

HotFlow – A Visual Language for Workflow Applications in E-Commerce

Daniela Handl

*Darmstadt University of Technology, Dept. of Computer Science,
handl@pu.informatik.tu-darmstadt.de*

Abstract

HotFlow has been architected to control the dynamic workflow of negotiating and contracting between business partners within the scope of MALL2000, a project on business-to-business electronic commerce. HotFlow allows users with minor knowledge in information technology to visually define a workflow and modify it during run-time with simple drag-and-drop actions.

Keywords: visual workflow definition language, dynamic workflow, business-to-business electronic commerce, document-centred.

1. Introduction

When Electronic commerce (EC) came up, it mainly provided the additional possibility to send the usual order forms via Internet to a supplier. In the meantime, there have been important developments of EC in the business-to-business area. The requirements go far beyond the "customer orders, supplier delivers" line of action, which is usually based on filling forms. Instead, extensive transactions have to be handled, which require the agreement on many fundamental details, varying from one case to another. The manifoldness of those details disables the use of standard forms with predefined fields.

Establishing a business contact or adjusting offer and demand for an item both suggest a peer-to-peer relation among the negotiating partners, with each of them equally powerful. The question is how to handle this in an electronical environment.

The counterparts to rigid forms are freely shapeable text or image files, e. g., sent as an attachment to an email. They are neither adequate for the task, because they do not offer any control of the procedure. Extensive transactions often involve multiple parties before a contract is signed. Their work has to be coordinated, and the adherence to the planned procedure has to be monitored.

Workflow Management Systems (WfMS) provide planning and controlling facilities, but they are not flexible enough to be used in EC. WfMS let the workflow be defined once during build-time, which is then to be exhibited during run-time. Even though there are attempts to enable (authorized) users to modify the workflow during

run-time, a structural, basic change is rarely possible. But the need to add and/or replace partners, include conditions like time-limits to offers or licensing procedures might occur quite often in extended EC negotiations.

MALL2000 is a project on document-based EC (see section "Acknowledgements" in this paper and [1] for further details). Its target group are small and medium sized enterprises (SMEs). MALL2000 will enable them to establish international contacts and to do business with partners from all over the world. In the scope of this paper the focus is on the possibility for and the handling of document-based negotiations [2] within MALL2000.

Negotiations in EC include more sophisticated procedures than bargaining for a price. EC enables trading among partners who wouldn't even have known about the existence of each other. This is especially significant for SMEs who are more easily handicapped by distances, national regulations for trading, and language barriers than big enterprises which often have branch offices in many countries.

The conduct of a business consists of many steps ranging from getting in touch with (former unknown) partners, checking whether one partner can supply something the other one wants, up to concluding a contract. Maybe even multiple partners are involved. The organization and control of these steps is important in our context, since there might be multiple partners from different countries (that increases the time needed for postal communication) in maybe different time zones (that complicates telephone contacts), speaking different languages. Within the scope of MALL2000, HotFlow has been architected as a specialized WfMS to meet these requirements.

In section 2, after a short explanation of the concepts of document-based negotiations within MALL2000 and the entailed workflow handling, an example scenario for a MALL2000 negotiation is given in order to make the idea of document-based negotiations vivid. In section 3, the requirements of HotFlow are analysed, connected to a description of visual presentation of workflows. This section concludes with a revival of the example scenario, this time considering workflow procedure. The topic of adaptable, predefined workflow definitions for document-based negotiations is investigated in section 4. Finally, the ideas of this paper are concluded.

2. Documents as a basis for negotiations

2.1 Documents and Workflow

A MALL2000 negotiation document (MALLdoc) is an initially empty canvas which will be filled gradually by the business partners with hierarchically structureable parts (DOCparts). Available parts are, e.g., text editors, planning and simulation spreadsheets, business graphic presentations, and database access forms. Following the principles of OO technology, all DOCparts have a functionality attached, giving them an active behaviour, operating upon their own state or the state of linked DOCparts. The concept of DOCparts in MALLdocs is developed in the Smalltalk-based HotDoc framework for document composition (see section "Acknowledgements" and [3]). HotDoc sets up the basis for the document-centred services within the MALL2000 project. This framework provides a common functionality for structuring parts, for state presentation, interactive modification, and more.

