Concepts for a flexibilisation of workflow management systems with respect to task adaptable solutions

Keywords

flexibility and adaptability of workflow management, management of decentralised workflows, workflow management scenarios and applications

1 Abstract

Workflow management systems are an effective means of guaranteeing a high quality in the execution of business processes and services. Furthermore, they enable the establishment of telework places which are gaining more and more importance in the competitive business environment. Despite the obvious advantages, there are still some obstacles which will have to be overcome to make distributed working a real success. One of the major drawbacks of the existing systems is that they have no means of supporting synchronous co-operative work. Another apparent shortcoming of the current systems is their inability to interface with other systems of the same kind. As a consequence, it is not possible yet to execute one coherent workflow using a different workflow management systems. In this paper we present some concepts which lead the way to more developed, intelligent, distributed workflow management systems which will be able to comprehensively support co-operative work. Different scenarios will be outlined to clarify our approach. The concepts described are based on the work from the project WoTel of the Siemens AG (developed with other major companies and the German Telekom) and from the project Polivest, from SNI AG and Siemens AG with the German Ministry for Research.

2 Workflow Management and Multimedia Collaboration

Workflow management systems can only support more or less sequent tasks what we call asynchronous telecooperation. They proceed on the assumption that work can be divided into steps so that every step can be handled with the results of the former steps and knowledge of the current employee. They also presume that no mistakes have been done earlier in this chain. Unfortunately in daily work there are many violations on these assumptions. Finally today's workflow management systems do not take into consideration that even well structured operations have often tasks that strongly influence each other because the nature of the tasks is interrelated, concurrent or informal. These processes could not be captured by a workflow management system. The use of Multimedia Collaboration (MMC) Conference systems can contribute to eliminate these drawbacks, since they allow to work together in teams on specific topics, directly from the desktop without leaving once place. This mode of operation we call synchronous telecooperation. Additionally the integration of MMC Conference systems into workflow management systems allows to contact managers, other workflow participants or the system support group without lengthy interruptions.

Another advantage of MMC Conferences is the reduction of media breaks which inevitably occur when a workflow participant leaves his place to join a „normal" conference.

The following illustration describes how a MMC Conference is embedded into a workflow (fig.1) (see also [Wote95]).
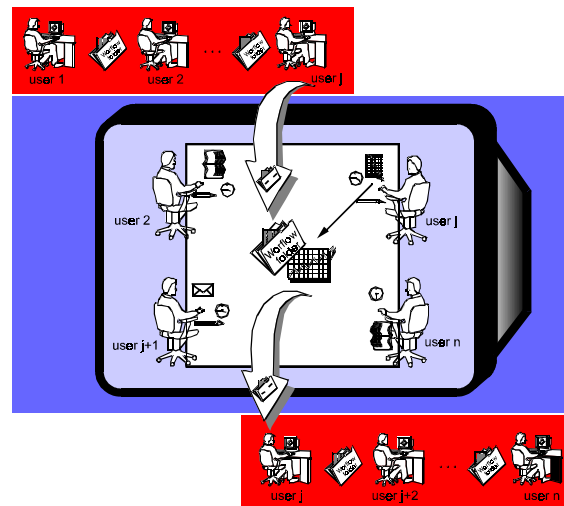

fig. 1: Integration of Workflow and Telecooperation

Figure 1 shows how a MMC Meeting is integrated into a workflow. Consider that „user j" has to reconcile an action with some other colleagues taking into account newest interpretation. He starts a MMC Meeting with „user 2", „user j+1" and „user n". They have the means to discuss the case directly via an audio-visual communication. As far as they have the authorisation they can directly manipulate documents, so no useless work has to be done like writing down notes and typing them afterwards into the computer. Additionally they can use supporting material, like spreadsheets or other documents. This informal meeting removes time-consuming and expensive waiting periods. Furthermore the feedback from the other colleagues is faster than with electronic mail. After the conference the result is passed to the workflow management system and the workflow continues. As we can see in the

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example a conference participant must not necessarily be a workflow participant. This fact enables to consult external specialists.

2.1 Distinctive Characteristics of Multimedia Conferences

This section considers MMC Conferences in the context of Workflow Management.

First we introduce some terms. In the following we differentiate between process activity and conference activity [WfMC94].

Process Activity:

„A logical step or description of a piece of work that contributes towards the accomplishment of a process. A process activity may be a manual process activity and/or an automated workflow process activity."

An activity which takes place during a MMC Conference is called conference activity. In contrast to process activities several persons are working jointly and simultaneously.

