A Real-Time Cooperative Swim-Lane Business Process Modeler

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Abstract. In this paper[1], we propose an advanced business process modeling system, which is called a real-time cooperative swim-lane business process modeler, that enables several real actors/workers to cooperatively define a business process model in a real-time collaborative fashion. Through implementing the modeler, we are able to accomplish the goals - maximizing efficiency as well as involvement of real workers in the business process modeling activities. In the traditional approaches, the modeling work is done by a single designer who has to know all about the detailed and complex knowledge for business processes, such as relevant data, organizational data, roles, activities, application programs, scripts, etc. However, when we take into account the recent trend that a business process has become more complicated and large-scaled, it is hard to say that the approach is feasible, anymore. Therefore, we propose a more realistic approach that enables several real actors/workers to cooperatively define a business process at the same time.

The real-time cooperative swim-lane business process modeler is implemented by using Java programming language and EJB framework approach so as to be deployed on various heterogeneous platforms without any further technical consideration. And its major components might be EJB-based DB component, graphical swim-lane workflow modeler, organizational dependency analysis algorithm, organizations, relevant data, invoked applications, and repositories management components.

Keywords: Information Control Net, Real-time Cooperative Swim-lane Model, B2B e-Commerce, Cross-organizational Business Process Modeling System

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1 Introduction

In the workflow and BPM literature, we can see two evidences - Merging real-time groupware into business process and workflow issue and Cross-organizational workflow issue. The first issue is related with the complexity problem of workflow. A business process has been becoming gradually complex more and more in terms of the structural aspect of the workflow as well as the behavioral aspect of the workflow. The structural complexity is concerning about how to efficiently model and define a large-scale business process consisting of a massively parallel and large number of activities. Therefore, by using the real-time groupware technology, a group of people (business process and/or workflow designers) is able to cooperatively model and define the large-scale business process in a real-time collaborative fashion. The behavioral complexity is related with the run-time components of workflow enactment. If a certain activity's implementation (application program, for example) has to be collaboratively done by a group of actors, then in order to support the situation, the real-time groupware technology should be merged into the workflow enactment components. In this paper, we are looking for a method for merging groupware into the business process modeling work.

The second issue is concerning about the interoperability problem of workflow. The interoperability problem addresses the following two issues - the build-time (construction) issue and the runtime (enactment) issue of a cross-organizational workflow or business process. The runtime issue has been treated and standardized effectively by the WfMC and other workflow-related standard organizations, as one knows well. Also, the workflow description languages aspect of the build-time issue has been well formatted and standardized by the standard organizations, such as WfMC's WPDL/XPDL, BPMI's BPML/BPMN/BPQL, ebXML's BPSS, RosettaNet's PIP, and so on. However, the modeling methodologies and systems aspect of the build-time issue hasn't been well done yet, because almost all workflow and business process management systems have their own modeling methodology and system, it is very hard to draw up a single standard. Additionally, it confronts with the dilemma stated in [2] that is the independence (or security) of organizations versus the efficiency of construction. In constructing a cross-organizational business process, the methodology and the system in one place have advantages on the efficiency of construction. However, the independence of each organization must be abandoned because they have to open their own internal workflow information. In contrast to the situation, each organization wants to be more secured and has the ability or the right to decide things on its own, so they have to give up the efficiency of construction. In this paper, we would also propose a method for solving the dilemma.

Conclusively, in this paper, we would like to seek a feasible solution for resolving the previous two methods at once. It is called cooperative swim-lane business process modeler hat is used for constructing a cross-organizational business process in a way of not only that a group of actors can be engaged in the modeling work at anywhere and anytime, and but also that it avoids the dilemma. We implement a cooperative swim-lane business process modeling concept with respect

to ICN (Information Control Net) and by embedding the real-time groupware functionality, as well. Therefore, a group of designers or actors are able to open a session, join to the session, and cooperatively construct a cross-organizational business process through the system. We describe about the system after introducing related works and backgrounds in the next section. Finally, we explain about the use and extension of the system.

