Journal of Universal Computer Science, vol. 7, no. 9 (2001), 826-847
submitted: 4/4/01, accepted: 1/3/01, appeared: 28/9/01 *© Springer Pub. Co.*

More Than WORDS
Collaborative Tailoring of a Word Processor

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Abstract: Tailorability (or adaptability) of software becomes more important with the increasing use of off-the-shelf-software. On the other hand, computers support the work of many groups which in turn have to tailor a commonly used software to support individual as well as group needs. This includes not only groupware, i. e., software that directly supports collaborative work, but also single user software. Research has shown that often adaptations to single user software are distributed among colleagues, thus leading to a systematization in a group's adaptations. Based on this observation an empirical field-study on the collaborative tailoring habits of users of a particular word processor was carried out. Based on these and literature research an add-on to this word processor was developed which provides a public and a private repository for adaptations as well as a mailing function for users to exchange adaptations. Some notification and annotation mechanisms are also provided. Results of two forms of evaluation indicate that users of different levels of qualification are able to handle the tool and consider it a relevant alternative to existing mailing mechanisms.
Key Words: Tailoring, CSCW, Groupware
Categories: H.1.2, H.4.3

1 Introduction

Generic single user applications for obvious reasons do not provide support to share adaptations (i. e. the results of a tailoring activity, tailoring artifacts) among their users. However, they are often tailored collaboratively. Complex tailoring is carried out individually or even jointly and distributed among colleagues. Particularly with the increasing number of group or organization wide computer networks such a form of collaborative tailoring seems promising in two ways: Firstly, double work can be avoided if adaptations that are helpful for several persons are made once only and then distributed. Secondly, sharing adaptations among groups of users can lead to a systematization of adaptations avoiding a confusing abundance of individual solutions. Therefore, I set out to develop design suggestions for a tool to help people to collaboratively tailor software.

In order to do so resources from different fields were gathered: There has been work conducted dealing with tailoring of software and particularly tailoring of word processors. Moreover, in CSCW (Computer Supported Cooperative Work) much effort has been spent to understand how people collaborate and several authors have provided empirical information and theoretical background on collaboration and particularly on tailoring a commonly used software. And finally, some work in the field of CSCW and Information Systems has been devoted to the evolving use of information and communication technology in organizations. While this paper does not provide a longitudinal study of such an evolving use, I used the idea as a starting point by attempting to understand how the use of a particular word processor had evolved in several different organizations.

2 Related Work

2.1 Tailoring Software

Tailoring software is not a new phenomenon. More than 20 years ago the EMACS editor provided mechanisms for extension by the user while it was running [Stallman 1981]. Since then, several authors have dealt with the issue of tailorability of software with a background of Human-Computer Interaction (HCI). According to [Mørch 1998] tailoring is the activity of modifying a computer application within the context of its use and can be considered to be further development of an application during use to adapt it to needs that were not accounted for in the original design. [Henderson and Kyng 1991] also consider tailoring to be an activity that continues design in use. They argue that there is a necessity to be able to change a system after its initial design due to the change of use situations, the complexity of the world that makes anticipation difficult, and different situations that one software might be used in. [Haaks 1991] distinguishes different dimensions of tailoring including initiator and actor, object, aim, time, and scope of validity. All of these authors stress that the discussion about tailoring should not only be lead in terms of technical measures, but that tailoring software is an activity that is deeply rooted in personal habits and preferences as well as socio-organizational circumstances and dynamism. In his plead for situative tailoring and local activities [Paetau 1991] explicitly distinguishes between different forms of cooperation and introduces the concept of *cooperative configuration* where tailoring of a technical system is to be considered as a basically cooperative process.

Tailoring software can be distinguished from use and development although it bears similarities with both. On one hand it is a way to continue design in use to account for unanticipated needs, on the other hand it extends use by providing means to make it effective and efficient. [Henderson and Kyng 1991] argue with the relative stability of an application in claiming that people tailor when they change stable aspects of an artifact. However, they also admit that the distinction may be difficult: Changing the font of a document can be considered to be use or tailoring. They also introduce the notions of subject matter vs. tool of work and claim that changing the subject matter is use while changing the tool is tailoring. Again, the distinction is not always clear, since one person's subject matter is another person's tool: For a person using an application programmed in C++, this application is a tool, whereas for its programmer it is the subject matter, and the C++ compiler is the tool (and for the compiler builders it is the subject matter). So if someone's main activity is using a text editor to produce text and she writes some macros with a built-in macro-editor to make text writing easier for her this writing macros is considered tailoring. If however, her main activity is writing macros for the text editor for the sake of the intellectual challenge or to provide a service to someone else this is considered use of the text editor and its built-in macro-editor rather than tailoring. That way sometimes tailoring may turn into use when a person who does a good job writing macros for a text editor starts to do this for a whole group of users so that finally the time and effort to write macros outweighs the time and effort to produce text related to the original task of that person in the group. Since this paper's focus is on end users who perform their primary work task and do some tailoring once in a while, the more advanced endeavors for the distributed development of Linux or the creation and maintenance of an EMACS Lisp library or an EMACS widget library shall be considered use of Linux and EMACS and the advanced tools related to them rather than tailoring: for a programmer programming is not a new dimension.

Some work in the HCI area has particularly focused on tailoring word processors. [Page et al. 1996] investigated the tailoring habits of users of word processors by means of a quantitative study surveying word processor usage and tailoring of 101 people over 28 days. They recommend to expect users to tailor the software and require that "tailoring features become an integral part of the system and its user interface" (p. 345). [Cypher 1993] reports that macro recording in a word processor can effectively automate many repetitive user activities. Both contributions, however, do not focus on the collaborative aspects of these activities.

