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Authors

Kantor, Michael L.
Redmiles, David F.
Zimmermann, Beatrix

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Michael Kantor, David Redmiles
{mkantor,redmiles}@ics.uci.edu
University of California, Irvine

Beatrix Zimmermann
bz@basit.com
Bell Atlantic
Science and Technology,
White Plains

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Department of Information and Computer Science
University of California, Irvine
Irvine, California 92697-3425
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Abstract

Coordinating work between many groups is an important issue for many complex tasks. While awareness tools are commonly used to enhance coordination within a group, this paper presents an awareness tool designed to enhance coordination between groups. This paper presents the Knowledge Depot Subscription Service and three studies which examine issues in providing this type of awareness and coordination.

Keywords: Intergroup Coordination, Awareness, Push Technology

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Supporting Awareness and Coordination Between Groups

Michael Kantor, David Redmiles

Information & Computer Science
University of California, Irvine
Irvine, CA 92697 USA
+1 949 824 {2703,3823}
{mkantor,redmiles}@ics.uci.edu

Beatrix Zimmermann

Bell Atlantic Science & Technology
500 Westchester Ave.
White Plains, NY 10604
+1 914 644 2503
bz@basit.com

ABSTRACT

Coordinating work between many groups is an important issue for many complex tasks. While awareness tools are commonly used to enhance coordination within a group, this paper presents an awareness tool designed to enhance coordination between groups. This paper presents the Knowledge Depot Subscription Service and three studies which examine issues in providing this type of awareness and coordination.

Keywords

Intergroup Coordination, Awareness, Push Technology

INTRODUCTION

Much research has been done to develop awareness tools that promote coordination among members of a single group. However, tasks that involve multiple groups require methods to help coordinate between these groups, and even between different levels of the organization or work environment [7]. With this goal in mind, our research has taken the principle of group awareness tools and expanded it. However, tasks that involve multiple groups require methods to help coordinate between these groups, and even betweenWith this goal in mind, our research has taken the principle of group awareness tools and expanded it that incorporates this extension to traditional awareness tools in a system called Knowledge Depot, which provides a subscription service that creates awareness links between user groups. The subscription service extends previous versions of the Knowledge Depot tool [10].

To understand the coordination problem that is addressed by inter-group awareness, consider a software development effort involving several groups of developers. If one group needs to change a component of the system due to a problem that they encounter, that change could have an impact on other groups who

depend upon that. If those other groups fail to learn of the change, the system as a whole could break. Effective coordination would require that the affected groups either modify their own work to compensate for the change or that they attempt to prevent the change from happening. For either of these types of coordination to take place, members of the other groups must be aware of the fact that the change is being made, or better yet, aware that a change is being discussed.

Effective coordination requires that people and groups be aware of changes that affect them [2]. In fact, there is a wide variety of types of information produced during any project which if summarized to the correct people can enable those people to stay aware of changes as they occur. If that information were online, coordination between groups could be enhanced [6], [1].

Notification of New Information

Assuming that it is easy to put project related information on-line, we are still faced with the challenge of making people aware that the newly created information is available. When new information has been created, regardless of whether it is announcing a change, posting a new answer on an FAQ, publishing a report or adding an entry to a database, there are people who will benefit from being aware that this information has been created or updated. There are a variety of approaches used to deal with the problem of notifying people of new information.

One approach is not to inform them at all, but to instead assume that if the information interests them, then they will check for it periodically. A person might check the CNN news site once each day for new content, and be sure of finding new information each day. A person may check other web sites only to learn that there is no new information added since the last time they looked. Bulletin boards are based on the premise that people will check them periodically.

A second approach is for the content creator to broadcast email to all people within a large group to notify them that new information is available. For example, when one company releases a new ISO 9001 related procedure, they email all employees to announce that it is available. This form of broadcast results in

significant quantities of junk mail when used repeatedly, especially if used by all groups within a project or organization to make what each group considers important announcements.

A third approach involves the person who creates the information emailing all of the people that the author knows to be interested in the information. This approach often misses people who are interested in the information, but are not known to or remembered by the author.

A fourth approach, which solves the problem of missing people who need the information as well as the problem of users feeling that they are receiving unsolicited email is mailing list servers and related subscription based services. A person decides if a type of information is of interest, and if so, add themselves to the list. This often opens a flood-gate of mail on a subject, much of which may end up being considered junk mail after the user realizes that there isn't enough time to keep up on all of the information being sent out on the many mailing lists that have some relevance to their work. This solution can work only if people are conservative in their use of the list servers. For example, if they restrict use to very specific types of announcements, and limit or eliminate discussions.