2 Backgrounds and Related Works

Recently, electronic commerce and its related technologies have been swiftly adopted and hot-issued in the real world. This atmosphere booming e-commerce is becoming a catalyst for triggering explosion of the electronic logistics and supply chain management technologies and markets as well. This also means that organizations are much closer each other and need to support the inter-organizational cooperative activities with great efficiencies. Hence, the workflow and BPM technology does also become a core platform for technologies bringing organizations much closer and make them much more tightly coupled by supporting inter-organizational activities. At the same time, the traditional workflow systems are now fairly setting up as a core platform for automating intra-organizational business process. Therefore, in terms of the conceptual points of view, the workflow and BPM technology has to be required with supporting not only cooperative people works but also cooperative organization works, which can be dealt with the intra-organizational workflow and the inter-organizational workflow, respectively.

Particularly, in terms of the inter-organizational workflow modeling aspect, there are several related works in the literature. According to the degree of complexity in collaboration among organizations (or inter-organizations), there might be two types of collaborative organizations - loosely coupled collaborative organizations and tightly coupled collaborative organizations. The Interworkflow project [2] conducted at the Kanagawa Institute of Technology, Japan, is one of typical frontiers pioneering inter-organizational workflow modeling methodology and system for the loosely coupled collaborative organizations. They focus on the definition of a global-workflow model (which they call interworkflow) for a cross-organizational business process. This interworkflow model defines the basic interaction between the associated parties, and then it is transferred into the workflow management systems of the parties. Within the system, the (local) processes are modified to be suitable for the needs of the individual enterprises. On this basis, the interworkflow definition tool is used to define the interworkflow process. After this definition work, the translators automatically convert the interworkflow process definition data into the workflow engines used in each organization. While on the other, as a system supporting the tightly coupled collaborative organizations, we implement the cooperative swim-lane business process modeling approach. The detailed idea and concept of the system is described in the next section. Also we explain what are differences between the [2]'s approach and ours based upon the issues, too.

3 The White-Box Approach

As stated in the previous section, we would propose a system for modeling a business process in a completely different way from the traditional modeling approaches. Our approach reflects the basic philosophies of the previous two factors as much as possible. That is, we look for a way not only that makes people closer and more cooperative but also that makes inter-related organizations more collaborative in modeling a global business process. According for the business process to be more complicated and to be engaged with many organizations, our approach will be more worthy and more effective. It comes from a simple idea, in which it should be not reasonable for only a single designer to define a whole business process. Then, how can we make as many designers as possible to be engaged in modeling a business process? In this section, we conceptually and operationally illustrate the idea of the approach, as an answer for the question.

From the point of operational view, we would name the [2]'s approach "black box approach," in which the internal process in each organization is treated as a black box, because it makes only the linkage with others visible. While on the other, our approach would be named "white box approach," because all of the internal processes associated with a global business process can be precisely described in one place where the modeler is located, and broadcasted into the other coordinators. As we described in the previous, our methodology is pursuing the closed e-business framework, not the open e-business framework. That is, while the black box approach might provide a reasonable solution for constructing the open e-business framework, the white box approach, our approach, should be appropriate for constructing the closed e-business framework. In this section, we explain how the white box approach, our modeling methodology, defines a global business process and generates its collaborative local business process, each of which belongs to an organization.

In summary, we have introduced our white-box modeling methodology, so far. The methodology might fit very well into the system that provides tightly coupled interactions among a group of people as well as a group of organizations in collaboration. So, we have a basis for implementing a workflow modeling system that is operable based upon the methodology, which avoids the dilemma [2] and provides a great simplicity and efficiency in business process modeling work that should be perfectly applicable for not only intra-organizational workflows but also cross-organizational workflows. Also, it can be embedded into the closed or process-centric e-business framework. The methodology's advantages can be summarized as the followings:

1. It is a white box approach, because each activity can be clearly assigned into the corresponding organization that has the responsibility of execution. So, the construction unit of a global workflow model becomes the activity, which is exactly same with the conventional business process modeling methodology.
2. A group of cooperative designers are always aware of collaborative linkages, in real time, existing among internal processes (or local workflow/BP) of a

cross-organizational business process model, because the cooperative swim-lane modeling tool provides WYSIWIS functionality to the designers logged on a session, and it is able to automatically generate a cross-organizational BP model by combining and arranging the local BPs.