A 1:1 relationship between process and conference activity is not necessary, there can also be a 1:n relationship. If each conference activity is a process activity there is a 1:1 relationship. As a consequence the conference organisation is strict because the workflow decides the proceeding (see fig. 2, left side).

Considering a 1:n relationship, from the point of view of the workflow a conference may look like a single process activity during which (invisible for the workflow) many conference activities will be accomplished (see fig. 2 right side).
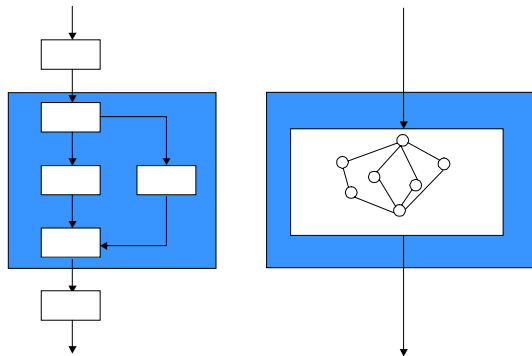

fig. 2: 1:1 versus 1:n relationship

Consequently a workflow cannot interrupt the conference. The purpose for this distinction is that the workflow mechanism is often too rigid to support teamwork tasks. The conference participants want to have the opportunity to react flexible in different situations during MMC Conferences, e.g. to add, postpone or delete tasks. The conference participants regard the conference activities as a dynamic „To-do list" which has to be handled.

In the workflow context, basically MMC Conferences can be differentiated by the following aspects (see also [SSS 96]):

- Moment of Modeling
- Coordination of the Conference

2.1.1 Moment of Modeling

Considering the time when the conference is modeled we can distinct two instants. Conferences that are already planned at the moment of the development of the workflow are called **pre-scheduled conferences**.

In contrast to that the occurrence of an **ad-hoc conference** is not foreseeable at the time where the workflow is specified, e.g. because of an unexpected problem. The point of starting a MMC Conference depends on the actual situation. At the development time there are no information about the conference, because at this time no conference is planned.

2.1.2 Coordination of the Conference

A further possibility to distinct MMC Conferences is how or by whom the execution of the conference will be controlled and coordinated (see [RSVW94]). If the conference is coordinated by the system it is called **static conference**. If it is coordinated by a participant of the conference we call it **dynamic conference**.

As it concerns a static conference the content and the way how the conference will be executed are described in detail. The conference activities are fixed (see also [Jabl94]). The conference has a rigid and somehow inflexible structure (1:1 relationship). The conference activities are totally transparent to the workflow system. Consequently the workflow can interrupt and reinvoke the conference.

In contrast to this the execution of a dynamic conference is free and imposes no constraints on the conference participants concerning the way how they organise their work during the conference. They are the only responsible for the conference coordination. The content is specified by the subject of the conference and an agenda. At the beginning of the conference the conference activities need not to be fixed. The workflow refers to the work on this agenda as a single process activity (1:n relationship).

2.2 Types of Integration

In the previous section we described the different aspects how Multimedia Conferences can be characterised. Now we want to focus on how to integrate conferences into a workflow and we will clarify our approach with some examples.

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First we focus on pre-scheduled conferences which are already modeled as part of the workflow, then we use the same approach for ad-hoc conferences. Combinations between the described conference types are also possible.
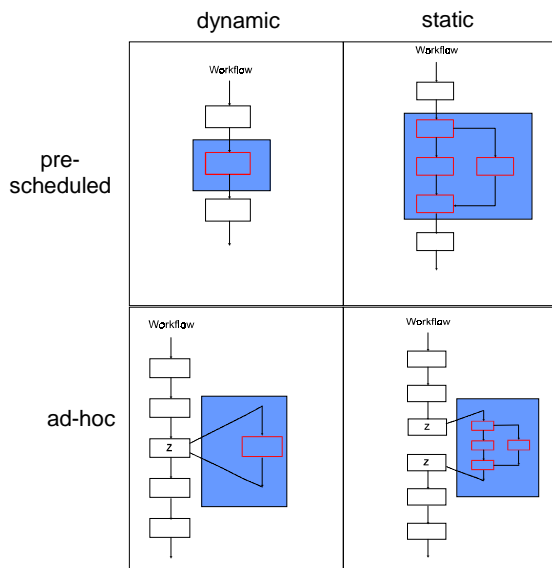

fig. 3: Possible conference types

In the next section we will describe the four possibilities (see fig.3).