The final approach, which is the focus of this paper is based on people registering themselves as interested in summaries. Such tools generally fall within the class of tools called *Push Technologies* [5]. The result of such tools is to create an awareness of what new information is available. For example, a user enters five new questions and answers to an FAQ web page over a period of a week. At the end of the week, email is sent to users summarizing the five new items of information that can be found. Digests are a similar approach. Rather than receiving a flood of email from a list server, digests allow users to receive summaries of the discussions that took place.

The next few sections discuss awareness and contrast existing research goals in awareness with our goal of inter-group awareness. Then we describe the Knowledge Depot and its subscription service, followed by a discussion various user studies performed as well as future studies planned to examine issues in creating inter-group awareness with tools such as Knowledge Depot.

AWARENESS TOOLS

A central belief to our line of research is that people can not read through all of the information that is in topics that are of interest to them. In fact, there is evidence that people often consume information to such an extent that it reduces their productivity [14], [17]. What people need is not to be flooded with information, but rather to maintain an awareness of what information is available. Awareness of information will give people three choices for each item of information:

1. The information is important to something the user is doing or planning now, and the user will retrieve the information in hopes that it will help with the task.

2. The information may well be useful at a later time, and the user now knows that the information exists and where it can be found.
3. The information is not applicable to any work the user expects to do, and can be ignored.

Information Awareness tools are not new to research in groupware, and generally focus on a specific piece of information that contributes to coordination within a group.

For example, Portholes allows group members to maintain an awareness of other group members current locations and activities [11]. Periodically, it refreshes photos on a user's monitor showing the offices of co-workers. These photos allow people to know when a co-worker is out of the office, in a meeting, on a phone, working with another co-worker, etc. Taking one specific piece of information, Portholes is able to make users aware with minimal thought or effort whether a co-worker can be contacted to ask a question. They can see if there is an impromptu meeting taking place that would be worth joining. Awareness of one's co-workers helps in coordinating the moment-by-moment communications needs of the group. The photos provide a concise summary of activity in the office over the past five minutes and the set of photos a user views is based upon which co-workers each user feels are relevant to their work.

Like the typical awareness tool studied in the CSCW field, it focuses on providing awareness of group members. Other tools support groups by providing different pieces of information. Calendars provide schedules to help people coordinate their meetings and tasks. ClearBoard [9] makes people aware of eye-gaze and gesture to enable them to coordinate conversations and work related to objects on a screen.

Some tools do provide pieces of information that can contribute to awareness between groups. Endeavors [8] is a tool that is used to manage and track processes, and can contribute to maintaining an awareness of what stage of a process other groups are on. Process awareness can help groups to coordinate, as well as helping to coordinate individual tasks within a group. Information Lens [13] can enhance coordination between groups by allowing users to specify what types of information within an organization are relevant to their work. Announcements from groups whose work can affect these people will then be forwarded to them. This helps users to maintain an awareness of announcements and other emailed information on topics that can affect them.

While these research projects have built tools that can provide support to inter-group awareness, they were not interested in this particular research area, provided no studies of what affect this information had on awareness and coordination, provide very limited sources of information to users, and are not scalable to awareness of many groups.

Push Technologies

Instead of requiring users to repeatedly check information sources in hopes that they will have new

information, push technologies [5] notify users of the arrival of new information, often summarizing the new information or forwarding it to the recipient. As a result, these are sometimes studied in the area of *Notification Systems* [16], [15]. Many push technologies are designed to be awareness technologies, containing features for capturing, distributing and presenting summaries of new information. In the past, groupware researchers who have studied push technologies have focused on issues of awareness within groups [3], [4].

The goal of many push tools is not only to make users aware of the existence of the new information, but often to make users aware of the implications of the information as well. A digest of news summaries that CNN emails out daily does not just make readers aware of what news articles are available, but also makes readers aware of what is happening in the world itself.

Push Technology as a Groupware Tool

Summaries used to maintain awareness between groups should have the same goals: not simply to make users aware of what information other groups have produced, but to summarize it so that users are also aware of what is happening within the group itself. The ability of a push tool to do this effectively depends upon the nature of the information that it distributes.