3. It needs not to develop a set of translators converting the description language of a global business process model into the language of each local BP model, because the description language of the global BP model collaboratively defined by a group of designers is WPDL/XPDL, and the corresponding local BPs are stored in the registry/repository component that provides interfaces to the runtime components of each organization.

4 The Cooperative Swim-Lane Business Process Modeler

In this section, we describe the implementation of a cooperative swim-lane business process modeler that reflects the white-box modeling approach. The CTRL research group of the Kyonggi University has been developing especially for the e-Logistics and e-Commerce framework, and is funded by the Korea Research Foundation Grant (KRF-2002-003-D00247). The system is based on the graphical notation of the information control net (ICN) [8] that is the most famous workflow model. Also we borrow the concept of swim-lane workflow model [9], too, which is very useful for composing the windows and user interfaces of the tool, because a swim-lane on the windows may represent an actor, a role, or an organization (and its local workflows). Also, the swim-lane becomes a boundary for access control. Therefore, we combine these two concepts, ICN and Swim-lane, to implement the approach. The system is completely operable now.

4.1 Architectural Components of the System

We realize the white-box modeling approach by implementing a business process modeling system that is based on the notations of the global information control net and the swim-lane workflow model as well. This system also pertains to the key principles of real-time groupware, such as concurrent work, WYSIWIS , group awareness, and supporting second-level language. The concurrent work is implemented through the event sharing mechanism, the group awareness is graphically represented by cursors with user's id, and the second-level language is supported through a chatting function. The functional architecture of the BP modeling system is presented in Fig. 1. The modeler has three major components - The cooperative Swim-lane Business Process modeler that is used to define a global BP through its graphical user interface, the cooperative Swim-lane BP modeling server that takes the roles of session control and event control, and the registry manager that has a repository for XML-based global BP models and provides APIs to a set of different BP enactment engines. We briefly describe about each of the architectural components of the business process modeler.

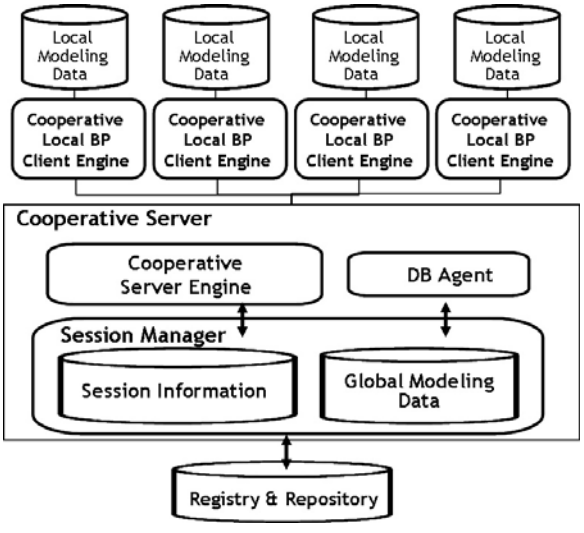

Fig. 1. Overall Architecture of the Cooperative Swim-lane BP Modeler

The Cooperative Swim-Lane BP Modeler. The modeler provides a set of functions and capabilities for the BP modeling work cooperatively performed by a group of users (or designers/builders). As a front-end component of the system, it has three major components - graphical user interface manager, cooperative fragment client engine, and local modeling data manager - that provide the group BP modeling functionalities, such as user management, session control, event handling and synchronization, floor control, space sharing, access control, message handling, modeling data management, model verification, and so on.

The graphical user interface manager enables a group of cooperative designers to define, edit, verify, and simulate a collaborative global business process on a shared space. The shared space is divided into the number of designers logged on the current session, each of whom is assigned into one swim-lane. Then, the owner of each swim-lane takes the responsibility for editing his/her workflow fragment. Of course, each of designers can't edit the others' local BPs, but they can only see and read the others' modeling works. As a result, the swim-lane means, in this modeler, the access control boundary (read/write permission for the owner, read-only for the others).