HotFlow provides in the setting of HotDoc a meta-level functionality for a new, powerful kind of workflow handling in document-centred business-to-business EC applications.

The workflow information for each part of a MALLdoc is handled via a Workflow Control Part (WfCP). A WfCP is one of the manifold available attachments to a MALLdoc in the MALL2000 environment. It is a means to control all working steps by businesspeople treating MALLdocs.

WfCPs may be considered to be specialized workflow control programs. Their functionality allows to interactively view and modify the currently followed workflow specification (represented by the state of the WfCP). For each negotiation document, HotFlow will provide a view of its contents (see figure 1) and a diagram of the workflow definitions (a detailed example will be given in section 3, Workflow handling in MALL2000).

In this sense, HotFlow is a visually supported tool for flexible control, viewing, and modification of (future) workflow steps by instantiating and varying a WfCP attached to a single part of a MALLdoc or viewing/controlling/modifying all WfCPs attached to any (sub-)part of a MALLdoc.

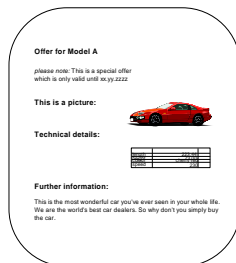


Figure 1: Contents view of a MALLdoc

2.2 An exemplary scenario

A sketch of a working scenario with a MALLdoc by a group of cooperating businesspeople should illustrate the role of WfCPs in the document-centred, business-to-business environment of MALL2000. We use the scenario as our running example for introducing HotFlow and the WfCP class in the HotDoc framework with details of its architecture.

A business enterprise wants to buy a company car for a physically handicapped employee. The car will have common extras (e.g., air-conditioning) as well as uncommon extras (e.g., special replacements for the pedals).

This scenario describes a successful negotiation which leads to the conclusion of a contract. It serves as an example for documents as a basis for negotiations. Mechanisms for breaking off a negotiation or transaction at miscellaneous points with the respective possibly resulting obligations must be provided as well. Additional services like translation support, information on export restrictions, taxes etc. are available at any time.

A MALL2000 correspondent can get in touch with potential partners by querying the MALL2000 database or by posting a note on the MALL2000 bulletin board.

When a contact is established, a negotiation document is created on the MALL2000 server – one document for each contact, if necessary.

Multiple partners can be involved in one negotiation document. In our example these might be:

- the manufacturer for the special replacements of the pedals,
- the motor-car dealer who installs the special replacements of the pedals,
- the purchasing department of the enterprise which wants to buy the car, and
- the handicapped employee.

As in most countries modifications on cars must be certified, the partners might decide to give access rights to the respective safety standards authority (MOT, TÜV, ...) or to integrate the certification into the workflow of the negotiation procedure.

All involved partners read and write DOCparts of the negotiation document. Each DOCpart has its own access restrictions – the purchasing details might be of no interest for the safety standards authority, whereas the technical details have to be readable and the certification of the technical modifications must be write-protected for the negotiating partners. They specify demands, prices, terms of delivery etc. until they come to the point of entering into a contract.

A MALLdoc can consist of several hierarchically structured DOCparts, depending on the preferences of the partners and the branching of the actually discussed alternatives. In our example there might be one DOCpart for each car model. The subparts might consist of a picture,

the choice of the common extras, the price and a description of the special replacements which would be possible or necessary in the respective car model.

Subparts can have some functionality, especially an attached WfCP, e.g., if one special car model is available for no longer but a short period, the potential buyer has to decide within a certain time limit. If he doesn't react (due to illness, having forgotten it or whatever), the subpart remembers the partner automatically (e.g., by e-mail).