A project can generate an enormous amount of information. Take, for example, a group of people organizing a conference. They generate plans, possible locations, multiple versions of documents such as Calls for Participation, paper submissions, reviews, lists of accepted papers, possible hotels for housing attendees, and much more. People helping to organize an aspect of a conference may not want to participate in discussions of other aspects of the conference, but may still want to be aware of what is happening, especially in aspects of the planning that can affect their work. The person in charge of reviewing papers will want to receive all email and documents concerning the review of papers for the conference. Those whose tasks depend upon the progress of the reviews but don't want to be overwhelmed with information on the subject would benefit from summaries of the communications and information produced during the review process.

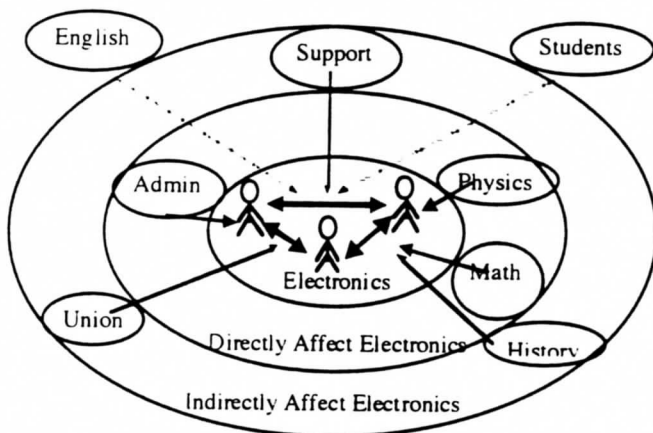


Figure 1: Strength of awareness links

Inter-Group Awareness Model

Figure 1 illustrates the awareness model that represents an aspect of our goal. In this example, our users are college professors developing a curricula. Each circle represents a group of teachers working on the curricula for a specific subject. A strong awareness is needed by people within a group (i.e. the people designing the electronics curricula will be highly aware of one another as they are working together). A weaker awareness is needed of other groups whose decisions can directly affect the electronics curricula. For example, if either the physics or math programs stop teaching courses that are electronics prerequisites (or are even discussing the possibility of stopping these courses), then the electronics group will need to know that as soon as possible. This awareness will enable them add the necessary material into their own program (or if the change is still in the discussion stage, explain to the physics or math faculty why this change would negatively affect the entire curricula). Even weaker awareness links are needed to groups that might indirectly affect the electronics group, and almost no awareness at all of groups whose decisions are very unlikely to have any affect at all on the electronics curricula.

KNOWLEDGE DEPOT

Knowledge Depot is a group memory which has evolved into an inter-group awareness tool through the principles of push technology. This section describes the group memory, its users, and the design of its subscription services.

Group Memory

Knowledge Depots capture group information and automatically categorize it into user defined categories. Their primary information source is email which they capture when users either Carbon Copy a Depot with their work related discussions, send mail directly to a Depot to be categorized and stored, or which Depots automatically receives when mail is sent to the group's mailing list. Capturing this type of information provides design rationale, historical and reference material describing a project.

Knowledge Depots also contain other information. Groups can use the Depot to store descriptions of all group members, calendars for each member and documents that are produced as part of the group's work. The result is a repository for the information and discussions of a group.

Next Step Program

Our main users for this system are members of Bell Atlantic's Next Step Program. This is a continuing education program for Bell Atlantic employees. Members of the program include those employees (i.e. the students), professors at twenty-five colleges in the New York and New England areas, and an organizational staff provided by Bell Atlantic.

Each group within the Next Step program was provided with a Knowledge Depot to capture and archive their discussions and documents (assignments, curricula, exams, etc...). Members of each group can decide to make their Depot accessible to other groups within the Next Step Program who might need be aware of the information within their Depot. There are different Depots for specific subjects where teachers can discuss the curricula and share teaching materials. There are Depots provided for campuses and regions where conversations and documents relevant to the Next Step Program for that area are stored. Student groups are each provided with a Depot so that when they work together to try to understand a concept or a homework assignment, their understanding can be archived for them to look at later, or for future students to examine when they encounter the same confusions.