Finally, a group of designers is able to cooperatively draw and edit a global BP model through the graphical icons that are exactly identical to the graphical notations of the information control net. The major information dealt with the modeler consists of four dimensions - global BP process models, global organizational information, relevant data structures, and the invoked application programs. After modeling the global business process, those related information are stored on the registry/repository's database through the JDBC operations of the database connection module. Moreover, the modeler provides a feature for

verifying the defined global business processes through the graphical animation approach, which is called XML-based open global BP animation tool.

The Cooperative Swim-Lane BP Modeling Server. The cooperative server consists of three major components - Cooperative Swim-lane Server Engine, Session Manager, and Database Connection Agent - that are implemented by the framework programming approach based on EJB (Enterprise Java Beans) infrastructure. From now, we give brief descriptions of the three major components.

The Cooperative Swim-lane Server Engine. The major responsibility of the cooperative server is to synchronize modeling operations among the modeling clients. The synchronization can be implemented by either a screen-sharing mechanism or an event-sharing mechanism. Our server engine performs the synchronization by implementing the concept of virtual cooperative server based upon the event-sharing mechanism. The virtual cooperative server is an instance of the cooperative server that resides in the client of the modeler and handles all events from the modeler to broadcast to the others. The types of events are listed such as insert, remove, move, awareness, pull, chat, and update.

The Session Manager. The session management functionality is the most crucial part of the server. It maintains opening and closing sessions, joining and dropping users on the sessions, and assigning access rights to the users. Especially, in terms of the access control mechanism, we newly implement the double-level floor control mechanism. The first-level floor control is for inter-swim-lanes of the modeler, and the second-level floor control is done within a swim-lane. That is, the users, each of whom is logged in a different swim-lane, are able to perform her/his own modeling work concurrently without any interference from others. In the contrast to this, the users who are logged in the same swim-lane can't perform their own modeling works at the same time. Through the two-level floor control mechanism, we accomplish that the concurrency level of inter-organizations' modeling work can be maximized, the concurrency level of intra-organization's modeling work can be minimized. From the access control policy, just like this, we can expect that the cooperative swim-lane BP modeling system can be primarily used for modeling cross-organizational business processes. Of course, the system can support the BP modeling work within an organization. In this case, the notion of swim-lane has to be replaced by a role not an organization. Then we can expend the system's usability without any further modifications.

The Database Connection Module. The module (agent) provides a set of JDBC-based APIs that are used for the server to access its database as well as the repository. That is, the module is located between the cooperative swim-lane server engine and the registry/repository system. Also it is deployed on EJB sever as a component. Through the EJB technology, we are able to guarantee a stable database agent that can be characterized by the distributed object management, reliable recovery mechanism from system failures, reliable large-scale transaction management, and the security functions.

The Registry/Repository Manager. The registry manages the model information of cooperative swim-lane BP models transformed in XML. It consists of two major modules, the APIs for workflow enactment engines and the database connection module. The former takes in charge of maintain the business processes, which is formatted in the XML format (WPDL/XPDL). The latter has the database access functionality that is exactly identical with the database connection module in the cooperative server. Moreover, it carries out connections with the cooperative swim-lane server engines that are operable on the EJB computing environment.

4.2 The Operational Examples

In this section, we would present a couple of captured screens of the modeling system. We would simply prove, through the selected screen, that the methodology is completely workable on the real environment. Fig. 2 is a screen of the modeler, which simply shows a global business process definition containing ten activities, one or-split and one and-split. As you see, the window has three vertical partitions - the left-hand side is for the global business processes with tree structures, the middle is reserved for a set of icons that represents, from the top, the start node, end node, activity, nested activity, cooperative activity, AND-split node, OR-split node, loop activity, control flow, data flow, and finally the relevant data, respectively, and the right-hand side is the shared space for the cross-organizational BP modeling work, on where eight workflow designers are cooperatively performing the modeling works. The pencils labeled with numbers on the window represent the designers, which mean the group awareness that is one of the real-time groupware's key features. As we described in the previous, the right-hand side is, again, horizontally partitioned into eight swim-lanes, each of which represents an actor or an organization. And the graphical notation of the modeler follows the rules of information control net.