When the partners decide in favour of one model with certain common or uncommon extras, the subparts for all other alternatives are closed.

The contract is built up by all partners on the basis of the DOCpart of the negotiation document with the description of the favoured alternative. In this subpart much of the contract-relevant information is already available. Court of jurisdiction and other necessary details have to be added. MALL2000 offers draft agreements which can be modified. Articles of the contract can be filled in those agreements, but the partners can start with just a selection of them or even a blank sheet as well.

As the documents are stored on the MALL2000 server, MALL2000 is the guarantor for fair trade and distributes copies of the contract (in translated versions, if requested) to all involved partners.

The execution of the agreements of the contract (delivery of the car, modalities of payment etc.) might be guarded by further active DOCparts of the document if the partners request it.

3. Workflow handling in MALL2000

3.1 Specific requirements to HotFlow

HotFlow provides a Visual Language to define, display and control the workflow of document-based negotiations.

Let us first compare the special environment of HotFlow with the common environment of WfMSs.

The Workflow Management Coalition defines a WfMS as a system that completely defines, manages and executes workflows through the execution of software whose order of execution is driven by a computer representation of the workflow logic, whereby a workflow is the computerised facilitation or automation of a business process, in whole or part [4].

All WfMS provide support for

- build-time functions:
defining the workflow process and its constituent activities,
- run-time process control functions:
managing the workflow process in the operational environment and sequencing the various activities to be handled, and
- run-time activity interactions:
the interaction with users (actors) and IT application tools to process the various activity steps.

Activities can be differentiated into automated, partly automated, and manual activities [5]. All activities are performed by processes at one or more workplaces within an organization (such as an enterprise or a business unit thereof), the workplaces are usually connected, e. g. via the intranet of the organization or a client/server infrastructure. Information on the current state of the workflow tasks is readily available, because the actors are connected to the WfMS at any (working) time.

The definition of the workflow process and the activities is typically done by business process experts [6, 7]. They might be involved in the execution of activities, but in the ordinary they are not.

The situation of HotFlow differs from the one described above. There are some aggravating circumstances.

First, HotFlow has to handle disconnected clients. It is not very likely that the business partners are logged-on all day: The negotiation procedure will be only one of the many tasks in the business partner's workaday affairs, and being logged-on all day would raise communication costs for SMEs significantly.

Second, there is no clear temporal and personal separation of defining/modifying, running and administering the workflow. Run-time and build-time will be time-shared a good many times, since the course of negotiations can be roughly anticipated but is not predictable in detail. There will be incomplete workflow definitions which have to suffice for the time being. And, since we assume a peer-to-peer relationship, there might be no partner with access rights to every DOCpart of the MALLdoc in question. As indicated earlier in this paper, situations might occur in which even the originators of the MALLdoc cannot have full access rights to a DOCpart inside "their own" MALLdoc, e. g., if this DOCpart contains some certification from an external authority like a MOT approval.

Third, the process definition will be done by the actors, who are experts in the business area, but most likely will be laities in workflow and information technology topics.

As will turn up in the following section, all three of the mentioned differences have impact on the Visual Language provided by HotFlow for the workflow definition.

However, the third point is a special challenge for the workflow definition language (WfDL) of HotFlow. It requires the WfDL to be

- applicable intuitively,
the users will not be willing to consult a handbook before they are able to implement a time-limit on some DOCpart,
- simple and straightforward,
the language constructs which are generated intuitively by one workflow amateur have to be correctly understood by another laity user, and
- capacious,
so that all business processes can be mapped.

On the other hand, the environment of HotFlow has some facilitations in comparison to common WfMS. In our context the most important alleviating circumstances are:

- there will be no need for an integration of existing systems,
- the workflows to be designed will be less complicated and extensive, and
- there is no risk of misunderstandings between workflow experts and business experts, because the persons who define the workflow are the experts in their sphere.