2.2 Collaborative Aspects

In the CSCW literature tailorability has been identified as a key requirement for groupware systems (see, e. g., [Bentley and Dourish 1995], [Oberquelle 1994], [Stiemerling et al. 1997]). The special demands of collaborative work make it a critical issue in the design of groupware applications. Complexity, dynamism, as well as inter- and intra-individual differences constitute the need for system designs, which can evolve over time, exhibit different behavior in different usage situations, and accommodate individual or group needs and preferences.

On one hand several suggestions have been made for groupware architectures and technical approaches to tailorability. On the other hand collaborative aspects of tailoring have been observed and discussed in different fields (see, e. g., [JCSCW 2000] for both). Some research has also been concerned with collaborative aspects of single-user software.

The contributions up to date are primarily of observing nature. [Mackay 1990], for instance, describes how users of different qualification levels exchange customization files. While writing such a file from scratch demands a high level of qualification, simply using a file copied from a colleague is quite easy. She describes different "patterns of sharing" such files in real world fields of application. In [Mackay 1991] triggers and barriers for customizing based on data from 51 participants working in a UNIX software environment are described. [Nardi 1993] presents the result of two field studies concerning collaborative tailoring (*end user programming* in her terminology) among spreadsheet and CAD users. She views collaborative tailoring as a natural consequence of the division of labor and stresses that this aspect of tailoring has to be taken into account in the design of software systems.

Other work investigates collaborative tailoring in an organizational setting. [Carter and Henderson 1990], for instance, postulate the necessity for a ”tailoring culture” within an organization. They argue that tailoring not only poses technical problems, but since tailoring changes the way individuals and groups work, a culture has to be created in which technical and organizational change is something everybody can participate in and contribute to. [Trigg and Bødker 1994] found an emerging systematization of collaborative tailoring efforts in a government agency. In their study they were looking at the tailoring of word processors.

Few contributions do not only observe and analyze but also take collaborative tailoring into account in the implementation of software systems. The first of these is presented by [MacLean et al. 1990]. The authors describe the ”Buttons” system, the main tailoring entity of which are button-like objects. These objects are designed to be sent around the office by email. Thus, more experienced users who tailor, e. g., the lisp-code behind a button, can share these adaptations with their colleagues. However, while the ”Buttons” system was actually used even in the non-academic parts of the research institute, it was restricted to the Xerox InterLISP environment and therefore was not exposed to users in other types of organizations. The Tviews approach [Wasserschaff and Bentley 1997] allows users to define different views on a commonly used object. Those tailorable views serve as means to show selected attributes of an object and their changes, e. g., indicate, that a shared document was changed by another person. The tailored views can be stored, retrieved and manipulated like other files via a shared workspace. However, the approach and its implementation are presented without evaluation.

2.3 Evolving Use

One of the argument for tailorability of software is the impossibility to anticipate the future use of the software. This is due to changing task requirements, changing individual preferences, and changing group and organizational structures but also to the fact that individual and particularly group use of software is subject to evolution per se. Individual users and groups become more experienced with the software, they might find ways to use it that had not been foreseen by the software developers and they find out about the interrelation of the software they use with their task and organizational setting and how they can and do change each other. Taking this into account, there is a growing debate about *evolving use of software* particularly in the field of information systems (IS) and CSCW (see, e. g. [JCSCW 2001]). The contributions stress the situatedness of all work and aim to understand the forces driving this evolution. [Orlikowski 1996] found out that in an organization using Lotus Notes both planned and emergent changes in use appeared. An organizational solution for the distribution of labor between people working with Notes in the front- and backoffice of customer care could only be found after a while of use of the system when people had understood what they could do with the system and how it had changed and possibly could change the work and distribution of labor. [Wulf 1999] describes how in a section of a German federal ministry the common work on text documents like manuscripts of speeches of the federal minister, answers to inquiries from the parliament or answers of letters sent by citizens changed when computers for the section members and a groupware system were introduced. Before this the texts were handwritten by members of the section and then typed by a member of a typing pool, checked for mistakes or changes to be made by the person who had originally written it and then (partially) retyped by someone from the typing pool. After the introduction of desktop computers to the section members they started to type shorter documents themselves which after a while lead to a restructuring of the division of labor. While this was considered to be more efficient than the previous state it also meant an increase of the workload of the section members and a decrease of workload of the typing pool that finally might lead to a cutback of jobs there. While it can certainly not be foreseen how software use will evolve in a particular organization I agree with [Stiemerling et al. 1997] that it is necessary to look at different possible use situations in order to get a broad although incomplete perspective. Since I did not feel that the existing literature provided enough material on actual use and collaborative tailoring of a word processor, interviews with users seemed a good way a to broaden the perspective [see Section 3 Empirical Pre-Study].

2.4 A Next Step

So far, the analytical achievements of understanding collaborative tailoring within different settings had not yet lead to an implementation of mechanisms to support collaborative tailoring of a generic widespread single-user software. In the work presented this is provided and the question is investigated how collaborative tailoring of real world applications can be supported by technical mechanisms. I have taken Microsoft Word 97 as an example of a widely and extensively used product. As a first step, in order to learn more about how groups of users actually tailor collaboratively, a field study in four different fields was undertaken. The result of the study are a number of different collaborative tailoring use situations focusing on the exchange of document templates and toolbars. Based on an analysis of these use situations requirements for the design of a tool were developed and implemented as Microsoft Word 97 add-in which provides collaborative tailoring functionality. The implementation of the prototype is described in [Section 6 Implementation]. The use situations drawn from the field study also serve as a basis of the evaluation of the prototype which is described in [Section 7 Evaluation]. The paper concludes with directions for future work.

