

## Collaborative Research Tools for Students, Staff, and Faculty

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### Abstract

*There are many challenges inherent in getting a research group to work as a team. Many of these can be addressed, at least in part, by collaborative, web-enabled, electronic tools that facilitate the management, communication, and organization associated with a research project. During the course of the fall 2005 semester, we, as a team, piloted, among our own research groups, four open-source, web-enabled, electronic tools, Calendar, E-Notebook, Subversion Repository, and a research document database interface that have, indeed, been effective in facilitating time management, the scheduling of meetings, the posting of meeting minutes, follow-up on action items, the sharing and generation of documents, software, data, and tools, and the writing of papers. A preliminary survey conducted across research group members and presented in this paper indicates the effectiveness and user-friendliness of the tools, and gives evidence that the tools are used by student, staff, and faculty researchers on a daily basis.*

**Keywords:** collaborative research, open-source tools, web-enabled tools

### 1. Introduction

Within a collaborative research environment a myriad of challenges present themselves with respect to the storage, organization, sharing, and communication of information within and across groups. Meeting these challenges in effective ways can provide the foundation for building a common ground of understanding, especially in interdisciplinary teams, prevent duplication of effort, assist in problem solving, provide scaffolding for the generation of new ideas, facilitate the writing of papers and development of software and tools, establish good communication, aid in project management and reporting, and help in time management. Through the use of open-source, web-enabled, electronic tools, we have begun to address these challenges and, as reported in this paper, have provided our research teams, many of which collaborate with research teams at other universities or other departments within our university, with a collaborative research toolbox that currently is being used with a high level of satisfaction. Because the tools are web-based, they are portable, i.e., they can be used across platforms and operating systems, e.g., Windows, Unix/Linux, and Macintosh. Because the tools are open-source, they do not require payment of license fees and they can be partially customized and extended to accommodate new features. These two important aspects make these tools unique if compared with existing tools on the market, e.g., Outlook (Microsoft).

The remainder of the paper is organized as follows: First we describe each of the tools in our collaborative research toolbox, giving an example of its application and providing information for downloading the tool. Next we present a preliminary assessment survey, taken by students, staff, and faculty at the University of Texas at El Paso (UTEP), who have used the tools. Finally, we present conclusions and plans for future related work.

## 2. Collaborative Research Toolbox

The collaborative research toolbox that we have assembled is comprised of four main tools:

- web-enabled calendar,
- electronic notebook,
- software repository, and
- web-based research document database.

Below, for each of the tools, we describe its functionality and perceived benefits, and give an example of its application.

### 2.1 Web-enabled Calendar

In our environment, the web-enabled calendar, which is entered by means of a username and password, is used to maintain personal research team member calendars and shared team or project calendars. A calendar's look and feel is completely customizable, for example, color schemes can be changed and the user's language can be selected. Generating, changing, and deleting appointments is made easy by buttons, drop-down menus, and forms. A calendar, with its stored information, can be imported to other calendars such as iCal (Macintosh) and Outlook (Windows).

Individual calendars facilitate time management, a skill that often is lacking in both students, staff, and faculty alike. With respect to collaboration, the tool concurrently tracks the recorded activities of different team members and groups, and allows a user to overlap several different calendars on one screen by means of colored layers. This feature facilitates the scheduling of meetings and events. Another feature of the tool is the capability to enable email reminders that warn team members of upcoming events and meetings.

The web-based calendar [1] can be downloaded from <http://webcalendar.sourceforge.net/> and is covered by an Apache/BSD-style license agreement.

### 2.2 Electronic Notebook

The web-based, multimedia electronic notebook, i.e., the DOE 2000 Electronic Notebook software, which is a product of the Oak Ridge National Laboratory (ORNL) Electronic Notebook Project [2], can be used to store and access data from multiple client platforms. For example, it can be used to store text, images, or whole files as time-stamped HTML pages, which, when uploaded, immediately become visible to all members of a research team. Optionally, mail warnings can be sent automatically when new material is put into a notebook or when content is changed. We are using this tool to support distributed collaborative research through the:

- sharing of documents among team members,
- automated tracking of project progress, and
- development of documents at runtime, e.g., tutorials.

Like the web-based calendar, an electronic notebook is entered by means of a username and password. When adding a new entry, the user name and document title must be entered. Optionally, keywords can be entered as well. A document can be entered into a notebook either via a provided form or it can be uploaded. A table of contents by date or a list of entries associated with a keyword, author name, date, or title can be viewed via a built-in search capability.

Several research projects at UTEP, both within and outside Computer Science, are using this tool – see <http://enotebook.eng.utep.edu>. Moreover, the authors currently are using this tool for the exchange of documents and information within the NIH Multiscale Modeling Consortium that groups scientists across the nation and within the program committee of SC06, the International Conference for Performance, Computing, Network, Storage, and Analysis [3]. The web-based, multimedia electronic notebook can be downloaded from <http://www.csm.ornl.gov/~geist/java/applets/enote>.

