Effects of a Targeted Notification on Collaborative Work

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Abstract

Collaborative work has become increasingly more popular but issues still obstruct the potential benefits. Previous research presents evidence of poor or in some cases non-existent support for awareness. Awareness is the up to the moment understanding of others’ activity in a shared space (Gutwin and Hill, 2003). Research has established that systems supporting collaboration must create and maintain awareness of others intentions and actions. In the present study a notification system was investigated to provide a solution to this problem. An experiment prototyping the solution was conducted with a convenience sample of 20 undergraduates (both sexes) receiving either a non-targeted notification (only notifying participants that updates have been made) or a targeted notification (additional detail of where and what modification have been made). The participants had to search for information from a report, which was stored on a collaborative system. Changes were made to the report by the collaborator with a notification informing participants of the updates. Participants had to then re-collect the information. A Wiki was used to represent the collaborative system and MSN Messenger as the notification system, with the collaboration simulated. Participants gave feedback via questionnaires and post-experimental interviews. Participants using the targeted notification had a lower completion time and reduced number or errors with a higher perceived awareness of their collaborator. Thus, the targeted notification increased efficiency and supported awareness. It is concluded that further developments are required to increase the notification confidence. An example is that a correct notification will raise the participants’ trust as it will continue to accurately inform participants of the changes. In doing so will make locating information simpler. The finding provides guidance in the design of future notification systems and technologies that support collaboration in general.
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Chapter 1

Introduction

With the emergence of global economy comes the globalization of businesses whereby businesses are distributing their business functions to countries all over the globe, where ever is cheapest for the business to achieve cost effectiveness. The globalization of businesses creates a need for collaboration between the different business units across the globe. With technological advances of the Internet and networking, businesses are now able to communicate and collaborate remotely. Connecting offices around the world making it seem like one big office. These changes are moving traditional businesses to Digital Firms (Laudon and Laudon, 2002).

Digital firms now have the opportunity to allow businesses to move away from the arduous ways of communicating with suppliers by having to visit them and spending hours on the phone trying to collaborate with them. However for businesses to take advantage of the opportunities they must overcome problems that exist in collaboration.

Issues with some systems existing in industry include not informing users explicitly that a piece of work that they have been collaborating on had been modified. Users
have to look into the system and look at the document to see if it has been modified. If the changes are big this may not be a problem; however if the changes made are subtle it could be easily missed by others. Another issue in some systems in industry is that the project planning tool within the system lack useful functionality such as reminding users that deadlines to the project milestones are coming up, which are even more important whilst collaborating, so that it is possible to realistically allocate the correct amount of time for the milestones. The usability of these systems in industry are often overlooked by the designer as they think that because businesses are now moving towards Digital firms everyone will be highly computer proficient. The fact is that people have been in business for years and have adapted to use the new technologies but are expected to instantly be able to adapt and that is not the case.

Carroll et al. (2004) finds in their paper that such problems with collaboration is caused by a lack of clear overview of shared planning, and that collaborators are underestimating the tasks and so are changing their plans often. He also finds that there is no continuous communication causing collaborators not being fully aware of the current status of work.

The current issues existing in industry systems do reflect the problems with collaboration found by Carroll et al. Overcoming these issues would mean that businesses would be able to collaborate with their suppliers more effectively and would address some of the problems mentioned in their research.

1.1 Aim

Issues will be investigated through the literature survey to gain knowledge and understand where the problems of collaboration lie. From the research a prototype system will be used to tackle problems that exist in systems currently used by
industry. The project will propose a solution of using a notification system, which may help improve the efficiency of work by providing detailed information of what activities the collaborator has performed and where. With the notification offering regular updates it could help enhance the awareness between the collaborators. To determine whether such a notification system will achieve this goal an experiment will be conducted measuring performance and awareness factors.