Note, that this paper is not about groupware but about groups of users using the same software and thus being able to employ the fact that this software is tailorable to collaborate. While this does not exclude groupware it encompasses a much broader range of (single user) software. [Oberquelle 1994] proposes a classification of collaborative tailoring (in his work only related to groupware) where he distinguishes between actors, who can be individuals or a group and persons affected by a tailoring activity, who can again be individuals or a group (see. [Fig. 1]). Different aspects and intensities of collaborative tailoring of a single user software can fit in all of the resulting four categories. Examples are given for a word processor:

- Individuals can tailor for themselves and are the only ones affected by the tailoring activity – e. g. individual keyboard shortcuts or the window layout of an individual email client (quadrant I).
- Individuals can tailor for a whole group who then agree or are obliged to use the adaptations – e. g. a system administrator or expert user provides a letterhead to be used by the group (quadrant II).
- A group can tailor synchronously or asynchronously and its members agree or are obliged to use the adaptations – e. g. several persons work on a letterhead to be used by the group (quadrant III).
- A group can tailor synchronously or asynchronously for its members to use and change the adaptation – e. g. several persons work on collection of macros that individuals can use and change (quadrant IV).

		Actors	
		Individuals	**Group**
Persons Affected	**Individuals**	I Individualization	IV Individualization supported by group
	Group	II Tailoring effective for group	III Group tailoring

Figure 1: Classification of collaborative tailoring following [Oberquelle 1994]

This contribution provides examples for different forms of collaborative tailoring and introduces a tool to support these for a word processor.

3 Empirical Pre-Study

To learn about users' habits and to inspire the design, a qualitative field study with users of Microsoft Word was carried out. 12 semi-structured interviews with users from 4 different fields were conducted (public administration, private company, research institute and home users).

The interviews started with general questions about the interviewee's qualification, their general task and the way they apply the word processor. In the following they were asked which tailoring functions were in use, which barriers hindered the usage of existing functions to tailor, whether and how collaborative tailoring did take place, and whether organization wide standards concerning the tailoring activities are existing. In the end of the interviews ideas concerning the design of support for tailoring activities and of improved user interfaces to ease tailoring were discussed. To be able to refer to the software, the interviews were performed next to the interviewee's computer.

The interviews took between 20 and 120 minutes with an average of about 45 minutes. They were audiotaped, transcribed and later analyzed. According to their self-estimation two interviewees had little to medium, two interviewees had medium, three interviewees had medium to good, three interviewees had good and one interviewee had very good knowledge about the word processor. Five of the interviewees were providing system support to other users in their organizations.

Together with the literature review these interviews are the basis for the requirements. The interviews are enriched by empirical studies concerning the usage and sharing of a tailorable search tool for groupware. A prototype of this search tool was presented, used and discussed in a workshop with users of the representative body of a German state government where some of the interviews about Microsoft Word had taken place. The workshop about the search tool and interviews about it revealed interesting aspects of sharing adaptations in this organization.

Depending on their field of application the interviewees reported about differences in the extent and the way tailoring is seen as a collaborative activity. To give an impression of this variety and to motivate the design, I will present the main statements of the interviewees concerning collaborative tailoring.

3.1 Use Situation I: Central Repository for Standardized Forms

One group of persons interviewed were two system administrators and two researchers from a German national research institution. The system administrators were responsible for supporting the Unix and the PC environment in one of the subunits of the research institution. The researchers were employees of the same subunit working in two different research groups.

The interviewees reported about little collaborative tailoring activities. Since the members of this subunit employ a rather heterogeneous spectrum of word processors and software versions, since their tasks are rather individualized, and since most of them are rather experienced with the system, they participate in little collaborative tailoring. Nevertheless the organization uses an intranet to provide certain document templates in a standardized manner. The members of the organization find document templates of administrative purpose on one of these intranet servers (e. g., ordering and billing forms). These templates are created and updated by a central organizational unit, which has been built up recently. All the other users can just copy these templates. Ideas for new forms have to be proposed to that unit. This is an example of "tailoring effective for the group" in [Fig. 1].

This quite centralized view of sharing adaptations is similar to the situation found in the search tool workshop. However, in the search tool case it would have been possible for all participants to tailor and share but they argued that for reasons of an adequate division of labor it would be sensible for the colleague who provides local computer support, an administrative clerk, to tailor the search tool and provide different versions among which the others would then only choose without tailoring themselves. This "local expert" later argued in an interview that he would like to have his own private corner where he could work on different search tools and store incomplete versions without the others being able to access them.

3.2 Use Situation II: Collaborative Tailoring and Organization-Wide Distribution

Four of the interviewees were working for the representative body of a northern German state in the federal capital. The organization had been equipped with generally available desk-top computers about three years ago. Two of the interviewees were heading sections responsible to represent the interests of their state within the process of federal legislation. The other two were working in the administration of the body. One of them provides system support to the other users.

All of them reported about a rather intense exchange of adaptations. One of the employees from the administration site reported how she created a document template together with a colleague. Both of them carried out parts of the whole job. Then she put her part of the template on a disk and carried it to her colleague who pasted the parts together. This could be considered to be “individualization supported by group” in [Fig. 1] or even “group tailoring” if after a while of usage everyone agrees to make this template their standard.