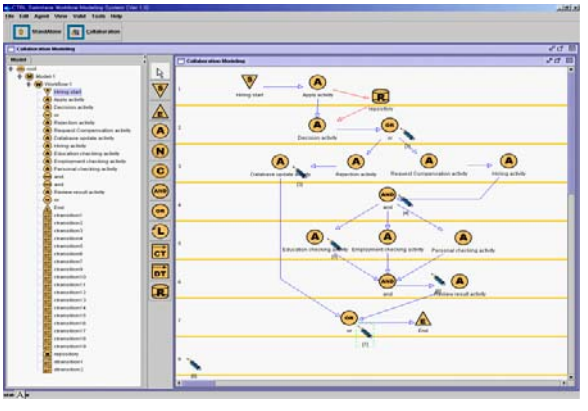

Fig. 2. Graphical User Interface of the Cooperative Swim-lane Modeling System

As mentioned in the previous sections, the system's design goal is based upon the fundamental principles of real-time groupware systems - Concurrent work, WYSIWIS, group awareness, double-level languages. So, the following is to summarize how the principles are implemented on the system:

- Concurrent Work: The Double-Level Floor Control Mechanism
- WYSIWIS: The Event Sharing Mechanism
- Group Awareness: Pencil labeled by a number
- Double-Level Languages Support: The First-level Language(Swim-lane and ICN), The Second-level Language(hatting Function)

Where, the double-level language support has a special meaning in a groupware system. Generally speaking, the language is a communication tool supporting a group of people to exchange knowledge each other. However, in a groupware system, a group of users communicates each other through its shared objects. That's why we call it the first-level language of the groupware system. But, the only single-level of language might not be enough for a group of users to communicate each other. So we need one more language during a work group session, such as chatting, email, telephone, and so on. And one of these languages becomes the second-level language of a groupware system. Fig. 3 shows the double-level languages support in the cooperative swim-lane BP modeler - The first-level language is swim-lane and ICN, themselves, and the second-level language is provided through a chatting function. We would not show other screens here that are used for defining activity information, performers, organizations, relevant data, invoked applications, and so on.

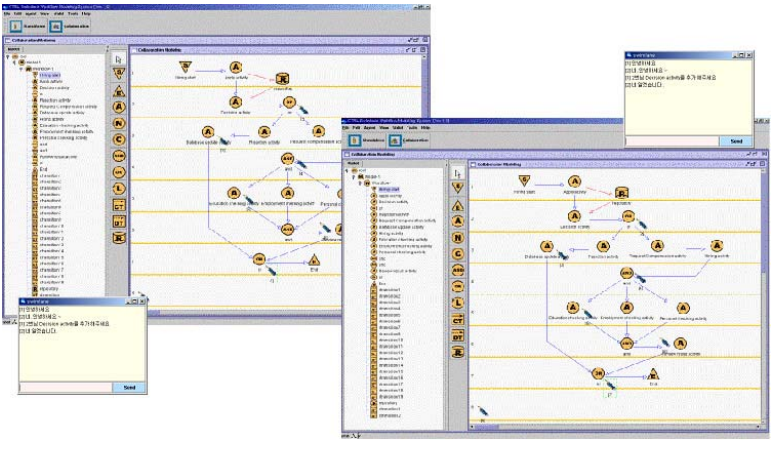

Fig. 3. Collaborative Modeling through Double-level Language Support in the System

5 Conclusion

So far, we have proposed the cooperative swim-lane business process modeling approach (the white-box modeling approach) and proved that the approach is a feasible and realistic by developing the cooperative swim-lane business process modeler. We strongly believe that the modeler fortifies the modeling approach, and vice versa. Also we assure that the modeler fits very well into the tightly-coupled framework for the workflow-driven e-Commerce domains. Especially, the approach might have a strong advantage in terms of the high degree of modeling ability for not only complex and maximally parallelized business processes but also collaborative global business processes. At the same time, it should be very applicable to the type of collaborative global business process models that is defined and characterized, by us, with tightly coupled global BPs in collaborative organizations.

Recently, BPM and its related technological fields, including process-centric e-Business and e-Logistics, are catching great attentions from the society of information science and database management fields. So, there are a lot of challenges to develop and commercialize e-business solutions. This paper should be one of those active attempts for pioneering global business process modeling methodologies and systems toward supporting cross-organizational BPs in collaboration.

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