2.2.1 Dynamic Pre-scheduled conference

This conference is part of the workflow already from the beginning. It is foreseen at modeling time. The contents to be discussed during the conference will be fixed as conference activities before or during the conference.

As an example of this type of conference consider the following. A petition arrives at the German environmental ministry. After some routine tasks like controlling the attachments etc. some managers sit together and discuss which subordinate offices are responsible to work on this petition. This kind of conference would be regarded as a meeting.

The conference tasks are defined as follows. After a short introduction the petition will be examined. Then a decision is made about the further proceedings and a suitable subworkflow will be initiated as result of the conference. Because the conference has a brainstorminglike character a strict ordering of the tasks would be too rigid. During the conference it often happens that leaders of subordinate offices are consulted concerning their responsibility to different problems. This procedure can barely be captured by a workflow. For this reason we suggest the use of a checklist to capture the work items for the conference and leave the conference coordination to the participants.

2.2.2 Static Pre-scheduled conference

Static Pre-scheduled conferences are modeled as part of the workflow. They are (sub-)workflows themselves. The workflow management system only uses a special resource to support this subworkflow as a MMC Conference. The procedure of the conference is coordinated controlled and recorded by the workflow management system.

An example for this type of conference is a hearing. Consider the following example. A decision has to be made how a workflow has to proceed. In a hearing several participants give up their statements than two managers have to decide how the workflow will continue. The justification for this decision must be recorded and authorised by the managers.

As described the activities and the ordering of the activities are prescribed. As a result the conference can be modeled as a workflow which also guarantees the regular execution of the task.

2.2.3 Dynamic Ad-hoc conference

Ad-hoc conferences are not foreseen and therefore they cannot be part of the workflow from the beginning. Situations in which this type of conferences is required are day-to-day problems like software problems or a check-back with a manager.

In this case a conference will be invoked (task „z", lower left corner, fig. 3). After finishing all conference activities the workflow will continue.

2.2.4 Static Ad-hoc conference

Static Ad-hoc conferences are not previously part of the workflow. In contrast to the dynamic ad-hoc conferences they describe a standard situation. When a conference of this type is invoked the participants have to follow a specific procedure.

An example is a process activity not correctly executed by a participant because of a mistake. This error is detected in a later activity from a colleague. When he wants to correct the mistake he normally would not have the authorisation to do so. In this case he interrupts his task (upper task „z", lower right corner, fig.3) and starts a conference with the earlier participant. In this conference the employees correct the mistake. Together they write down a note to record this change. After having done this the workflow participant resumes his task (lower task „z", lower right corner, fig.3) and continues his activities on the workflow.

Because such a procedure is well structured it can be specified as a subworkflow. When this situation arises the participant will select the suitable subworkflow to invoke and control the conference.

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The workflow management system knows which activities are executed during this conference and records the results. The conference can be interrupted and reinvoked by the system.

2.3 Concept of Integration

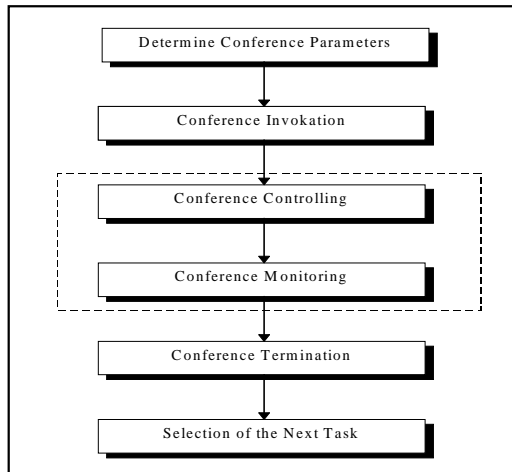Figure 4 shows the concept of the integration of workflow and MMC Conferences.

fig. 4: Integration concept

2.3.1   Determine conference parameters

The conference parameters contain data necessary to establish a conference. They pass also information from the workflow to the conference system such as:

- Date when the conference will take place
  This date must be fixed. For ad-hoc conferences this date is usually „now".

- Conference participants
  The participants that will be invited to the conference.

- Conference leader
  If there is a conference leader he will be passed to the conference system with this parameter.

- Conference topic
  This is an informal parameter.

- Agenda (conference activities)
  The agenda contains the conference activities. Even if the conference is coordinated by a workflow the participants should be informed about the work they have to complete in the conference.

- Conference activity responsible
  Equivalent to the responsible for a workflow activity there is a responsible for each conference activity.

- Conference documents
  The conference documents are shared during the conference.