In the representative body there is not a formal procedure on how to decide on commonly used document templates. One of the employees reported that it is often a difficult task to find a consensus. At the times the interviews were conducted, templates were printed out and handed over from employee to employee. Each of them could annotate the printout. The interviewee being responsible for the creation of document templates was often overwhelmed by the inconsistent feedback and found it difficult to decide on the final layout. In cases she could not satisfy all of the requirements, she recommended her colleagues to create individualized versions of the template on their private desk. Thus, the process to create document templates was rather unstructured.

To make document templates publicly available, the representative body used the groupware system whose functionality offered shared workspaces to exchange documents. To publish newly created document templates within the whole organization, a specific workspace was used. Within this workspace simple users just had the right to copy documents. Because several of the employees suffered from lacking computer skills, the right to change these templates or to add in new templates was reserved to the system administrator. The templates were seen rather as a collective resource than as a means to enforce organizational standards.

3.3 Use Situation III: Shared Document Templates and Notification of Users

An experienced user working in the marketing division of a car-manufacturer described how he had implemented department-wide standards for presenting certain data by means of tables. Before, everybody in ”his” department had used his own mode to create these tables. He started to standardize the layout of these tables by creating a first template containing some macros. He then discussed it with his colleagues. Having found an agreement with them, he asked his boss for a final approval. In the end he put the templates on the LAN giving most of the workers of his department read and write permission. One of the users of whom he thought that he would endanger the template due to lacking skills was just granted read permission. Read permission was given to another user from a neighboring department who was interested in that template for his purposes. When everything was set up, the interviewee informed his colleagues verbally about the location of the shared template on the LAN. This could be considered to be another example of "tailoring effective for the group" in [Fig. 1]. One could also argue that discussion of the templates among colleagues makes this "group tailoring" according to [Fig. 1].

Obviously, when adaptations are distributed via a shared directory, it is crucial to inform the other users. Along the same lines, a system administrator reported that he put a notice on the department's black board to inform his colleagues about newly created document templates.

3.3.1 Use Situation IV: Experience Transfer Among Insulated Home Users

The interviewees working at home were two law students. They used their word processor to work out law cases, which they had to deliver for getting certain credit points. Each student has to write these papers almost every semester by himself. Such a paper contains about 30 typed pages. Moreover, both students used the word processor for typing letters of different kinds.

The students reported about few collaborative tailoring activities. One of them describes these rare occasions as follows. Occasionally when he meets other students applying the same word processor he sees an unknown tailoring feature – for instance a new toolbar. In such a case he asks how the feature has been constructed. After receiving a demonstration he goes home and tries to repeat on his own system what he has seen before. Considering the classification of [Fig. 1] this can be regarded as enhanced "individualization" where one person's solution is used in parts by one other person or as a first step towards "tailoring effective for group".

4 Discussion

Looking at the different use situations quite a wide variety of collaborative forms to tailor word processors covering the classification of [Fig. 1] can be found.

While use situation IV just deals with experience transfer, use situations I to III are based on an exchange of adaptations. In these use situations, this common use of adaptations is either technically non-supported (exchange of floppy disks) or supported by tools, which are realized apart from the word processor (intranet, LAN directory, groupware application). Both of these solutions seem to be problematic because they require the users to leave the application to acquire the adaptations. Therefore, it seems worthwhile considering to integrate support for collaborative tailoring into the word processor's functionality.

To design such an integrated support, the following considerations seem to be of special importance. Depending on the state of a tailoring activity there are different groups of users involved in carrying them out (e. g., use situation II). The extent to which adaptations are reasonably shared obviously corresponds to the tasks which are supported by them. Such a task can be specific to an individual (e. g., use situation IV), a group or a department (e. g., use situations II and III) or even a whole organization (use situation I).

Thus, support for collaborative tailoring should allow differentiating among various groups of users when sharing adaptations. Sharing of adaptations can require different mechanisms. There are obviously situations where mail support seems to be appropriate to exchange adaptations. Use situation II presents such a case where users are jointly building a document template. Moreover, in cases an experienced user builds an adaptation especially required by a user for the task at hand, a mail tool seems to be the appropriate technical support for distribution. On the other hand, in case adaptations are not required instantly by a specific user, a publicly accessible store allows to select among these adaptations at the moment required by the task at hand (e. g., use situations I to III).

Finally there is a need to make users aware of the fact that somebody else has produced an adaptation with relevance to them. Right now users get notified verbally or by a notice on the black board (e. g., use situation III). An integrated tool to support sharing of adaptations could provide additional awareness within the system.

In the end of the interviews, the design of support for collaborative tailoring activities was discussed with the interviewees. Two main design issues emerged during the discussion. First, several interviewees suggested hiding the underlying directory structure of the tool from the users. An experienced user put it this way ”The people get crazy when they have to look for something on drive M:\.. […] You find out that every user just wants to store. If he needs something he just wants to load. He does not care at all where it is from.” Such a hidden structure obviously eases the handling of such a tool. Moreover, some of the interviewees asked to store the shared adaptations in an anonymous way. One user argued this way: ”Information about the creator of the tailoring data are a mess. […] He should be anonymous in the public network because otherwise someone says ‘What have you done there? That is ridiculous!’” While this argument tries to protect the creator against criticism from other users it nevertheless does not consider that creators of successful adaptation may get positive feedback. The mode to handle this issue seems to depend on the tailoring culture of an organization – especially whether it is possible to reach organizational appreciation by providing useful artifacts.

