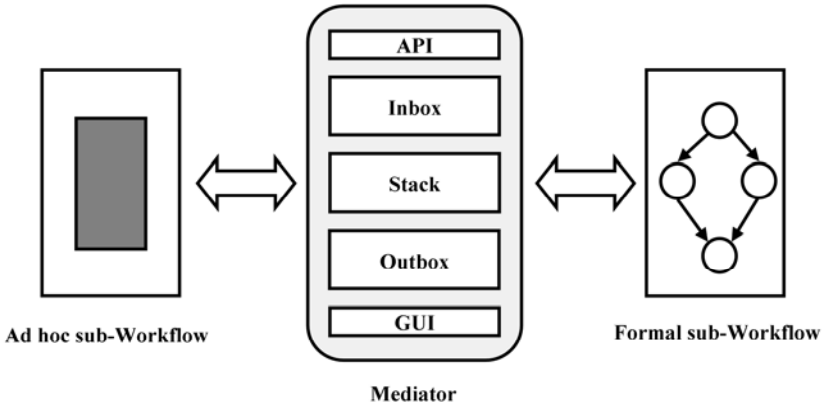

Fig. 3. The role of Mediator between an ad hoc and a formal Workflow

The mediator process consists in three steps:

- Take a request from the Inbox. This request is given either through the GUI for ad hoc Workflow or thanks to the mediator API for formal Workflow.
- Put the request in the process stack while searching the convenient Workflow segment.
- Forward the results to the outbox using either the target Workflow API for formal Workflow or the GUI for ad hoc Workflow.

In order to clarify the notions of building global Workflows by means of Mediators, a case study from the domain of B2B e-commerce is illustrated in the next paragraph.

4 Case study

As a case study we consider a global Workflow of e-procurement which depicts the treatment of a Purchase Order (PO) created by a Client in order to buy a Product directly from a Manufacturer. This Product is made up of two Raw Materials RM1 and RM2. RM1 is supplied by one Supplier S1 whereas RM2 is supplied concurrently by two suppliers S2, S3. In order to fulfill the command, an instance of a Workflow is initiated by the Manufacturer which might encompass other Workflows managed by the suppliers of the Manufacturer. With PO being validated, the next task is to verify if it can be fulfilled directly form the stock. In this case, the Manufacturer proceeds for the delivery directly. In the case where the stock level for the demanded Product does not permit the fulfillment of the PO, a fabrication process is needed. According to production capacity and the reserve of raw materials RM1 and RM2, the PO might be accepted or rejected as illustrated in figure 4.