3.2 Visual support for dynamic workflows in EC

Most of the common WfMS provide the possibility to picture the workflow process (examples in [7, 8]).

Irrespective of promotional inducements for the use of appealing charts, there are good reasons to provide a well-designed visual language for the definition and presentation of workflow processes in HotFlow.

The definition of a workflow process is a task similar to programming. In section 3.1 it was pointed out that

- the typical "workflow engineer" is very likely to be a laity in information technology – and, as a consequence, in programming as well, and
- the workflow processes to be defined will be of a moderate size.

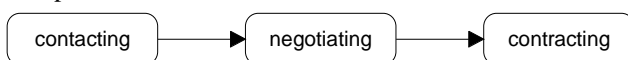
In several studies (see [8] for an overview) it could be observed that visual notations can yield better performance than textual presentations in small-sized problems, and they play an important role in end-user programming, where problems are usually smaller than the problems encountered by professional programmers. One advantage of Visual Programming Languages lies in their accessibility to (certain classes of) non-programmers.

So what is needed may be summarized as:

Users must not be deterred from using the system by formalism, but the presentations have to yield a predictable and defined functionality. And the visual presentation has to enable the user to define the workflow tasks as needed and must not reduce the scale of appropriate steps within a negotiation to the extent of an easily constructable workflow process.

HotFlow meets the special requirements by a radical reduction of the available control connectors to those which are elemental. For the convenience of the user, predefined, adaptable workflow schemes are provided as well, as a compensation to the very basic parts, which necessitate extensive specification of parameters. This topic is handled in section 4, Workflow Patterns. The user can also define and use his/her own workflow schemes.

The (optional) standard entry provided by HotFlow is threepart:



The user who originates the workflow for a business procedure fills any of these three phases with activities and names the activities. Details on each "actor" are needed.

The workflow will be managed by persons who might have minor knowledge in information technology. So the interface must be plain and easy to understand.

Application data (for the business process) may be filled in DOCparts. Therefore, each activity has an input and an output container with links to the respective DOCparts. If one DOCpart is mentioned in the input containers of two activities, HotFlow ensures that only one actor may modify it. Any operation on a DOCpart is one of the following:

- create • connect_to • view • modify • delete •

The leading actors of the negotiation (i.e. the persons who would "sign" the contract – in the example above these would be the motor-car dealer and the responsible employee of the purchasing department) are authorized to modify the workflow and define the roles of other participants (the handicapped employee, ...).

The workflows will be visually presented as graphs which are put together by simple drag-and-drop actions from palettes containing basic connectors and DOCparts (for predefined subactivities see section 4, Workflow Patterns)..

To give an impression, an extract of the palette is presented in Figure 2.



Figure 2: HotFlow Workflow Basics for DOCparts

Each person who shall participate in the negotiation has to be "introduced". Several details are necessary in order to administer the DOCparts properly. Among them are the following:

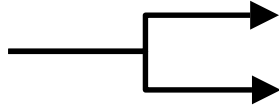
- Name and ID (for technical purposes)
- organization ID: to which enterprise/organization does this person belong to?
- Position: What is this person's position, who is the substitute? (workflow shouldn't depend on names)
- Authorization: what is this person allowed to do in this particular negotiation? Especially: Is this person authorized to conclude a contract?

A list of activities and actors does not yet make a workflow. Activities are brought together by arrows as

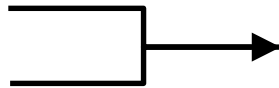
Workflow Connectors. The simplest connector (which will probably be used most often) indicates the flow of the work:



A variation is the split in n parallel procedures



and its counterpart, the reunion:



($n > 0$, the pictures show both variations for $n=2$)

Another connector indicates a semantic coherence. It is used e. g., to connect a time-limit to the respective activity:



Each DOCpart of the negotiation document must have some attached information, for example:

- is connected with
- recipient (who is the next one to fulfill a task on this document?)
- task (what is the task? e. g., "give details to the marked text areas")
- is actually locked by
- time-limit on/off
- alarm activity (e. g., "send email to ...") and alarm text (e. g., the text to be sent automatically by email)

3.3 An exemplary workflow

For the execution of the scenario described in section 2.2, a MALLdoc has to be created. It provides all functionality needed for building and running a negotiation workflow. As a standard starting point, the triplet contacting – negotiating – contracting is suggested, as pictured in the previous section.