The use situations also show that the categories of that classification need some refinement considering for example the question what “the group” should be (more than one person of the group or necessarily all members) and the issue of different intensities of collaboration (using or changing someone else’s adaption vs. equally distributed work on an adaptation).

5 Design requirements to support collaborative tailoring

Evaluating the use situations and summing up the results of the final discussion with the interviewees, the following main requirements for the tool emerged. It turned out that this empirical evidence is in line with theoretical and empirical work described in the literature about tailorability:

- tight integration in the word processor application (see [Henderson and Kyng 1991], p. 233: “most interesting are mechanisms that are itself part of the system“);
- mechanisms for sharing, sending and receiving adaptations
    - a public store to provide a location to exchange adaptations (see [Bentley and Dourish 1995], p. 145: “it is possible to add attachments to the shared workspace for others to retrieve and use“);
    - mailing mechanisms for users to be able to send adaptations directly to other single users and groups of users (see [MacLean et al. 1990], p. 178: users “can send a button to someone else by email“);
    - a private store for adaptations that may be copies of files from the public store or files received from others via the mailing mechanism;
- an awareness service which notifies users about modifications on adaptations (see [Henderson and Kyng 1991], p. 233: “news must be published that change is available“).

The use situations indicate that the document templates are probably the most widely used adaptations in Microsoft Word 97. According to the interviewees, toolbars are an other function of word processors, whose tailoring is perceived being rather beneficial. Therefore, I decided to focus on this part of the functionality by extending Microsoft Word 97 to support the sharing of adaptations.

6 Implementation

In this section the options that Microsoft Word 97 in the default version provides to create and exchange adaptations are explained. Then the implementation of the first prototype based on the requirements stemming from the analysis are described. First I focus on the basic architecture of the system. Then I present the different sharing strategies offered by the tool. Finally, the questions of privacy, finding or identifying adaptations, and the implementation of a notification service are discussed.

6.1 Default Options for Adaptations in Microsoft Word 97

Microsoft Word 97 provides several options for users to tailor it to their needs. The menu item *Tools/Options* allows for the activation or deactivation of numerous check boxes thus ”choosing between alternative anticipated behaviors” in the terminology of [Henderson and Kyng 1991]. These parameters concern, e. g., the options for saving, printing or spell checking. Their settings belong to one executable program and are saved to be accessible only to the system (e. g., in the registry of Microsoft Windows NT). They cannot be extracted or given to others by an averagely experienced user.

The menu item *Tools/Customize* allows for the modification and creation of menu items and toolbars and the assignment of key shortcuts. Moreover, it is possible to tailor on a higher level and ”construct new behavior from existing pieces” [Henderson and Kyng 1991], e. g., by recording keystrokes and other actions to create a macro. Such a macro can then be manually edited in Microsoft’s Visual Basic for Applications or created completely from scratch. Since the macro consists of Basic code it is basically possible to extract a macro and send the ASCII text to someone who can then incorporate it for their own work with Microsoft Word 97. Macros, toolbars, styles and AutoText can also be saved as part of Microsoft Word 97’s document templates (.dot files). These templates are very similar to Microsoft Word 97 document (.doc) files and can also include ordinary text or forms to fill out. Like documents the document templates can be saved as separate files and can therefore be exchanged, e. g., by email or floppy disk. Moreover, it is possible to copy macros, toolbars, styles, and AutoText between document templates (menu item *Tools/Templates and Add-ins*). That way, document templates and the included tailoring information that are located in a shared directory can be used by all persons having access to that directory.

This functionality for adaptations coming with Microsoft Word 97 is obviously intended for the use of single persons but not meant to support groups in joint tailoring. While it is possible to extract, share, and reuse some of the tailored functionality there are no mechanisms for explicitly working together on adaptations, sharing or sending them, commenting them or notifying others about useful adaptations that one might consider helpful for them. In the next section the architecture chosen to enhance Microsoft Word 97’s functionality accordingly is described.

6.2 Basic Architecture

The prototype was developed in VBA (Visual Basic for Applications), the Microsoft application macro language which allows direct access to the object model of the application and offers language elements and components for the design of graphical user interfaces.

The exchange of toolbars and document templates is done transparently (in the technical sense) for the user via the distributed file system of the operating system. The application logic resides completely on the client side. [Fig. 2] shows the basic architecture of the system.

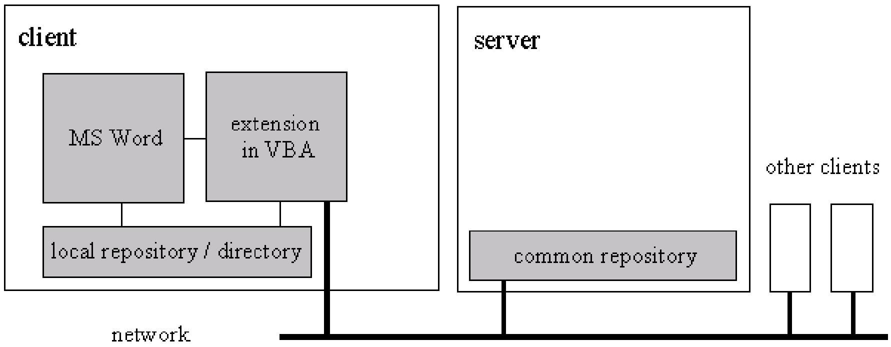

Figure 2: Architecture of the prototype

The extensions are integrated in the Microsoft Word 97 menu bar in order to make it easy for users to access the tailoring system. The basic functionality comprises loading and saving document templates and toolbars. It is also possible to combine a document template and several toolbars in a package, intended for a certain word processing task, e. g., design of a web page or writing of a mathematical paper. The functionality is provided by a Microsoft Word 97 add-in (labeled ”extension in VBA” in [Fig. 2]).