1.2 Objective

The proposed objective of the project is as follows:

- To gain a thorough knowledge of what issues are causing barriers to collaboration.
- Investigate previous research to see what has been done and find any gaps where they failed to look into.
- From the research, recommend a possible solution that could assist collaboration.
- Prototype a system with the solution and conduct an experiment to decide whether the solution does support collaboration.
Chapter 2

Literature Survey

This project proposes the investigation into making collaborative systems more effective to improve co-operative work in distributed locations. Before discussing this, research into previous work would be useful to help identify the existing problems in the systems at present. The importance of collaborative systems cannot be denied. The globalisation of businesses creates a need for collaboration between the different business units across the globe. With technological advances of the Internet and networking, businesses are now able to communicate and collaborate remotely. These changes are moving traditional businesses to Digital Firms (Laudon and Laudon, 2002).

2.1. Collaboration

Collaboration helps individuals to achieve a common goal. It allows people working in a team to share resources and knowledge. This gives the team an advantage, having additional material from each individual. It also gives members in the team to acquire help or gain second opinions from the other members.
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To improve the benefits from collaboration, the concept was moved to using computers, introducing collaborative software. The introduction of computers to help with collaboration has been studied for many years. Grief and Cashman (1984) presented it as computer supported co-operation work (CSCW). CSCW is defined as combining the understanding of the way people work in groups with the enabling technologies of computer networking, and associated hardware, software, services and techniques. Initially the software involved were basic ranging from e-mail to Instant Messaging. As the Internet advanced and evolved to Web 2.0, the opportunity arose for more sophisticated collaborative software. These systems are used more widely by businesses to improve the effectiveness. For example teams can now organise their work better with project management tools that tracks progress and who is doing what task.

Especially now, a more useful collaborative system is required to satisfy the growing needs of the businesses so they can carry out their business processes effectively. For example, without computers, colleagues from different sites would have to rely on other mediums such as telephones to work collaboratively. Functionality provided by initial collaborative software such as e-mails helped, by allowing attachments of files, which colleagues are working on. These simple features had its limit of increased effectiveness because e-mails can be lost and too many versions would be sent around making it very confusing to know what the current version is. The new collaborative systems must address these issues to ensure successful collaborative work at different sites. For example, a simple system that allows documents to be stored centrally with modifications taking immediate effect would solve the versioning problem.
2.2. Existing collaborative systems

Collaborative systems have been developed for years supporting the collaboration of members within teams.

The following section shall discuss just some of the existing systems.

2.2.1 Microsoft NetMeeting

Microsoft NetMeeting as the name suggests was developed by Microsoft. It is an Internet-based conferencing tool. It offers an interactive space via its Whiteboard functionality. The Whiteboard allows users to draw on it and other users in the meeting with the Whiteboard activated can witness what is being drawn and can participate. Drawing can occur simultaneously (Wang, 2006). This is a useful feature as users could use this to brainstorm ideas, teaching and the concept of everyone having the opportunity to give their opinion on the space. This functionality however lacks structure so when it comes to more formal work the Whiteboard becomes ineffective.

Within Microsoft NetMeeting there are many other features, for example a file transfer function. This functionality is identical to all other file transfer features (Wang, 2006). What is absent from Microsoft NetMeeting is a notification feature for when a member of the team that have received the file and edited it. Such a feature would improve the awareness of the group. Without a notification the user would have to inform the other member(s) of the team where changes were made to the file either by e-mail or some other medium.

The screen sharing function allows users to share either a certain program or their entire desktop with other members in the team. Not only does it allow others to share
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their screens, users can grant control to people. The idea of screen sharing is good in terms of collaboration but it does not permit members of a team to work asynchronously which is needed sometimes for effective work. Asynchronous work should be supported because people have various working styles. For example some people are introverts, which suits synchronous work. However asynchronous work suits people who are more extroverts. Collaborative systems should be able to cater for these different types of work styles.

For initial users the interface is difficult to navigate around due to the lack of word description indicating the different functions. The interface only has icons to illustrate the various functions, which are not easy to guess what all the different icons do.

2.2.2. **Lotus Sametime**

Developed by IBM combining the basics of collaboration software such as e-mailing, file transfer and adding useful feature to it, Lotus Sametime is an Instant Messaging tool that also introduces web conferencing features. The instant messaging interface looks similar to other standard instant messaging application for example MSN Messenger. The interface is straightforward and simple to use (Schluting, 2007).