In many cases, the Depot only archives discussions that are broadcast to all people within a group; however, this information can be very helpful for understanding what issues a group is encountering. By making these discussions available to other groups, the archive provides the beginnings of an awareness tool. Members of the electronics group can occasionally check the math and physics depots, enabling them to not only notice when a change has been decided upon that may affect the electronics curricula, but to also notice when a discussion is in progress for making such a change (see figure 1). Forewarned, they can then discuss the impact with faculty in the other areas, and either prevent the change from having such a large impact, or have time before other groups put their decisions into affect to modify their own curricula. Users willing to put in the effort to monitor relevant Depots can stay aware of these issues.

Initial Subscription Service

A subscription service was added to Knowledge Depot to help users monitor archives that they believed to be relevant. There were two goals: 1) to reduce the amount of time and effort invested by users who were already using the Depots to maintain awareness of other groups, and 2) to increase the number of people who were aware of what was happening within the Next Step program. Preliminary studies of faculty (whom this initial service was restricted to) showed two types of users: those who were not motivated enough to check what new information was available on-line, and users who spent a lot of time checking the various Depots, but spending very little time during each check.

To help both groups, we simplified the task of monitoring Depots. We enabled users to subscribe to be emailed periodic summaries reporting on all new and modified information within any public Depot of interest to the user. The low motivation people could then maintain a better awareness of what is happening in various aspects of the Next Step program that can affect them. The users who frequently checked for information, but rarely found anything worth spending time on could then sit back and let the information be sent to them, deciding only after the summary had been sent to them whether there was any new information worth retrieving. This approach has the potential to improve coordination

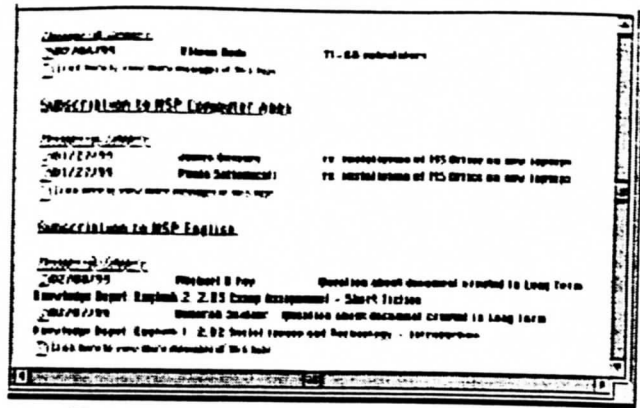


Figure 2: Subscription message with multiple Depots

within the Next Step program by making larger numbers of people aware of changes within the Next Step program.

Furthermore, we enabled users to specify how aware they wanted to be of each Depot by enabling them to set the frequency with which they receive summaries of new and modified information. This means that information which needs to be timely and is of greater importance can be checked frequently, and information with a much lower relevance can be checked infrequently, enabling users to set the strength of awareness based on how directly other groups can affect them.

Figure 2 shows an emailed subscription, containing summaries of various Depots, and links (document icons) that allow users to jump to any item of information that looks relevant.

Subscribing to Any Type of Information

After 6 months of usage, we enhanced the subscription service and provided it to all members of the Next Step program (not just faculty). This enhanced service allows users to not only subscribe to Knowledge Depots, but also to subscribe to any Lotus Notes database on the Lotus Notes network. Instead of being limited to maintaining an awareness of discussions and decisions of other work groups, people can now maintain an awareness of any type of information that might affect them.

For example, each Next Step members is provided a computer for their work, and are expected to use Lotus Notes to communicate electronically. An important resource for these people is an FAQ database that contains information on maintaining the hardware and software (such as Notes) for these computers. The helpfulness of an FAQ can be greatly enhanced if users already know what new questions and answers are available, especially if the summary of new information in the FAQ makes them aware that there has been an answer posted to a problem that they themselves have been having. There are many other types of information that can be monitored using this approach. Below are listed just a few possibilities:

1. Subscribing to a Name & Address database can allow users to remain aware of the arrival of new group members and what specialties they have.

2. Subscribing to a customer support database could allow people to remain aware of how many calls or emails were sent in a time period, and get an idea of the subject of each call.
3. Subscribing to a calendar database allows people to be aware of changes to schedules, deadlines and vacations.
4. Subscribing to a log allows users to maintain an awareness of system activities. If a log is used to store error conditions that arise from a system, the developers can maintain an awareness of how many and what type of errors are arising. The same approach can be taken to any type of system generated information.
5. Subscribing to a database of services and prices can

allow users (sales representatives) to maintain an awareness of changes to the price of any service, as well as the addition of new services.