6.3 Sharing document templates and toolbars

The prototype offers both a sending and an access mode for sharing adaptations. In order to support centrally administrated environments, adaptations can be sent to groups of users. This operation might be used by administrators equipping all Microsoft Word 97 installations with a new corporate letterhead. The operation can also be used by users to mail, e. g., a certain template to a specific colleague.

It is also possible to simply store the adaptations in a shared workspace (”common repository” in [Fig. 2]). If another user is searching for a certain adaptation she can access the required templates or toolbars in the common repository.

The existing functionality of Microsoft Word 97 concerning adaptations and the extensions provided by the tool can be found under a new item in the main menu named *Adaptations*. While there are still good arguments against such a central collection of tailoring options I followed [Oppermann 1991] who argues in his comparison of situated and anticipative tailoring that a dedicated menu item increases the chance that users remember the possibility of tailoring options and how to find them. The prototype related entries in this menu allow for saving toolbars only or for saving toolbars together with document templates, starting the notification and starting the adaptation browser.

[Fig. 3] shows the adaptation browser which offers send and access functionality to the user. It can simply be accessed via the ”Adaptations” menu of the word processor.

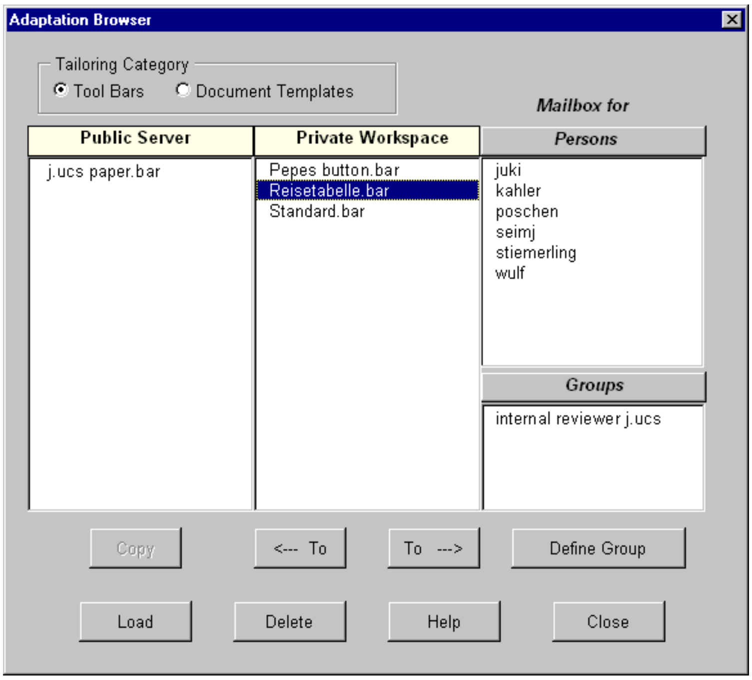

Figure 3: The browser to share adaptations (screenshot translated from German)

On the left side one can see the content of the shared workspace, while the private, local repository is shown in the middle. The two lists on the right side show the other users in the system and user groups. In the screen the user can select adaptations and move them between local and shared workspace or send them – as describe above – to single users and groups. For repetitive mailing, groups of users can be defined and maintained (lower right of [Fig. 3]).

6.4 Identifying adaptations in common workspaces

Using the access mode of sharing requires the identification of relevant adaptations in the eventually rather large common repository. To this end the prototype offers three features.

First, it is possible to annotate an adaptation with a *textual description of its rationale*, e. g., describing the circumstances or tasks for which it might be useful. The description is displayed when browsing both repositories. The possibility to annotate the adaptations and particularly the need for annotations that were commonly understandable had been stressed in the search tool workshop in the state representative. Moreover, since elaborate adaptations are usually not self-explanatory and often closer to programming than to just choosing from some alternatives it is sensible to learn from the experiences in groups of programmers where commenting your code is mandatory. Furthermore, it is possible to identify the author and the date of an adaptation with the tool.

Second, concerning button bars, a preview mode was implemented, allowing the quick instantiation (and removal) of toolbars on the screen. This feature is supposed to appeal to more visually inclined users. The users can immediately explore the alternatives.

Third, when searching in the private or public store the users can select which categories of the adaptations should be displayed by the browser. Currently it is only distinguished between toolbars and document templates, but I believe that a more differentiated categorization might be useful, especially if the tool is supposed to scale for larger organizations. It might be even be necessary to go as far as providing a tool for logical search (based on certain attributes of the different adaptations).

6.5 Notifying the user of the arrival of adaptations

The send mode of sharing makes it necessary to inform the users when new adaptations have been mailed to them. Otherwise the available document templates and toolbars might not conform to their expectations which leads to confusion. Therefore a simple notification service was implemented which informs the user via a message window at start up time of the word processor and at the time the user activates a tailoring function in the menu. This window presents the adaptations and asks the user either to store it in his private repository or to delete it instantly. Currently, the user is notified when she starts Microsoft Word 97 and when she enters the *Adaptations* menu.