These information are necessary to successfully complete a conference.

From a technical point of view the conference parameters are divided in obligatory and optional parameters. Obligatory parameters like date and participants must be specified to establish a MMC Conference. Optional parameters are not essential to initiate a conference out of a workflow but contribute to their successful result. They convey information to the conference system and the participants. If conference leader, conference topic and agenda are determined before the conference the participants are able to prepare carefully for the conference. So the conference can be carried out more efficiently.

Furthermore we want to use similar concepts to those used in MMC Conferences than for the workflow management system. As there is a responsible for each process activity the conference should have an equivalent feature for the conference activities e.g. the leader. This enables uniform reporting for the whole workflow concerning the task execution.

2.3.2 Conference Invocation

The conference parameter are used to establish the conference. The system invites the participants and shares the applications.

2.3.3 Conference Controlling

The controlling of the conference depends on whether the conference type is static or dynamic. Static conferences are controlled by the workflow. If one activity is completed the next activity will continue automatically. This does not work with dynamic conferences. Dynamic conferences are controlled by the participants themselves. At the moment we support this task by a checklist which captures the conference activities and serves as an agenda. The checklist will be described in detail later.

2.3.4 Conference Monitoring

The monitoring of static conferences will be completed by the workflow management system. Since the workflow does not know about the conference activities for dynamic conferences we also use the checklist for this purpose. It will be used to control dynamic conferences. At the moment this checklist has to be filled in manually.

2.3.5 Conference Termination

When the last conference activity is finished the workflow will terminate the conference for static conferences. Dynamic conferences are terminated manually by agreement of the participants after completing all conference tasks.

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2.3.6 Selection of the next task

The choice of the next task after a MMC Conference depends on the result of the conference. If all activities are successfully completed and results are recorded a decision can be made by evaluating the results. Considering for static conferences this decision can be made from the workflow management system. As far as dynamic conferences are concerned the results must be delivered to the workflow management system in an adequate way. For this purpose we use also the checklist which contains the relevant information as it captures the conference results.

2.4 Checklist

The checklist is an additional document that will be shared during a MMC Conference. As for static conferences all conference activities are workflow activities the checklist serves only as an information source for the conference participants.

fig. 5: Checklist

Dynamic conferences need the checklist for conference coordination and monitoring. It describes the activities for the conference like a to-do list, which can be dynamically changed (expanded or shortened). Furthermore the checklist is a tool to record the conference results. Figure 5 shows how the checklist looks like. The row containing „activity state" indicates whether all conference activities are completed. If the conference is interrupted and continued some days later the participants know which activities have been completed and on which activities work is required. This is necessary because the workflow cannot support this task as he refers to the conference as a single process activity. The row „importance"

enables the conference participants to postpone or ignore activities that do not necessarily contribute to a successful conference result such as activities like writing a protocol. The „Checklist Responsible" is regarded as a conference leader. This person undertakes the conference coordination.

2.5 Realisation

During the project WoTel a first demonstrator has been developed. The demonstrator shows the invocation of a Multimedia Conference (MMC/GroupX Tool) direct from a workflow activity of the workflow management system WorkParty.

The workflow management system and the multimedia conference system are running on different connected computers (PCs and workstations). Necessary are workflow clients (PCs), a workflow server (workstation) and conference clients and server (both workstations).

The goal is as shown in fig. 6: all components - workflow client and server, conference client and server - are running on one computer, called workflow/conferencing computer. Thus there are some connected workflow/conferencing computers in an enterprise. Combinations of workflow/-conferencing PCs and workstations should be possible.
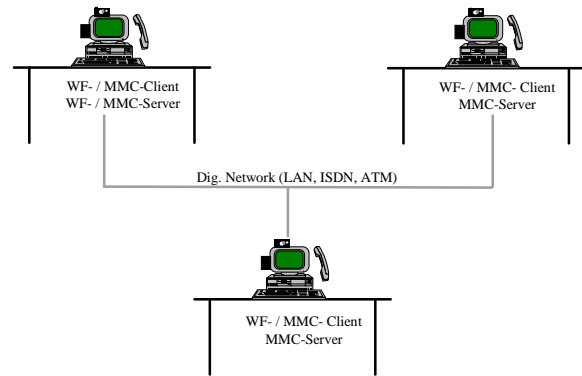

fig. 6: Scenario

3 Workflow-Workflow Interoperability

Since workflow management systems and their functional scopes are not standardised until now, many different products are available. Depending on their strength each of these different systems will be used to support specific tasks or to satisfy the requirements of the particular companies, departments within companies, etc.. For this reason in the future it will become a challenge to find interoperability concepts to connect these different

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products. A workflow will neither have to stop at enterprise borders nor will an enterprise have to concentrate on a single product. So business and task specific workflow frameworks will be established that exploit the advantages of the workflow management systems used. Furthermore these interoperabiltity concepts make it possible to efficiently establish virtual enterprises.