Features are very similar to Microsoft’s NetMeeting and so are the faults such as the lack of notification and no opportunity for asynchronous work.

Notably a useful function on the web conferencing side is the poll function. This lets the user vote either for or against a certain motion. Interface wise the conferencing aspect is very straightforward. It’s easy to join meetings with word descriptions of the different features available in the conference.
2.2.3. EMC eRoom

A web based collaboration tool. It allows users to create a room and can include members of the team within the room. Only these listed members can see the content inside the room. Within the room there is a wide range of features from creating a project plan to a dashboard.

The project plan function lets users set up different tasks that are required to be completed. These tasks can be delegated to the different members in the team. Deadlines can also be set up to make sure that the tasks are finished to ensure that the project is concluded on time. If a deadline is not met, an e-mail will be automatically generated and sent to the individual informing them that the task is overdue. This feature is very useful; as it makes sure that the members of the team are aware of the situation of the project.

Files can be uploaded into the room and can be downloaded by other members. Another option for the users is that they can edit the file online and any changes made will again generate an e-mail to the other members of the room notifying them the file in question has been modified. This again helps keep up the group awareness and helps concurrency control. The downside to this is that the notification will only tell users which file has been modified. This would not be a problem if it was a small document but if it is a larger document it could be time consuming. Users would have to read through the document to find where the modifications are unless other users are courteous enough leave a note where editing have taken place. It cannot be certain every user would do this. What makes this feature stand out is that it can set different security levels for the files. The administrator of the room can allow certain members to view a file where others cannot. This is particularly useful for when you have confidential information that only people who need to see it can see it, giving users control over the transparency of the room.
The interface of eRoom is similar to Windows. Folders similar to Windows are used so users can build a hierarchy for their documents so they can be found easily. Big clear icons with word descriptions are used to describe the varied functionalities of the eRoom.

Having such a rich array of features could hinder the usability for the users (Swartz, 2004). Users may not know which function would suit their needs best therefore not making the most out of the functions they should be using. One of the functions missing is the screen sharing that is available in the other two systems above. This means there is no synchronous work. Synchronous collaboration such as the whiteboard for free drawing and annotating allows for more creativity within teams (Kramer and Wegner, 1999). Also eRooms suffers similar issues as the other systems whereby, they need to provide support for different working styles of people to create a successful system.

2.2.4. Wikis

A web based collaborative tool that allows users to store work in a central location. The defining characteristic of Wiki technology is the ease with which pages can be created and updated (Anon, 2008). Typical functionalities of Wikis are creating links to other pages and being able to search for information within the Wiki (Shanks, 2006).

Wikis have recently taken off in businesses. One of the reasons for this is because they are simple to use, so the less computer literate people can negotiate it. Most Wikis are open-source, which means that they are free for businesses to implement. When it comes to work, the content can be updated immediately due to it being a web based tool. There is no need to distribute the work as it is stored in one central location and others will know where to find the work (Goodnoe, 2005). Wikis
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supports the usual file types used in businesses such as spreadsheets, Word documents and PDF files. Users can leave comments on any page or with uploaded files to let others know of their opinions or any other important information. This feature is very useful as it acts as a medium to gain feedback and to initiate discussions amongst the users. There is no need for an administrator because structuring is flexible and is maintained by the users themselves so they feel more familiar with the system. The downside to such flexibility is that it needs to be maintained regularly so content does not become hard to find and as a result harder to work with. A moderator could be elected to maintain content but this would void the idea of not having an administrator. Moderators would not be needed if users took responsibility in keeping content tidy and inserting their work in the correct areas.

Usually contents placed in Wikis are accessible by all members of the Wiki but for special situations, users may only want certain people to have write access and others to have read-only access. This is useful to avoid people who should not be editing the content to be allowed to but still lets them view the document. Wikis have built-in version control which creates a record of what have been changed from previous versions. The version control feature even allows users to revert back to previous versions if necessary. A reason for this happening could be if a user deleted information they should not have and could not get undo what they have done. This is useful because it acts like a backup that automatically occurs when the content is updated ensuring content is difficult to lose.