Almost any kind of information can be stored in databases, ranging from images and documents to member lists and travel vouchers. A subscription feature that permits users to subscribe to any type of database allows for people to maintain an awareness of almost any kind of work produced information.

Subscriptions create awareness. They allow people to create on-line information without having to concern themselves with notifying people that new information has been created. The information goes to the people who have decided it is important for their work. Given that any person within an organization may at some point create an item of information that belongs on-line, it is important both to provide this assurance that the information will get to those who need it, and that people will be aware of the existence of this new information.

Implementation

To enable each user to specify which databases they want to maintain an awareness of and how strong of an awareness, each user is provided with a preference setting (Figure 3) stored in a preferences view of a database. A preference setting contains a list of subscriptions (a list of lines). Each line contains a list of database names, followed by the number of days that should pass before checking all of those databases and reporting on any new information found in them. The first row of Figure 3 shows a user subscribed to the databases "Next Step: General Information", "Next Step: Curriculum Info" and "Next Step: FAQ", and once every fifteen days this user will receive one report summarizing all information added or changed in these three databases.

#	Press Enter and select or type in the database(s) you want to subscribe to	Enter frequency in days that you will receive each subscription (minimum: 1 day)
1	Next Step: General Information, Next Step: Curriculum Info, Next Step: FAQ	15
2	MSP Math, MSP Computer apps, MSP English, MSP Physics, MSP General, MSP Social Science, MSP CDE, MSP Forensic	14
3	Semester 1 Lab, Term A0, Semester 2 Lab, Term A1, Semester 3 Lab, Term A0, Semester 4 Lab, Term A0, Semester 5 Lab, Term A0, Semester 6 Lab, Term A0, Semester 7 Lab, Term A0, Semester 8 Lab, Term A1, Technical Prep, Long Term A0, Next Step: Faculty & Staff	15
4	MSP A0 Admin, MSP MATH	17

Figure 3: Preference form for specifying subscriptions

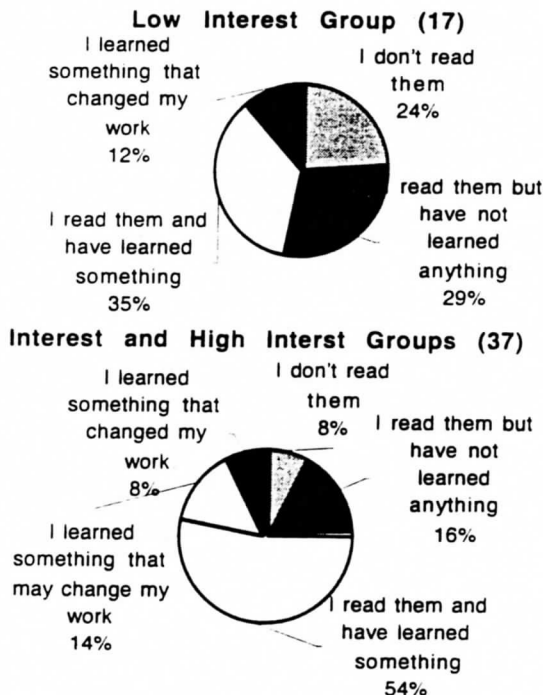


Figure 4: Survey Results

EVALUATION

We have performed a number of small studies to look for evidence to support or refute our assumption that the reports made users more aware of other Next Step groups, and that this awareness improved coordination.

In order to study these assumptions, we have performed three types of studies: surveys, interviews and usage studies.

Survey 1

The Next Step program periodically sends surveys to the students and faculty, and we were able to add a small number of questions to these surveys. We asked faculty how interested they were in the decisions of other curricula (answers range from not at all to extremely interested), and whether they learned anything from the subscription reports (possible answers included: didn't read the reports, didn't learn anything, learned new information, learned information that may affect work in the future, and learned information that has affected work). Users who answer that they learned information that affected their work will strongly support our hopes that the tool will enhance coordination between groups.

Users who were Interested Were More Likely to Learn

An analysis of how users answered these two questions can be seen in figure 4 (parenthesis in chart indicate number of responses used for that chart). We organized responses into two groups: answers from users who had little or no interest in the decisions made within other curricular groups, and answers from users who had medium or high interest in the other curricula. From this, we can see evidence that users with an interest in decisions of the other curricula were more likely to read the reports, and more likely to learn from them than users with little or no interest. If we assume that users answered that they were interested in information because they believed that the information was relevant to their work (in figure 1, information from groups that could directly affect the Electronics group), then they have attempted to create a strong awareness link by reading the reports.