6.6 Privacy aspects

In this prototype I have strictly distinguished between a private and a common repository for adaptations. In organizations with intense internal competition, certain successful (e. g., in the sense of time-saving) adaptations are regarded as precious assets by their inventors and thus are considered worth a certain degree of protection. Therefore the private repository is located on the local machine and cannot be read by remote adaptation browsers. The common repository is right now based on the idea of equal access rights for all its users. Any user can make his adaptations available by storing them in the common repository. This repository is accessible by any user.

7 Evaluation

In this section the evaluation of the prototype is described. It consisted of two parts, a usability test and a quantitative evaluation.

7.1 Usability Test

The goal of the usability test was twofold. On one hand I wanted to find out if and how well the users taking part in the usability test understood the concept of sharing adaptations and the way it was implemented in the prototype. On the other hand I expected some hints for the improvement of the prototype. The usability test took part in two sessions with a team of two participants at each session. Three of the participants had been interviewees in the empirical pre-study, one of whom was the experienced user of use situation III and another one an administrator from use situation II. The sessions took place at our research site. Each of the sessions lasted about two hours. Besides the participants two observers took part in the usability test session. Each session was recorded on an audio tape to allow for clarification of what was said after the test. The sessions consisted of three parts. In part one the participants were explained what they could do with the sharing tool and were given a sheet of paper with the tasks that I asked them to perform with the tool on two networked computers. In part two the participants tried to work through their collaborative tailoring task. Part three consisted of a set of questions to the participants on how they experienced the work on their tailoring task, what they thought about the tool and certain parts of it, how they understood the sharing modes, and what they would suggest to improve.

In the first task that the participants had to work on, person A had to create a document template, then modify a toolbar and integrate a toolbar received from person B. Afterwards he had to save all of the above as document template connected with a toolbar in the private folder, and finally send it to person B. Person B had to create a toolbar with certain icons and send it to person A who then used it. The second task required A to define a group and then send a document template to the group, then change a toolbar and save it in the private folder and finally make this toolbar available in the public folder. In this task person B had to copy the toolbar from the public to the private folder and then load it via the preview mode.

The tasks required some coordination between the participants: they had to decide who was to do what in which order. By observing their discussion about how to proceed I gathered a first insight in how they perceived the tool and its affordances. The idea of having people discuss how they might proceed to reach a common goal is part of *constructive interaction* (see [Kahler 2000]). This method is particularly suitable for the CSCW context since for collaborative work talking with your colleagues about how you plan to achieve things is very natural. Insofar, constructive interaction lacks the awkwardness that accompanies the *thinking aloud* method where participants utter what they think while evaluating a computer system [Nielsen 1993]. Constructive interaction was also used after the initial phase of coordination between the participants when they worked on their task. Thus, I was able to log the comments, (mis)understandings and perceptions related to the common work on the tasks.

The usability test resulted in findings on different levels. Most obvious, there were some shortcomings of the interface. Some buttons created misunderstandings and needed to be renamed. One button's name needed to be changed from ”delete” to ”deactivate” since the action that it triggered was hiding a toolbar. Another button needed to be renamed from ”copy” to ”adopt” where participants could decide if they wanted to move an adaptation that was sent to them to their private folder.

Moreover, it became clear that there was a need to be able to delete an adaptation from within Microsoft Word 97 rather than having to use the file manager. This also resulted in the suggestion to introduce the role of an administrator as a person who is allowed to delete adaptations in the public folder.

All of the participants considered the possibility to save, connect and distribute adaptations to be very helpful for their work. Although not all participants were expert users they were all able to use the tailoring functionality and the sharing functionality. The overall usability of the tool was perceived to be good. One participant explicitly said that he would tailor his word processor more in the future since he now knew how to do it and was no longer afraid that the tailoring activities would make the software unusable. This was mainly due to the preview mode. The two participants who were network administrator and experienced user said that such a distribution of adaptations would be very helpful for their organizations. The discussion following the tasks revealed that the participants' conceptual model of how the distribution of files worked was very close to how we, the designers, had intended and implemented the distribution. This is an important result insofar as often and particularly in a more complex group work setting a misperception of the underlying model, e. g., about how links work or who gets to see and change what leads to inefficient usage or reduces a system's acceptance [Mark and Prinz 1997].

7.2 Quantitative Evaluation

Besides the qualitative usability test I also conducted a quantitative evaluation in which 32 persons participated. The aim of this quantitative evaluation was to find out how the adaptation browser and particularly its feature to send and receive adaptations performs in comparison to the sending mechanism already implemented in Microsoft Word 97 in the file menu. The menu item *Send To* spawns an external email client with an outgoing mail that contains the current Microsoft Word 97 document template as attachment. My hypothesis was that the adaptation browser would not rank worse than the internal mailing mechanism even if it was unknown to users.