A problem with Wikis is that it requires a critical mass of users before its benefits can be fully achieved. The study by Grudin (1994) iterates that groupware such as Wikis are designed to support co-operative and collaboration amongst groups rather than improve the productivity of individuals. Initially it could be hard for people to
suddenly start working with Wikis so incentives could be used to help promote the use of Wikis.

### 2.3. What has been done?

The next step in my research was to examine what previous work has been conducted to solve these problems hindering the advancement of collaborative software.

“Group awareness is a crucial part of successful collaboration” (Gutwin and Hill, 2003).

Group awareness is the up to the moment understanding of others’ activities in a shared space (Gutwin and Hill, 2003). Gutwin and Hill (2003) developed the MAUI (Multi-user Awareness User Interface) toolkit providing excellent features that will help with synchronous work. This helps to enhance group awareness. They try to tackle the problems in collaborative systems by supporting awareness in a shared workspace to increase usability. They bring forth the idea of face to face collaboration being the best form due to the heavy interaction occurring with one and another. Therefore they concentrated on how to incorporate some of that interaction into their system. Their main focus was on the persons understanding of others by observing their actions on objects. This mechanism was called feedthrough.

They stated, “Information given off by objects is valuable feedback to the person performing the action”. In groupware this kind of feedback (feedthrough) has to be explicitly gathered, transmitted and redisplayed, which differs from face to face situation where manipulated objects naturally produce this information (Gutwin and Hill, 2003).
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A concept throughout MAUI used to support feedthrough that really stands out is the different colour highlighting made by each individual, indicating clearly what they are doing. The highlighting is a form of notifying others what events are happening. This is helpful as you may possibly gain some insight in what the others are trying to accomplish and give visualisation of work conducted. This could aid the efficiency of work.

The limitation to the MAUI design is that the collaborative text work, which they called GTextFields in the paper, displays only single line text box. Therefore would not be useful to teams working on large documents. Working on large documents line by line would be very time consuming and not viable. The idea is there however, it needs further develop to become a more useful feature.

There is no aspect in the design for people who are working asynchronously. A successful collaborative system should allow for both. There is too much emphasis on the heavy use of visualisation. This would actually hamper users as their focus shifts to all the visuals rather than trying to get on with the task. Too much information displayed on the users screen demands more attention from the users. There needs to be a threshold to how much information is displayed to users that will not distract them from their own work.

Gutwin and Greenberg (1995) developed groupware toolkit that supports group awareness. The difference between this toolkit and the MAUI is that the users can see the view of what the other members are doing as well as their own view. What makes this toolkit valuable is that unlike many other applications that allow screen sharing for example Microsoft NetMeeting, the remote view of other group members is always centred on the cursor. The background in the remote view is panned instead of the traditional method of following the cursor movement. This means that
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users can concentrate on what the other user is doing because tasks performed is always the focus of the remote view. This greatly helps support synchronous work and graphical projects.

The toolkit also allows users the opportunity to trace where the other user have been and see where they have stopped through a history mechanism. With this the user can look back at what the other user viewed and have more awareness of what others are doing.

The problem with the toolkit is that it is too bespoke for graphical work. These features would be far too complex for shared document writing and the same problem again as the MAUI with over use of visuals. For shared document writing a simple highlight of where the changes are and what have changed is sufficient. The toolkit would also be less useful for general knowledge sharing.

Carrying on with the idea of too much visualisation being a factor for decreased usability. The study by Dabbish and Kraut (2004) suggests that it is true but with a more controlled visualisation it could be very helpful for collaboration. This involved a member of a team wanting to ask (asker) another member a question (helper) but by asking them a question it would prove an interruption to the member being asked. The discussion of displaying how much work the member being asked the question is researched. They come up with a hypothesis stating, “Both too much or too little detail will harm joint performance” (Dabbish and Kraut, 2004).