For reasons of clearness, detailed descriptions of contacting and contracting are omitted within this example. Contacting might simply consist of a query to the MALL2000 database. The contracting procedure depends on multiple international regulations and is of minor interest in the context of this paper.

The procedure starts with Workflow Definition, some initializing work has to be done. In contrast to common WfMS, the Workflow Definition can be revisited freely whenever some change or extension is needed.

At first, the participants are introduced. Let this job be done by the purchasing department, because they are the initiators of the business procedure. It might be done by any other participant as well. In real processing, HotFlow will demand more data than listed below (e. g., substitutes

for the actors, detailed contracting authorization, access rights to files).



member list

<i>Name</i>	On-the-Road & Co.
<i>description</i>	potential buyer
<i>ID</i>	ROAD
<i>position</i>	organization
<i>contract</i>	<email address etc.>

<i>Name</i>	Mr H. Wannadrive
<i>description</i>	prospective user
<i>ID</i>	HWAN
<i>organization</i>	ROA
<i>position</i>	gives technical demands
<i>contract authorization</i>	no
<i>contact</i>	<email address etc.>

<i>Name</i>	Ms M. Payall
<i>description</i>	purchasing department
<i>ID</i>	MPAY
<i>organization</i>	ROAD
<i>position</i>	administrative
<i>contract authorization</i>	yes
<i>contact</i>	<email address etc.>

Because Ms Cash is not familiar with personell details at the car dealer's, she simply introduces the enterprise:



member list

<i>Name</i>	WonderCar Ltd.
<i>description</i>	potential seller
<i>ID</i>	WCAR
<i>position</i>	organization
<i>contract</i>	<email address etc.>

HotFlow notifies each member of the instantiation of the workflow (and thereby checks the contact data).

Additionally, Ms Cash defines the basic workflow structure for the negotiation. She inserts four activities (see next page).

Ms Cash connects the activities (see Figure 3).

For the first activity (CHOICE), WonderCar Ltd. has to provide some information. The request for this information is put on their worklist. When this input is available, CHOICE will be written on Mr Wannadrive's worklist (see next page).

activities

<i>Name</i>	choice of car model
<i>description</i>	choice of the model and extras (air-conditioning etc.)
<i>ID</i>	CHOICE
<i>responsible</i>	Mr Wannadrive
<i>precondition</i>	information from WCAR
<i>assertion</i>	CHOICE

<i>Name</i>	description of special requirements
<i>description</i>	description of the special requirements due to Mr Wannadrive's handicap
<i>ID</i>	DESCRIPT
<i>responsible</i>	HWAN
<i>precondition</i>	-
<i>assertion</i>	DESCRIPT

<i>Name</i>	technical specification of reconstruction
<i>description</i>	technical specification of extras, see DESCRIPT
<i>ID</i>	TECHSPEC
<i>responsible</i>	WCAR
<i>precondition</i>	DESCRIPT
<i>assertion</i>	TECHSPEC

<i>Name</i>	delivering an offer
<i>description</i>	binding offer with price etc.
<i>ID</i>	OFFER
<i>responsible</i>	WCAR
<i>precondition</i>	TECHSPEC/CHOICE
<i>assertion</i>	-

Mr Wannadrive receives the notification that one item (DESCRIPT) has been added to his worklist. He starts with the description of his special requirements by creating a text-editor DOCpart with read access for all actors. The state of this task is set to "started". Tasks TECHSPEC and OFFER are not added to the worklist of WonderCar Ltd., because their preconditions are not yet fulfilled.