### **2.3 Software Repository**

The web-enabled software repository Subversion (or svn) [4] works like a time-machine in that files in the repository have a defined state and every time a file is added/committed to the repository or a file is changed and the change is committed, the current state is saved. In this way, a log of all changes made to each file is maintained. Using such a software system, team members can collaborate on the development of a document or a program without having to transmit it among themselves or coordinating access to it. The tool can sequentialize write access to a file, while permitting concurrent read access. Traditionally software repositories are used for software development. In addition, our research teams have found this tool useful for several other purposes, for example, to store and make available to team members grant-related documents, deliverables, related research papers, published papers, research-related software tools, and papers in progress. It also has been used extensively to coordinate custom code development among team members.

Like the other two tools discussed above, a software repository is entered by means of a username and password. Through a command-line or integrated, graphical user interface (GUI), team members can access the repository to checkout documents (for reading or writing), lock documents (for writing), commit documents (save changes), and unlock documents.

At UTEP, this tool is used by students, staff, and faculty in Computer Science, as well as in other departments in the College of Engineering. Moreover, it is used not only for research projects but also as a tool to share and coordinate access to course materials used by faculty within UTEP as well as faculty at New Mexico State University and New Mexico Institute of Technology. The repositories for the College of Engineering are located at <http://repository.eng.utep.edu>. The tool can be downloaded from <http://subversion.tigris.org>.

### **2.4 Web-based Research Document Database**

The web-based research document database tool was developed by the DAiSES research team [6] at UTEP. It is a web-browser search interface to a Subversion repository that can contain reports, papers, software, and other research documents. The interface, coupled with the repository software, provides a user-friendly, platform-independent, and portable research tool that provides search-based, fast access to documents and serves as a multi-format citation database, facilitating the preparation of bibliographic entries.

The research document databases at UTEP are located at <http://pubsearch.eng.utep.edu>. Several research projects, including the DAiSES (<http://research.utep.edu/daises>) [5] and DAPLDS (<http://research.utep.edu/daplds>) [6] projects, are using this tool.

## **3. Assessment Survey**

In order to assess the effectiveness of the collaborative research toolbox that we have assembled, we asked 15 users (two faculty members, one staff member, and 12 students) to complete a related survey

that evaluates their experiences with the associated tools during the period January-February 2006. The survey asks the following questions:

1. Do you use any of these tools (a) for your own research and personal use, (b) for research within your group, or (c) for research among groups?
2. On average how frequently do you access each of these tools per day?
3. How do you judge the user-friendliness of these tools?
4. How do you judge the impact of these tools on your research?

Figures 1.a, 1.b, and 1.c correspond to the answers given to question 1, parts a, b, and c. As can be seen from the depicted data, most interviewees use the tools for research within their teams and for their personal use.