If there was too little information being shown, the asker will not have sufficient knowledge to know how busy the other member is. Therefore, unless being told by the helper explicitly the asker will continue to ask questions whenever they want and hence interrupting the work performance of the helper. On the other hand if there is
too much information displayed to the asker about workload and other displays of
the helper it could disrupt the asker who is trying to pinpoint the correct time to ask
for help. It is said in the research that in this kind of situation a high information
display requires substantial visual attention and is more cognitively demanding
(Dabbish and Kraut, 2004).

To be sure that such a notification function is useful there has to be balance between
too much and too little information displayed to members of the team. There has to
be a trade-off between useful information and distracting information. However, too
much or too little information is bad for collaboration could be argued depending on
the situation. For example, if a team was collaboratively working and the need for
detailed information is critical then more information is essential.

Missing from the research is: if the affects would still be the same if there were more
than one asker and one helper. Typically in a team there are more than just two
members, therefore more than one asker and helper. It would be interesting to see
whether having the right balance of useful information and distracting information
would differ. People work differently so distracting information for one person may
not be for another. If a team consists of two helpers with one not finding the
information distracting but the other does, then they could compensate for each
other. The team member who did not find the information distracting could answer
the question. As the question is now answered there will not be any more distractions
for the other helper. This makes it incredibly difficult to strike that fine balance of
information.

Up to now only group awareness has been discussed but another important concept is
activity awareness. “Involves awareness of synchronous and asynchronous
interactions over extended time periods” (Carroll et al., 2004).
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This was a study from Caroll et al. (2004) researching peoples’ ability to see what is happening and who is doing what whilst collaborating on long term projects. Controlled experiments were conducted to determine what aspects in awareness breakdown. A breakdown is a problem in the system use that interrupts a persons activity, making them conscious of the system and therefore they are less able on the activity (Winograd and Flores, 1987). The experiment tested both synchronous and asynchronous collaboration.

Results show that the majority of the participants did not notice changes introduced by different scenarios such as tool change – completing a task on a different tool that was previously agreed upon. These changes were too small for the other participant to notice. Many participants were not aware that the content had changed. With no form of feedback it would be highly difficult to discover that content within the task had changed. The bigger changes were noticed by the participants such as role change within the team. These results were further broken down to understand why they happened. One factor that stands out and is the highest cause for breakdown is lack of communication between the participants. This is supported by the work of Herbsleb and Grinter (1999), which shows that communication and implicit information available to a team in the same place does not exist in distributed teams.

The findings indicate that for successful collaboration to occur there must be continuous communication throughout. Other members of the team must be informed about changes to content so that any additional work added by other members will flow correctly. It also makes sure that other members of the team know what version to work on, as it will be communicated which is the most up to date version. Before collaboration commences there should be a discussion between members to plan a clear and precise overview and plan to achieve common ground.
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This is where mutual knowledge, beliefs and assumptions exists and help in achieve a more effective team (Carroll et al., 2008). With long-term projects it could be easy to forget deadlines originally set. Notifications should be sent when a certain task is nearing the deadline instead of going over the completion date. This would insure that the project stays on time. These are the activity awareness issues that must be addressed when designing an effective collaborative system.

The experiment was only held for one week. When a project is deemed long-term it would usually last for months not just for a week. With the lack of communication and implicit information (Herbsleb and Grinter, 1999) in distributed teams many new challenges to collaboration could arise over this time. For example when would participants notices that content etc, has changed or if they will ever notice. With all these errors occurring, how long a delay would it cause to the project?

Studies by Sun et al. (1998) suggest that co-operative editing systems are very useful groupware tools. These tools help dispersed teams to carry out work and to encourage creativity amongst the groups in the form of brainstorms and meetings. Sun et al discusses about some of the characteristics that the co-operative editing systems should have. One of these characteristics is called unconstrained whereby multiple users can concurrently and freely edit any part of the document at any time.

This characteristic will help improve creativity with all the members inputting their ideas into the document but will also prove a challenge when it comes to activity awareness. It will be very difficult to keep up with the many changes to the different parts of the document that has been made by the group.