WonderCar Ltd. come into play actively with the sign-on of Mr A. Sellit, their clerk-in-charge of this business process.



member list

<i>Name</i>	Mr A. Sellit
<i>description</i>	car seller
<i>ID</i>	ASEL
<i>organization</i>	WCAR
<i>position</i>	sales department
<i>contract authorization</i>	yes
<i>contact</i>	<email address etc.>

The item in the worklist of WonderCar Ltd. is shifted to Mr Sellit's worklist. He creates a DOCpart with several subparts, containing pictures, tables and texts, describing the assortment of cars available from WonderCar Ltd. The status of this task is set to "completed". Since the preconditions of task CHOICE are met now, it is added to Mr Wannadrive's worklist.

Mr Sellit reads Mr Wannadrive's (draft) description of his requirements, and realizes that considerable changes will be necessary, which will require official approval (by MOT). He checks the workflow definition and inserts the certification activity. He adds a time-limit of one week to the certification activity.

After the task is activated, if one week goes by without its fulfillment (the certification), he receives a notification (let's say, an email) and has the chance to follow it up. The resulting Workflow Definition is pictured in Figure 4 (see next page).

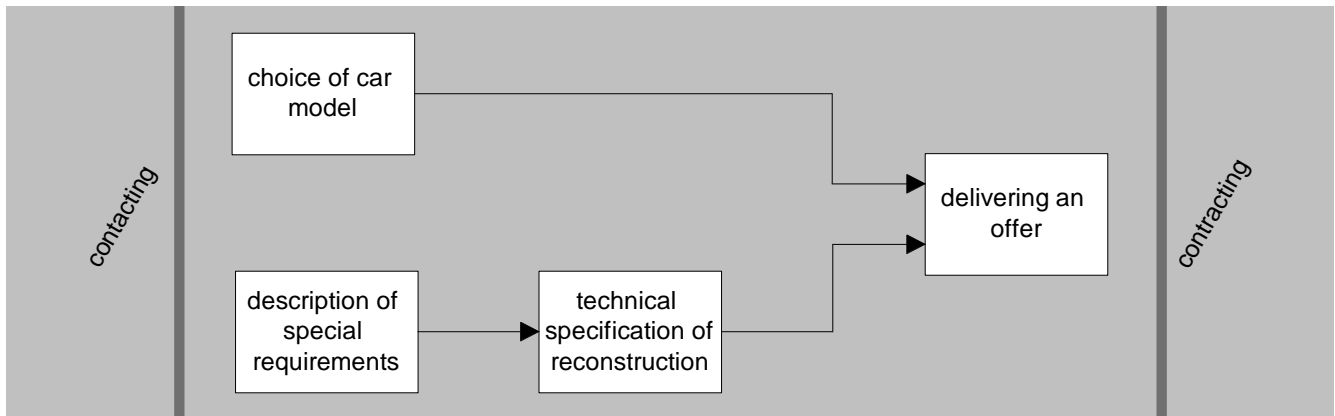


Figure 3: First draft of Workflow Definition

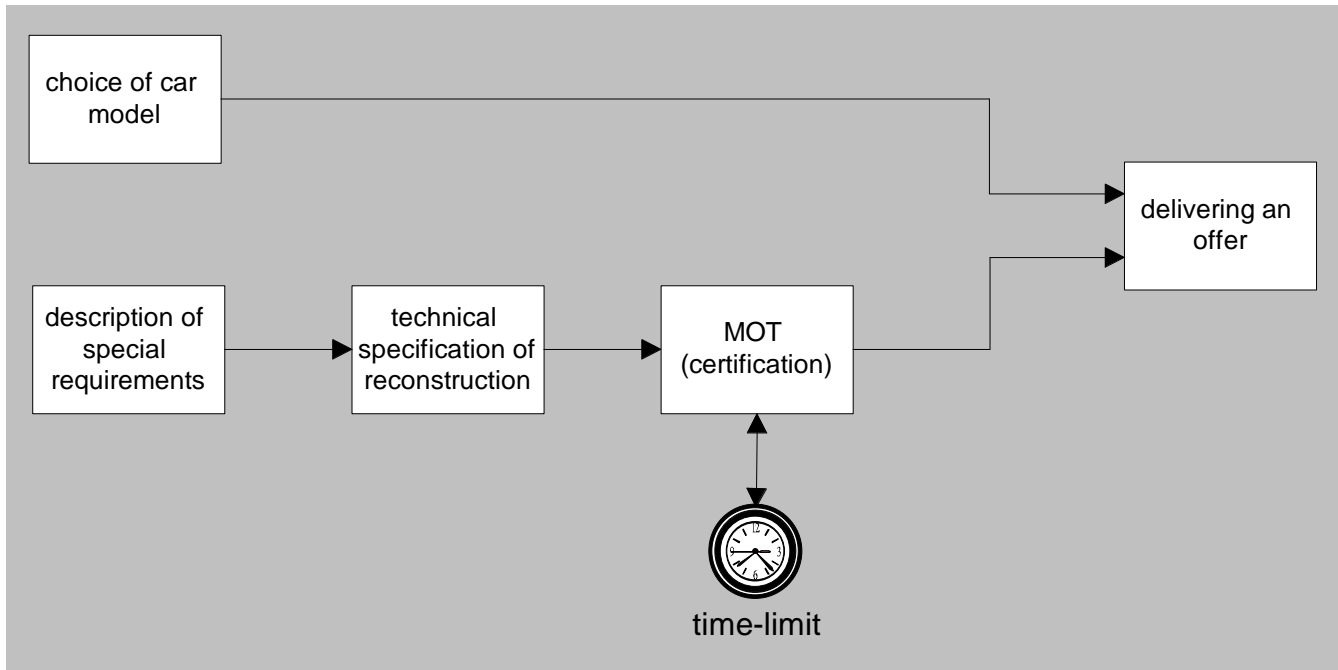


Figure 4: Workflow Definition, MOT introduced

The MOT is introduced to the WfMS as an external partner.



member list

<i>Name</i>	MOT
<i>description</i>	certification authority
<i>ID</i>	MOT
<i>position</i>	external organization
<i>contact</i>	<email address etc.>