In the Polivest scenario we contribute supporting the process of legislation of the German Government. Due to the federalism of Germany all federal states are involved in this process. These states actually use different software systems. Consequently they strongly demand interoperability between workflow management systems to simplify their daily work.

3.1 Workflow Reference Model

In order to be able to develop complex systems consisting of modules provided by different vendors, one has to refer to standards. Looking at workflow, the Workflow Management Coalition (WfMC) is dealing with the standardisation of interfaces related to workflow management systems. The German Institute for Standardization equally deals with these problems [Behr96]. The WfMC defines a workflow management system the following [WfMC94]:

„A Workflow Management System is one, which provides procedural automation of a business process by management of the sequence of work activities and the invocation of appropriate human and/or IT resources associated with the various activity steps."

The workflow management model requires the propagation of vendor independent interfaces. The Workflow Reference Model of the WfMC provides a general concept for the architecture of a workflow management system. It introduces a modular structure which consists of a main part, the workflow engine (or Workflow Enactment Service WfES), surrounded with an interface for communication with other modules, the WAPI (Workflow Application Programmers Interface) (see fig. 7).
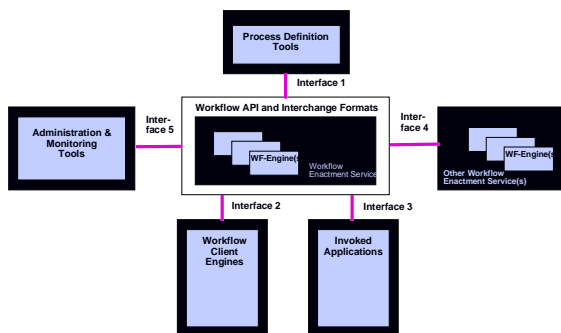
The WfMC defines five interfaces to the different modules :

- Process Definition Tools (Interface 1)
- Workflow Client Application (Interface 2)
- Invoked Application (Interface 3)
- Interoperability interface between two different Workflow Enactment Services (Interface 4)
- Administration and Monitoring (Interface 5)

Our work is strongly related to the specification of interface 4. Since this interface is not yet properly defined, the concepts used in our work are a proposal to generate a useful protocol that provides interoperability between the different workflow management systems. Furthermore we need a modular and flexible concept, because we want to take into account MMC Conference specific data to support this functionality equally in distributed workflows.

The WfMC defines the interoperability of workflow the following [WfMC94]:

„The ability for two or more workflow engines to communicate in order to co-ordinate and execute workflow process instances across those engines."

3.2 Workflow Connect (WfC)

workflow management systems consist of a server and a client component. The Workflow Enactment Service provides an interface to external functions. In our case it communicates via this interface with the Workflow Interoperability Service, which interacts with another system over a LAN or WAN. Having a closer look at the architecture of WfC it can be described as in fig. 8. It also consists of a client and a server part (WfCClient and WfCServer) with an underlying connection service. The exchange of information between two workflow systems will be realised by a protocol.
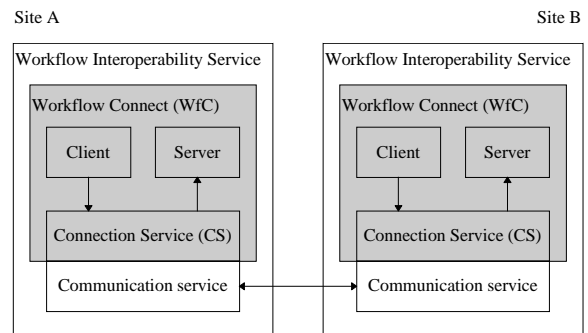
fig. 8: Workflow Connect

fig. 7: WfMC Refernce Model

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3.2.1 The protocol

The execution of processes over multiple workflow systems will be synchronised by sending messages with specific protocol information (and documents) from one workflow management system to the other over a connection and communication service. Looking at the heterogeneity in the area of workflow management systems the protocol must be very general to fit with all of them. Specific information need not be transmitted. It consists of two parts:

- Workflow related part
- Application specific extensions

Connection Service specific extensions

The Workflow related part of the protocol contains actions, that will be executed on the other workflow system. Moreover parameters for control are also part of the protocol, to guarantee correct execution and addressing.