Users Reported having Learned as a Result of Subscriptions

Two other points are worth noting from these results. First, it is interesting to note that many users with little or no interest also learned, some of them even learning information that they believed could affect their future work. Second, while critics of this study could point to the many people who failed to learn anything, we would suggest that it is more interesting to note that the rest of the users did learn information that they might not have otherwise learned. Even if only some users benefited from the system (and obviously many of them felt that they benefited or eventually they would have stopped reading the reports), then the system has benefited the group or organization as a whole.

Survey 2

In a second Next Step survey (which received over 240 responses) we added three questions.

- 1) Did users learn anything (same question as in previous survey).
- 2) Did users feel more aware of what was happening within the Next Step program as a result of reading the reports (a difficult question for people to answer

in an unbiased manner, but the results were still informative).

- 3) Did users follow links in the reports to the new or modified information being summarized in the reports (a true false question). This last question was designed learn two things:

- a) How were users using the subscription messages,
- b) To what extent was awareness and learning created just by reading summaries – did users have to retrieve the original information to become more aware?

Users Learned, but No Coordination Affect

As in the previous survey, many users did not learn, but clearly, learning took place as a result of the use of the system. 0% reported that the information that they learned directly affected their work (a drop of 7% from the previous survey). This means that we currently have no evidence to let us claim our subscription feature created a coordination affect.

Did not read	16%
Read without learning	18%
Read with learning	54%
Learned information that they believe may affect work in the future	14%
Learned information that affected work	0%

Both Reading and Reading with Learning Enhanced Awareness

The pie charts in figure 5 clearly illustrate that reading the reports (even without learning) increased the likelihood of people feeling more aware. People who learned were significantly more likely to feel more aware of what was happening within the Next Step program than those who did not learn. Those who learned information that they thought could affect their work were more likely to feel “much more” or “significantly more” aware. While we can not prove that coordination was enhanced, we have a convincing case for having

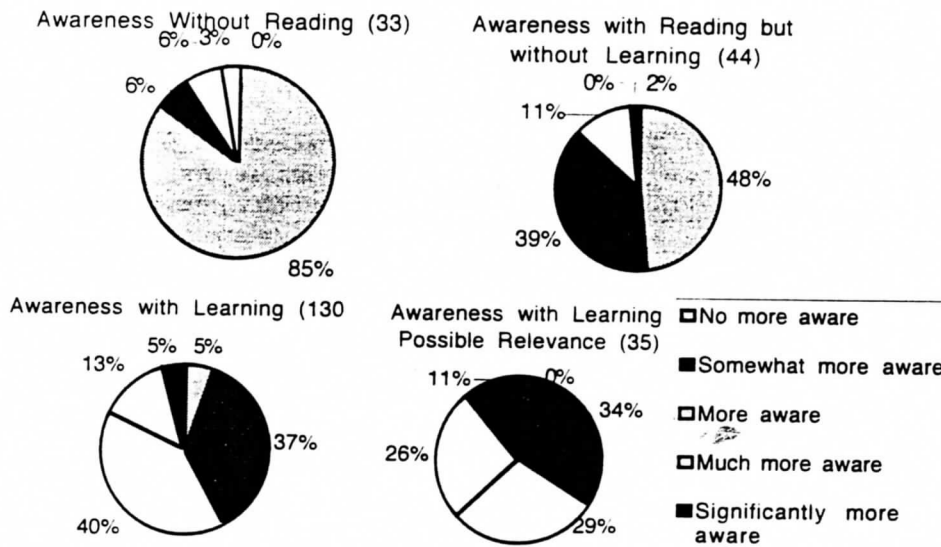


Figure 5: Affect of Learning on Awareness

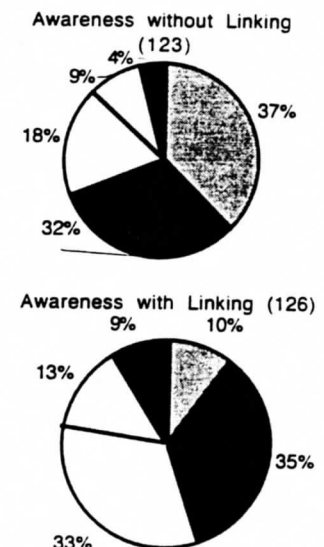


Figure 6: Affect of Linking on Awareness

enhanced awareness, an important ingredient for coordination.