Workspace awareness must be improved to help further improve collaborative systems. Gutwin et al. (1996a) describes workspace awareness as the up-to-the
minute knowledge a person holds about another’s interaction with the workspace. Such knowledge includes who is in the workspace, where and what they are working on and what they intend to do next. Gutwin et al. suggests that by improving workspace awareness efforts to co-ordinate resources and tasks is reduced and allows anticipations of others’ actions. Gutwin et al. (1996b) indicates that supporting workspace awareness can be difficult because participants are able to work in different parts of the workspace even when screen sharing. When this occurs people cannot directly see what they are doing and may lose track of where they are in the space.

Awareness widgets have been created to enhance the workspace awareness between group members. An experiment was conducted by Gutwin et al. (1996a) which involved participants working with a partner in a distributed location and their task was to re-place a newspaper article that was cut and scrambled up. Participants used a groupware that was augmented with different widgets supporting workspace awareness. From the results there were two widgets that participants commented on their usefulness. They were the miniature view and the radar view. The miniature view was an overview of the entire workspace of the partner that is reduced in area and sat at the top left of the users screen. The radar view also uses a miniature view but consists of extra information such as what the other person can see known as their viewport, which is represented as a shaded rectangle. Participants commented on how it felt as though they were working on the same table.

Missing from this study was the effects of these widgets in an asynchronous situation. Maybe in that situation other widgets could be perceived as being more useful than the miniature and radar view.
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With the knowledge of which widgets provide the most support for workspace awareness Gutwin and Greenberg (1998) wanted to determine whether the miniature view or the radar view provides the most awareness. To do this another experiment was done measuring the groups’ performance with each interface, their collaboration efficiency and the satisfaction with the system. The miniature view again only consisted of the overview whereas the radar view had others’ viewports, location and motion of others’ cursors and motion of workspace objects as they are moved. Participants completed the experiment in pairs with three tasks to finish. The tasks were designed to replicate activities that would occur in face to face collaboration. Task one required people to move around the workspace independently, task two used local and activity information and the last task emulated activities that would happen in a wide variety of workspaces (Gutwin and Greenberg, 1998).

Results from the experiment showed that for two of the tasks the radar view did indeed increase efficiency and tasks were completed more quickly. Participants were also asked which of the two views they preferred and the majority answered with the radar view.

Gutwin and Greenberg (1996c) also looked into other factors that would affect workspace awareness and developed a framework for workspace awareness. The framework considers elements that make up people’s workspace awareness and also the mechanisms people would use to gather awareness information. The framework could be a tool to help designers come up with their awareness requirements. To do this the framework could be used to analyse how awareness is achieved in face to face collaboration and then translated into a way computers can support. A set of information gathering mechanisms to maintain workspace awareness were also established. They were: -
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- Direct communication – communication through gesture or speech (Tang, 1991).
- Indirect productions – expressions or actions that are not explicitly directed at others but are intentionally public (Segal, 1994).
- Consequential communication – visible or audible sings of interaction with a workspace.
- Feedthrough (Gutwin and Hill, 2003).
- Environmental feedback – feedback from the environment or overall workspace caused by the indirect effects of someone’s actions.

With the framework and other the findings by Gutwin and Hill, it should help influence the future designs for shared workspace applications.

A groupware was developed by Roseman and Greenberg, which has very similar functionalities as the eRoom collaboration software mentioned in section 1.2 called TeamRooms. Users created rooms in which they would work in and every room had Instant Messaging and shared whiteboard tools. TeamRooms added additional features to improve awareness. Using the radar view widget from the work of Gutwin and Hill (1998), Roseman et al. (1996) implemented a room overview radar. The room overview radar shows the position of each user’s viewpoint and the location of their mouse cursors. As users moved around the room the view would track their movements.