The certification is added as an activity. It depends on the technical specification and the car model to be reconstructed. This run-time modification is possible, because the inserted part does not interfere with running activities.



activities

<i>Name</i>	certification
<i>description</i>	certification of the technical modifications
<i>ID</i>	CERTIFIC
<i>responsible</i>	MOT
<i>connected with</i>	CERTTIME
<i>precondition</i>	TECHSPEC/CHOICE
<i>assertion</i>	CERTIFIC

<i>Name</i>	time limit for certification
<i>description</i>	time limit for certification of the technical modifications
<i>ID</i>	CERTTIME
<i>responsible</i>	WCAR
<i>connected with</i>	CERTIFIC
<i>alarm</i>	on
<i>alarm activity</i>	send email to ASELE
<i>alarm text</i>	<notification: limit elapsed>

In the following, each task is marked after its completion, up to the completion of the whole workflow.

4. Workflow Patterns

Extended business contacts often follow a certain pattern, but they seldom take exactly the same procedure. Anyway, the use and recognition of patterns serve as a means to structure a more complicated workflow than the one built in section 3.3 into activities and sub-activities.

HotFlow provides some workflow patterns which can be used to build-up a custom-made workflow structure just with a few steps by dragging and dropping them from the palette. They are handled in the same way as activities.

In the following, some patterns are described.

4.1 General offer

In a general offer, the potential supplier is the initiating partner (in contrast to the situation described in the

scenario). He makes available a rather general description (like promotional material) of the item he wants to offer.

The initially presented activities are:

- provide general description (by potential supplier)
- ask for further details (by potential buyer)
- give binding and detailed offer (by potential supplier).