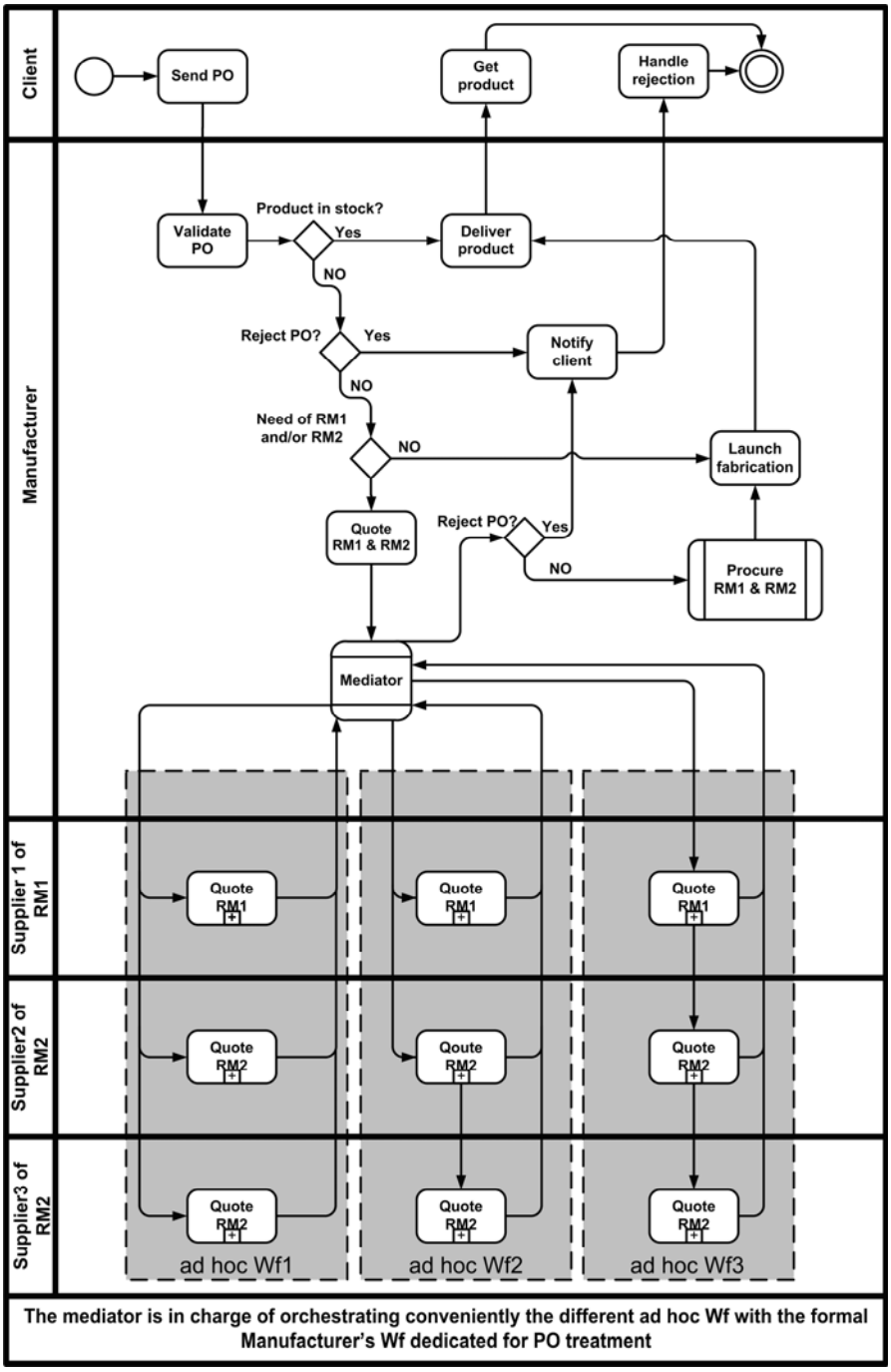

Fig. 4. Case study: electronic procurement

In order to show the role of the mediator, we focus on the case where the PO is accepted with the need of procurement for RM1 and RM2. Before the Manufacturer launches the fabrication process, a procurement process of RM1 and RM2 is initiated. This process is achieved in two phases: quotation and procurement.
As illustrated in figure 4, the part of this global Workflow distributed among the three suppliers is an ad hoc Workflow, that is the inputs and outputs of this part are predetermined, whereas the internal organization is not known. We show three possibilities for the procurement ad hoc Workflow:

1. The three suppliers S1, S2 and S3 are asked for quotations in parallel, in this case the Manufacturer waits for replies from the three suppliers. Depending on these replies, the Manufacturer decides to reject or to accept the PO and hence notifies the client in case of rejection or otherwise launches the fabrication process.
2. The suppliers S1 and S2 are asked for quotations in parallel, and then S3 is asked to quote in case of failure of S2 or inconvenience of S2's reply. Indeed, this case of ad hoc Workflow is carried out when the supplier S2 is privileged.
3. The three suppliers are asked for quotations sequentially, i.e. each after the other. In this case, the Manufacturer would not continue the process of quotation if S1 is not capable of supplying RM1.

During the exploration phase, the choice among these three possibilities could be made manually. The role of mediator is to determine which choice to be executed depending on information provided to Inbox. As mentioned previously (section 3), the mediator gathers information about each instance of ad hoc Workflow executed in the exploitation phase. These pieces of information are analyzed in the reengineering phase in order to choose the most convenient case of ad hoc Workflow to be executed according to the Business Process context. As the environment of B2B e-commerce is very dynamic, the task of Workflow reengineering should be a continuous process.

5 Conclusion

A basic step towards the evolution of B2B e-commerce is to deal with ad-hoc processes of enterprises in an adequate way. One of the challenging issues hinges on the integration of these dynamic ad hoc processes into a coherent global Workflow. In this paper we have provided a comprehensive analysis of ad hoc Workflows and their integration. We have addressed the problem of dynamic integration by proposing distributed synchronization points for specifying interfaces between processes. We have also provided a means of exchanging cases and information without influence of frequent modifications of business rules, conditions and constraints.

Further works first consist in refining the prototype and then will focus on the Workflow formal description so that dynamic controls could be achieved while the mediator orchestrates the Workflow interconnection.

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