Many Users Followed Links

50% of the responding users reported following links to information that looked relevant to them.

Following Links Increases Awareness, But Summaries Are Enough to Create Awareness

The pie charts in figure 6 show that regardless of whether users followed links to view the full information summarized in the reports, many users still felt more aware as a result of just reading the reports. This means that tools that just send out summaries can make many users feel more aware. However, the data indicates that users who follow links tend to feel more aware of what is happening within the Next Step program than those who do not.

Interviews

A second small study which involved two sets of 11 short interviews was also conducted. While the interviews were mostly oriented towards improving the subscription service, it also obtained a small amount of information about how people used it. One unanticipated result was to learn that the most enthusiastic users did not want to wait for the information to come to them, and while happy with the periodic reminders of what information was available, would still check for new information.

One user whose job it was to coordinate between students, faculty and Bell Atlantic administrators found the tool extremely useful. Her work required her to keep up on the activities of these three groups. Due to technical problems, she was unable to follow the document links to the information being reported upon, but the information being summarized was of such high interest to her that she frequently telephoned the authors of the information and asked them for more information. For tasks where maintaining an awareness of the activities of many groups is critical, the Knowledge Depot Subscription Service played a highly productive role.

Usage Study

Our third type of study is based on three months worth of usage data. On our initial release of the enhanced service, all members of the Next Step program (staff, students and faculty) were subscribed by default to sets of Lotus Notes databases. Which set of databases depended upon what groups the user was a member of. The usage logs showed how often people changed their subscriptions; either adding or removing databases from their preferences. It also showed how often users unsubscribed themselves completely (implying that they thought all of the subscription messages to be junk mail). During the three months of usage data, the highest number of participants in the Next Step program who were subscribed was 1,985. 25 users made changes to their preferences. 5 of those users unsubscribed themselves from all databases. Of the 25 users who made changes, 12 made only a single change (most likely either unsubscribing themselves to everything or simply seeing what happens when changing preferences) and the other 13 made multiple

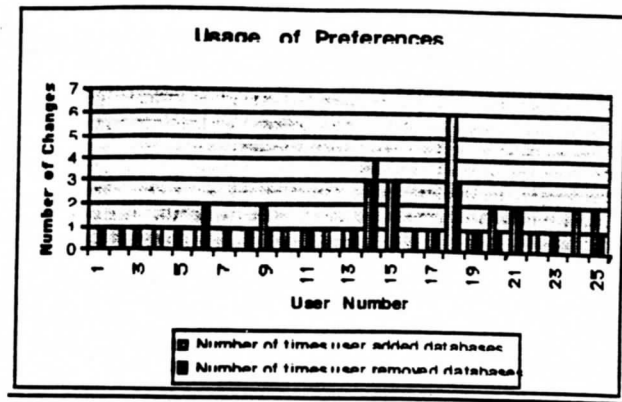


Figure 7: Usage of Preferences

changes (making some effort to refine their preferences to their needs).

These 25 users were not more or less interested in the information than other users. Some of them subscribed to more databases, others unsubscribed themselves. The relatively small number of users to change their preferences may be explained by [12] who explains that most users prefer to accept default settings over trying to understand a system well enough to configure it to their needs. While perhaps more technically motivated than the other users, these users are probably comparable in terms of interest and information needs. So we assume that these 25 are fairly representative in terms of interest.

Based on this study, 20% of these users felt that the subscription messages were junk mail and unsubscribed themselves. 52% of these people made changes at least twice, and 32% of these people made changes at least three times. From this we conclude that most users did not feel overwhelmed with information, and felt that with the right information sources, they would either gain an awareness of relevant information, or at least have the potential of such awareness.

DISCUSSION AND FUTURE WORK

We can conclude that in general, many people want information, and due to the quantity of information available and the number of sources that a person would need to check by themselves, they are happy to have summaries of the information delivered to them. Most users who figured out how to refine their preferences chose to continue receiving reports. Many of the users were reading the reports, and learning was taking place for significant numbers of these users.