A particular useful function is the postit applet would work as real life postits (Roseman et al., 1996) do. They have messages written on them to act as reminders or to allow users to give feedback on the content in the room. These postits are left in rooms and other people can make changes to them. These changes occur immediately. The postits could be used as a notification, letting other people know
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what changes have been made to the contents in the room. The only problem with the postits is that people have to physically be in the room to view them. If changes are made in the room and a user leaves a postit to inform others of the modifications then they would not know until they enter the room. This notification has a small visual range of notifying users what their collaborators are doing.

From the research of Lou et al. (2000) any new groupware must have the perception from users that it will benefit them. This is because if there is a perception that the groupware is useful by a few people their peers may be led to believe that it is useful and not difficult to use. Therefore all groupware must be able to capture the initial audience so that other people also start using it. With all groupware, a larger user base the more beneficial it will become with additional contributions made by users.

2.4. Case study

During the authors’ year out on placement working in the Commercial Division, there were issues encountered with collaborative systems. The role of Commercial Division was to procure raw material and other services, which meant dealing with supplier. This also meant having to deal with their systems. It was a global business making huge profits but was still exchanging information inefficiently. The author was part of a team called Effectiveness Team, which role was to make the Commercial Division more effective by looking into new technology available. The ability to be able to collaborate with the suppliers was greatly sought after.

Currently documents were e-mailed to and fro from supplier to the people in the Commercial Division. This was not ideal as e-mails could easily be lost during the mass e-mailing between them. It was difficult to keep track of the latest version of the document. What the people in the Commercial Division wanted was to be able to
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upload a document so that suppliers could work in a shared place and notifying whomever necessary when complete.

At the business Microsoft NetMeeting was already deployed but due to security issues it could only be used internally. Other options were looked into. The IT Division suggested a system called Breeze Meeting to the team. After testing the system it was found that it was solely for meeting as it allowed shared presentation, recording of meeting and screen sharing. All was good but it did not fit the purpose. Finally eRoom was looked into and it had the capabilities needed by the Commercial Division. The author was asked to test the system checking feasibility. The system did what was needed of it, however it had one shortcoming. The notification on the system worked but it did not tell users what parts of the document were modified. This cost time for people to have to read through the document to find the modifications and they were left feeling frustrated. This was an ineffective notification function. Another negative was the usability of eRoom was very poor; some features on it were not obvious to use. The Commercial Division were not highly computer literate as expected from the business side of the company. Due to these factors eRoom was not chosen. There were no other candidates found before the author had finished the years’ placement.

2.5. Possible solution

The case study shows how even searching through the different collaborative systems available still none were found to satisfy the needs of the business. Other businesses must be facing similar problems, as the requirements seen in the case study section are common ones. This suggests that there is a demand for an effective collaborative system. Especially now as technology is advancing giving more chance of opportunity for cost reduction and time saving.
Effects of a Targeted Notification on Collaborative Work

Referring back to the case study it appears the eRoom meets most requirements but still didn’t achieve the demands of the business. What it was lacking was an intuitive interface and effective activity awareness. Grudin (1988) suggests a factor that leads to failures in CSCW applications is that it requires people to do additional work, while those people are not the ones who perceive a direct benefit from the application. An example of this could be that when a co-author edits a document without informing other co-authors what they have done, will result in additional work for other members.

A lot of collaborative systems work hard on providing a good range or functionality but overlook in designing a simple, clear and user-friendly interface. In reality most users in businesses will not use all the available functions instead they would focus in on the few functions that will help them carry out their jobs efficiently. Therefore eliminating time spent on developing a complex system but devoting more time in building a system that will suit the demands for such businesses.

Looking back at the previous work to achieve an intuitive interface would involve making clear names and descriptions for each functionality. Storage of files should be something users are used to for example the folder hierarchy similar to Windows operating system. Finally there needs to be a drastic improvement on the awareness within the collaborative system. To achieve this communication between the members must improve and be continuous (Carroll et al., 2004). The planning of the overview and the process can be determined beforehand. The collaborative system could possibly allow them to upload their project plan into a function on the system, thus achieving good grounds upon starting the project.