4.2 Time-limited offer

An offer which is valid only for a limited time is a variation of the general offer. The time-limit is inserted as an additional part. It might be connected to the initial general description, to the detailed offer, or to both.

The time-limit refers to a date (not the duration of the working on the task, as in the example).

4.3 Offering alternatives

Offering alternatives includes the decision for one item and the rejection of the others. For each item sorted out, HotFlow "cleans up" the administrative and application data. For example, a time-limit for the offer of an item which is no longer considered, will be deleted.

4.5 Certification

When a certification by an official authority is necessary, it is important to preserve the state of the document. As a consequence, even the creator of the document (in our example above: the car dealer) loses his rights for write-access. This modification of access rights can be done automatically by HotFlow.

5. Conclusions

The document-centred approach of HotDoc contributed by the TU Darmstadt to the MALL2000 project allows to integrate controlled, dynamic workflow processing with business-to-business EC-applications. *Workflow control parts* (WfCPs) in a business document realize a new, advanced workflow processing functionality. The *HotFlow* tool gives visually supported, dynamic modification capabilities for a document workflow to businesspeople, who often might have minor knowledge in information technology. Working with the HotFlow tool offers a specialized, powerful visual language for workflow applications in E-Commerce.

Acknowledgements

The work reported here is supported in an INCO Copernicus project of the European Community, #977041 ([1], [2]): MALL FOR ONLINE BUSINESS BEYOND THE YEAR 2000 (MALL2000).

The HotDoc framework is the result of work 1995 – 1998 supervised by Prof. Dr. H.-J. Hoffmann, Darmstadt University of Technology, leading to the doctoral dissertation of J. Buchner [3].

The MALL2000 project ends in fall 2001. This paper describes the architecture of the HotFlow tool and of the WfCP class to be included at about end of 1999 into a MALL2000 prototyp.

Partners in the MALL2000 project are: *Darmstadt University of Technology*, Darmstadt, Germany; *Digital Equipment Intl. BB*, Galway, Ireland; *DirectNet Consulting Ltd.*, Brno, Czech Republic; *Object Technology Intl. GmbH*, Zwingenberg, Germany; *Sofia University*, Sofia, Bulgaria; *Stylo srl*, Bologna, Italy; *VirTech Ltd.*, Sofia; and *Techn. University of Brno*, Brno, Czech Republic.

All opinions expressed in the paper are the opinion of the author.

References

[1] MALL2000 consortium, <http://www-it.fmi.uni-sofia.bg/mall2000/home.html>, 1999, and <http://www.pu.informatik.tu-darmstadt.de/Projekte/Mall2000>, 1999.

[2] H.-J. Hoffmann and D. Handl: „Document exchange as a basis for business-to-business co-operation“, accepted for *EMMSEC 99*, Stockholm, 21 – 23 June, 1999.

[3] J. Buchner, *HotDoc – Ein flexibles System für den kooperativen Aufbau zusammengesetzter Dokumentstrukturen*. Doctoral dissertation, Darmstadt University of Technology, 1998.

[4] Hollingsworth, D., "The Workflow Reference Model", Document Nr. TC00-1003, Workflow Management Coalition, 1995.

[5] M. Amberg and F. Zimmermann, "Enabling Virtual Workplaces with Advanced Workflow Management Systems", in: Igarria, M. and M. Tan: *The Virtual Workplace*, Harrisburg, PA, 1998.

[6] IBM Corp., "Concepts and Architecture", *IBM MQSeries Workflow*, Version 3.1, 1998.

[7] CSE Systems Corp., "Standards and Experiences in the Workflow Management World", <http://www.csesystems.com/public/products/docs41/white-papers/oracle97.htm>, 1998.

[8] K. N. Whitley, "Visual Programming Languages and the Empirical Evidence For and Against", *Journal of Visual Languages and Computing* (1997) 8, Academic Press Ltd., pp.109-142.