However, there are issues other than what users want. Is the subscription service going to enhance productivity by enhancing coordination, or will it disrupt productivity through information overload? For example, a person without subscriptions might spend a certain amount of time browsing through information sources, and perhaps spending more time than is productive[17]. Now that there is a tool that allows people to get summaries of new information from a variety of information sources, a person can now subscribe to many more information sources than before. This person may end up spending as much time each week trying to keep up with subscription messages as they once spent browsing. The Web has shown us that

as a person's capacity to explore new information grows, so will the expectations in their area of work that they will use that additional capacity, leaving the person better informed, but no less overwhelmed by the vast quantity of information available.

Consider a web browser's bookmarks. Each time a user finds a new interesting site for information, it gets added to their bookmarks, resulting in a huge list of interesting sources of information. If users treat subscriptions the same way and subscribe themselves each time they find an interesting new information source, the user will eventually be overwhelmed with subscription messages.

The real question that this study does give us some insight into is whether the Knowledge Depot subscriptions and Push Technologies in general can act as awareness and coordination tools. There is strong evidence for enhanced awareness, but more carefully designed studies and extended usage may be required to detect enhanced coordination resulting from that awareness.

Many users believed that they had learned something and were more aware, and even people with a low interest in the material still found that they learned something that looked relevant to future work.

CONCLUSIONS

This paper has studied a new approach to enhance that involve multiple groups require proof for enhancing coordination has yet to be established, the approach taken had a clear affect on awareness methods to help coordinate between these groups, and even bet While the technologies labeled as "Push Technology" are rarely targeted at group work, this study shows that applying them to this domain is an important research direction.

REFERENCES

1. Brooks, F.P., *The mythical man-month : essays on software engineering*. Anniversary ed. 1995, Reading, Mass.: Addison-Wesley Pub. Co. xiii, 322.
2. Curtis, K., Iscoe, *A field study of the software design process for large systems*. Communications of the ACM, 1988. 31(11): p. 1268-1287.
3. Dourish, P., Bly, S. *Portholes: Supporting Awareness in a Distributed Work Group*. in *Conference on Human Factors in Computing Systems*. 1992: ACM.
4. Fitzpatrick, G., Parsowith, S., Segall B., Kaplan, S. *Tickertape: Awareness in a Single Line*. in *Conference on Human Factors in Computing Systems*. 1998: ACM.
5. Franklin, M. and S. Zdonik. "Data in your face": *push technology in perspective*. in *SIGMOD International Conference on Management of Data*. 1998. Seattle: ACM.
6. Freeman, P., *Software perspectives : the system is the message*. 1987, Reading, Mass.: Addison-Wesley. xxv, 294.

7. Grudin, J., *CSCW: History and focus*. IEEE Computer, 1994. 27(5): p. 19-27.
8. Hitomi, A., Bolcer, G., Taylor, R. *Endeavors: A Process System Infrastructure*. in *International Conference in Software Engineering*. 1997.
9. Ishii, H.K., M. *ClearBoard: A Seamless Medium for Shared Drawing and Conversation with Eye Contact*. in *Conference on Human Factors in Computing*. 1992: ACM.
10. Kantor, M., Zimmermann, B. Redmiles, D. *From Group Memory to Project Awareness Through Use of the Knowledge Depot*. in *California Software Symposium*. 1997. Irvine.
11. Lee, A., A. Girgensohn, and K. Schlueter. *NYNEX Portholes: initial user reactions and redesign implications*. 1997.
12. Mackay, W. *Patterns of Sharing Customizable Software*. in *Conference on Computer Supported Cooperative Work*. 1990: ACM.
13. Malone, T.W., Grant, K. R., Lai, K.-Y., Rao, R., & Rosenblitt, D. A, *The Information Lens: An Intelligent System For Information Sharing And Coordination*, in *Technological Support for Work Group Collaboration*, M.H. Olson, Editor. 1989, Lawrence Erlbaum: Hillsdale NJ. p. 65-88.
14. O'Reilly, C., *Individuals and information overload in organizations: Is more necessarily better?* Academy of Management Journal, . 23: p. 684-696.
15. Ramduny, D., A. Dix, and T. Rodden. *Exploring the design space for notification servers*. in *Conference on Computer Supported Cooperative Work*. 1998. Seattle: ACM.
16. Segall, B., Arnold, D. *Elvin has left the building: A publish/subscribe notification service with quenching*. in *AUUG*. 1997. Brisbane.
17. Simon, H., *The Sciences of the Artificial*,. 1981, Cambridge, MA.: The MIT Press.

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