To test this hypothesis 32 persons of at least average computer skills had to test both the adaptation browser and the internal mailing mechanism. On a 1 to 3 scale on how often they work on a computer (never – sometimes – often) they averaged a 2.56; on a 1 to 3 scale on how often they use email (never – sometimes – often) they averaged a 2.44; 29 of them used Microsoft Word as a word processor. Their task was to get to know both ways of sending and receiving and in a third step to decide which they like best and to send and receive a file in this preferred way. Both ways of sending took place directly from Microsoft Word 97. Receiving files with the adaptation browser could be done directly from Microsoft Word 97, the other way to receive files was via ordinary email. The files then had to be loaded to Microsoft Word 97. Performing the task took them from 9 to 26 minutes with an average of 15 minutes and 19 seconds. Of the 32 persons in the test 14 (44%) preferred the adaptation browser for both sending and receiving, 11 (34%) preferred the internal mailing mechanism for both sending and receiving, 3 (9%) preferred the adaptation browser for receiving but the internal mailing mechanism for sending, 1 (3%) preferred the adaptation browser for sending but the internal mailing mechanism for receiving, and 3 (9%) used the internal email mechanism for sending but did not receive a file due to time constraints in the third part of the task. After the test I asked the participants how they liked the adaptation browser and the internal mailing mechanism on a scale from 1 to 6 (very bad – bad – rather bad – rather good – good – very good). They gave eight marks according to the combination of the dyads adaptation browser or internal mailing mechanism, sending or receiving, functionality or usability. The following means resulted from the participants' judgements:

adaptation browser	functionality	sending	4.9
internal mail mechanism	functionality	sending	4.8
adaptation browser	functionality	receiving	4.6
internal mail mechanism	functionality	receiving	4.7
adaptation browser	usability	sending	4.7
internal mail mechanism	usability	sending	4.5
adaptation browser	usability	receiving	4.5
internal mail mechanism	usability	receiving	4.5

All of the means are between 4.5 and 4.9 with a maximal difference of 0.2 between the adaptation browser and the internal mail mechanism in any given category. The results show no significant difference for the adaptation browser and the internal mail mechanism which proved the hypothesis that the adaptation browser would not rank worse than the internal mailing mechanism even if it was unknown to users. Despite the fact that the adaptation browser was only an unoptimized prototype with the first version of the user interface the participants could obviously detect the value in the strong integration and the enhanced functionality of the adaptation browser.

8 Conclusion

While the fact is well known for quite some time that tailoring activities are often carried out collaboratively, there is a lack of support for this. Based on an empirical study, four different use situations were presented about how joint tailoring of a word processor takes place. Up to now generic single user applications – like word processors – do not provide support to share adaptations among its users. Nevertheless, with the increasing number of computer networks, a technical infrastructure to share such artifacts is often existing. To clarify how support for joint tailoring of generic single user applications could look like, the functionality of Microsoft Word 97 was extended. Based on the requirements derived from the above use situations the functionality provides a public and a private repository for adaptations as well as a mailing function. It is fully integrated into the user interface of the word processor. Finally, the results of a usability test were presented, which indicates that even non-expert users understood the concepts. Moreover these results hint to the fact that such a tool may increase the frequency of tailoring activities.

I assume that such a tool may also serve as a medium that encourages groups to discuss group standards, e. g., for letter templates that then can be shared. The systematization of customizations [Trigg and Bødker 1994] resulting from a collaborative tailoring process would then contribute to common norms and conventions needed for collaborative work [Wulf 1997].

Suggestions for the use of such a tool cannot be restricted to technical design requirements but must include organizational suggestions as well. I am convinced that the establishment of a ”gardener” [Nardi 1993] or ”translator” [Mackay 1990], e. g., a local expert responsible for the coordination of tailoring activities is a vital part of tailoring measures in organizations.

Right now it seems that adaptations are most usefully applied in the organizational context of their emergence supporting the tasks they are made for. The sharing tool in its current form is most helpful for small work groups with a rather similar work context. Future work will also address the question of technical and organizational scaleability of such a tool. The hypothesis here is that the model of public and private spaces and the distinction between creator and user of the artifacts need to be enhanced to more than two levels when the group size exceeds a certain limit. Like in shared workspaces for general purpose, a more sophisticated access control model is needed [Pankoke and Syri 1997]. Meta-information like annotations made by an adaptation’s creator may help to compensate for part of a lacking context. Another enhancement of the tool would be to allow to distribute adaptations worldwide, e. g., via the World Wide Web (WWW). Thus, one could even think of supporting global teams or even establish widely accessible libraries for adaptations. Whether this is, however, reasonable in the light of the poverty of organizational and task context is unclear. How context could possibly be provided and how large groups of participating contributors can be handled may be learned from recent experiences in distributed software development. This is particularly interesting when taking place without existence of a formal organization as in the case of the distributed development of Linux and its components.

However, in my experience it is clear, that collaborative tailoring does not scale easily. As always the question remains open how much administrative work the participating individuals are willing to contribute for the benefit of a group or organization and how much administrative effort is still reasonable to stay on the profitable side of collaborative tailoring. More refined tools to measure this and more refined categories to weigh the individual and group pains and gains against each other are needed.

Other plans for future work on the sharing tool include the integration of other tailoring functions of the word processor (e. g., macros) and the enhancement of applicability from Microsoft Word 97 to the whole Microsoft Office package. Besides adaptations, the tool can easily be extended to support the distribution for Microsoft Word 97 documents on which a group of people works.

Another alternative the time of which has yet to come is the embedding of such a mechanism to exchange Microsoft Word 97 related adaptations into a generic organizer of adaptations belonging to different applications. This organizer could combine mail mechanisms (or even be part of an email client) with the operating systems' functionality for access rights or shared workspaces and an enhanced explanation and commenting functionality. I believe that first steps in this direction are taken by work dealing with component architectures for CSCW and, in particular, for tailorability in groupware (see [Stiemerling et al. 1999]).

Acknowledgements

I thank my colleagues Oliver Stiemerling and Volker Wulf for many and ongoing discussions about collaborative tailoring. Jörg-Guido Hoepfner provided the implementation.

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