Application specific extensions:

This block is used to give the possibility to make the protocol individual configurable and easy extendible. It will be used by applications to transfer specific information.

Error handling

In case of an error, an error message will be send to the initiating workflow management system with an error code.

3.3 Realisation of WfC

The realisation of the transmission of the data, the protocol etc. and the synchronisation will be done by the WfCClient (fig. 9). The WfCClient also includes objects like documents and sends all as a request in the context of a session with an unique ID to the partner WfMS. The ID is used to unique assign replies, confirmations, actions, etc. to the right session [Mull94]. The model demands, that the execution of a task defined in a request will be done exactly once, that means the session must be an atomic transaction, which satisfies the requirements of the „at-most-once"-semantic. The session itself will be initiated by a process activity within the flow.

The whole session consists of the preparation of a request with the protocol and the needed objects, the transfer of the request to the connection service, the actions to transmit it to the WfCServer of the receiving system and the execution of the specified action.
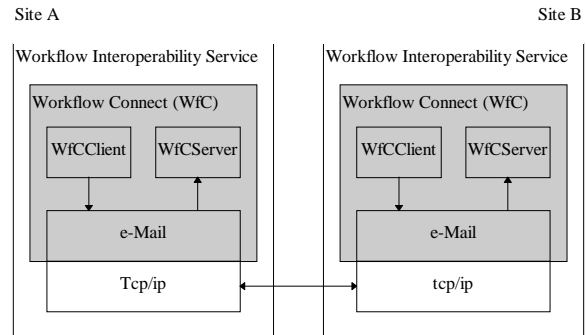

fig. 9: e-mail solution

A possibility to realise the connection service is the use of CORBA (see [DLF96]) but there are still problems with the interoperability of different CORBA2.0 implementations (see [Lawt95]). Therefore we decided to use Internet mail as connection service in a pilot implementation. Another advantage of Internet mail is that almost all workflow management systems already offer (see [WeFa96]) this service. Features for the parsing of workflow management system related e-mail contents, address resolution, time-out mechanisms for lost mails, automatic receipts to avoid multiple sending of messages have been included. The WfCClient and WfCServer have been implemented in a modular way, so that the change of the underlying connection service is simple.

4 Conclusion and Outlook

We have done basic work towards a flexibilisation of workflow management systems to tailor them to specific tasks. The use of MMC Conferences contributes to the flexibilisation of workflow management systems themselves (intra workflow). The connectivity service between workflow engines (inter workflow) allows to establish workflow frameworks where the strengths of the systems are optimal exploited.

For the future our major concern is to continue supporting MMC Conferences. For this purpose we want to use knowledge already available from the workflow system to perform conferences. This can either be knowledge from the workflow model or from the workflow execution.

The conference preparation is the crucial point for the success of a MMC Conference [BKLS95].

[Schn85] points out that a comprehensive instruction improves the result of a group activity. For this reason we require at least an agenda for all types of conferences. As static conferences are concerned this agenda can be prepared automatically from the process activities since all knowledge about the conference activities is available. In a further step we want to include short abstracts about the work to do, so the participants will join the conference better prepared.

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Another topic is the resource planning for MMC Conferences. Resources in this background are human resources and time. A schedule must be compiled to fix the time of the conference to assure that all participants are available. Since the participants of a MMC Conference are specified by an organisational role and not by their name, not only the time is variable but also the participants. To improve the quality and the results of the conferences we want to take into account psychological questions to find good teams [Schn85].

Further important aspects on which work is required are the recording controlling and monitoring of the results of a MMC Conference.

The possibility of an automatic evaluation of the conference results is imperative for a future user-optimised integration.

On the other hand we want to improve the Workflow Interoperability Service. We focus on the amelioration of the protocol specification to enlarge its functionality towards an international standard, e.g. interface four [WfMC94]. Furthermore we will adapt our service to other workflow management systems. We also intend to enhance the security and the reliability of the communication, for example by using a transaction monitor.

We want to investigate the possibilities for an intelligent connectivity agent (see [Kirn94]), who is able to negotiate an exchange specification with another workflow management server in a manner that all common features are supported.

Finally we aim at the integration of MMC Conferences into heterogeneous systems e.g. for workflows that affect different workflow management systems. A connectivity protocol for data exchange must not only transport workflow specific data but also MMC Conference specific data.

5 Literature

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