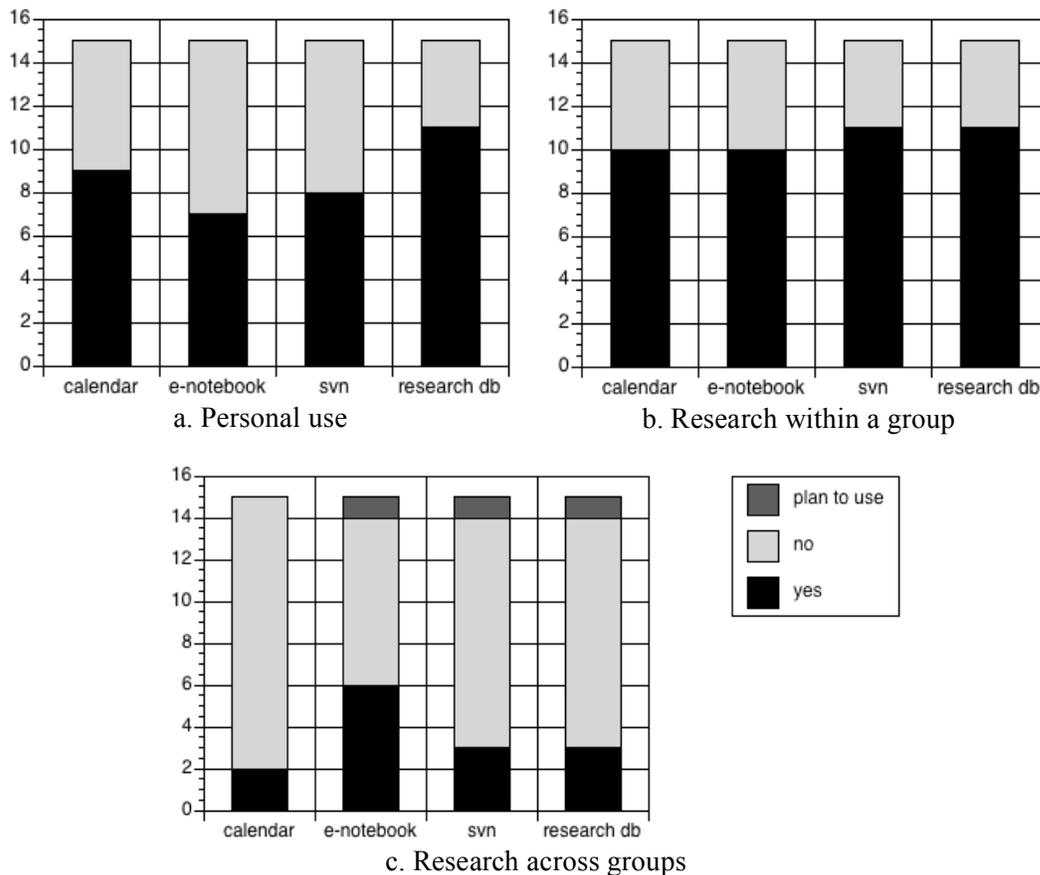


Figure 1: Deployment of the tools

Figures 2, 3, and 4 correspond to questions 2, 3, and 4, i.e., to the frequency of use of the tools, the user-friendliness of the tools, and, finally, the impact of the tools. With respect to Figure 2, never means that the tool was used 0 times per day. As can be seen from the depicted data, most interviewees use the tools at least once a day. More in particular, 60% of the interviewees use the web-enabled calendar at least once per day, 66% use the electronic notebook and the repository at least once per day, and 80% of the interviewees use the research document database at least once per day. With respect to Figure 3, the user friendliness of a tool is judged in terms of how hard it is to use. As can be seen, most interviewees find the tools easy or even very easy to use. The interviewees find that the software repository is the most

challenging tool to use. Finally, Figure 4, indicates the effectiveness of the tools in facilitating research productivity. As the figure indicates, most interviewees consider the impact of these tools, in particular the research document database, on their research productivity to be very high.

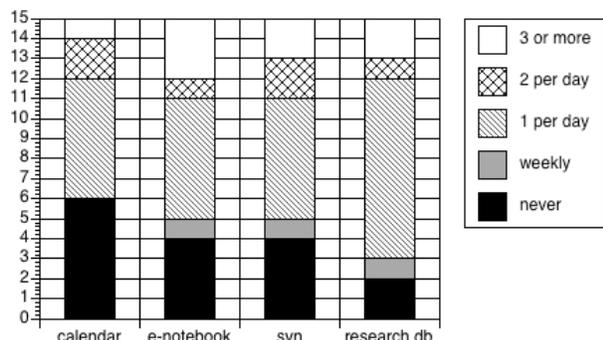


Figure 2: Frequency of the tool usage

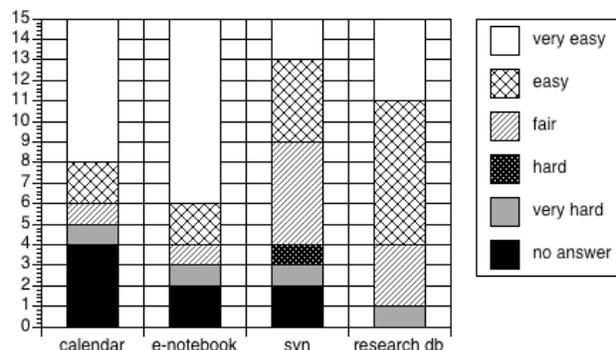


Figure 3: User-friendliness of tools

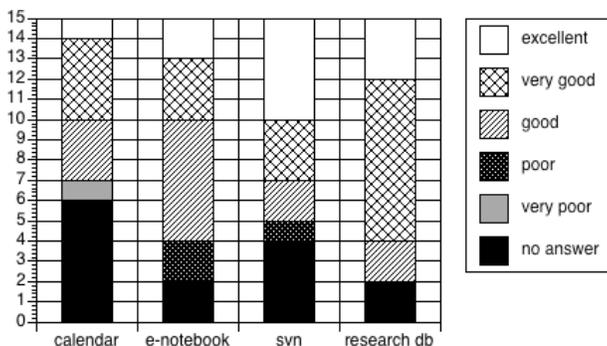


Figure 4: Effectiveness of tools

#### 4. Conclusions and Future Work

This paper presented a set of open-source, web-enabled, electronic tools that are being used at UTEP to facilitate research team activities. The teams are comprised of students, staff, and faculty at different institutions. In addition, the results of a survey that assesses the frequency of use, ease of use, and impact of the tools was provided. The assessment shows that the majority of the interviewees use the tools on a regular basis, find the tools relatively easy to use, and report that the tools facilitate the research process. In addition, individually the tools have been used to manage personal schedules, provide a shared storage facility for documents related to conference organization, and provide a shared curriculum resource. If you would like further information about any of the tools, please feel free to contact the authors.

Work in progress includes extension of the research database tool to automatically format citations in a variety of formats, e.g., those specified by the Association of Computing Machinery (ACM) and the Institute of Electrical and Electronic Engineers (IEEE). In addition, training tools are being developed to overcome the existing challenges in using the tools, especially those associated with the use of the software repository.

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