Gutwin and Greenberg (1995) discuss in their work to manage shared tasks in a group, each of the members must know what the other members of that group are
doing with respect to the group activity. They suggest that the more detail known of what the members are doing within the group the better. It is known that face to face meetings are best for group work because members can gather information by seeing and hearing what people are doing (Gutwin and Hill, 2003). This information is not available in groupware, therefore detailed information on members activities are needed. Along with this detailed feedback there must be continual communication of this information to help improve group awareness.

Many researchers have discussed the importance of awareness but the study from Prinz (1999) attempts to explore two specific types of awareness. Prinz classifies them as social awareness and task-oriented awareness. Social awareness is information about a member’s presence and their tasks in a shared environment. Task-oriented awareness is the activity to be performed to achieve a shared task. Prinz describes in his work that both social and task-oriented awareness can be achieved by notifications. The notifications report about past actions. Prinz developed an awareness environment called NESSIE to help support social and task-oriented awareness. What is different with NESSIE’s notifications are that they also show the current presence of co-authors. This is a very good feature as it improves upon the social awareness within shared work.

With NESSIE when a new event has occurred, the new event will be transmitted to the NESSIE awareness server, which task is propagation and notification of events. The innovative feature of NESSIE is that it incorporates real world indicators to enhance awareness. This is different to the traditional way of indicating awareness in the form of a window or pop up. An example of real world indicator is a balloon blown up and a fan is activated blowing the balloon around in a circular motion. These are both connected to the NESSIE client via an interface card. The balloon moving is used to promote a sense of virtual presence.
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The problem the real world indicator is that though the balloon does not make any noise it can still become a nuisance after a while with the balloon moving around. It does have its advantage over the usual pop up or window as it can be easily seen. Despite what Prinz claims a balloon is a distraction as it can easily take the users attention off their work with the constant movement. The notification could be further improved to help awareness by introducing highlights where changes have been made so that the co-authors do not have to search through the document to find changes if they are not obvious.

Within distributed groups there must be a continual channel of communication. This perhaps would be accomplished by implementing a successful notification feature.

2.5.1. Importance of notification

Most activity awareness breakdowns are due to communication problems (Carroll et al., 2004) as discussed in section 1.3. These problems lead to members of teams being unaware that contents of shared work have been modified. By implementing event notification this would improve the visibility in collaborative systems when usually data changes are invisible to other users (Liu et al., 2001).

Notification function in a system should generate an automatic e-mail to any listed user tagged to the document. The users would then know that the document has been updated from the notifications and so gaining awareness of what activities has taken place within the shared work. Many previous systems have implemented the notification function but it never seems to provide enough or the correct information to users. A typical notification to users would be telling them which document has been updated when and by whom. The information is formative but still means that the user would not know what part of the document has been modified unless track
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changes or comments are left in the file. Another method could be that the users who have just updated the work sends another e-mail telling the other users what changes has been made. The problem here is that more work is needed from the user and more reading is also required. This additional work gives the opportunity for errors to take place.

Notifications can also be used to support concurrency control and therefore maintaining the consistency of the contents (Shen and Sun, 2002).

Carroll et al. (2003) researched into different ways notifications can be represented. Carroll et al. worked closely with a school developing a system called the Virtual School which showed the presence of collaborators, actions and contributions to collaborative activities. These were provided by tools such as the roster pane which indicates the current presence of people, location and their activity within the system. The notice board gives a permanent notification log of significant user actions, for example creating and editing pages. The auditory cues notify users when other people leave or join the session.

The class were asked to participate in a serious of projects using the Virtual School development. Some breakdowns were observed from insufficient situation awareness. This is where participates are unaware of changes to the situation in which they are completing the task in. For example some of the deadlines were changed but nowhere in the Virtual School tool did it indicate to participants this had occurred. To overcome this problem a ticker was implemented at the top of the screen. A ticker is an animated information line that cycle through new items such as deadline alterations (Carroll et al., 2003). Having a ticker continuously scrolling across the screen could be very distracting, despite Carroll’s claims that it being not
intrusive. It could easily distract a user’s attention who could be watching the ticker to see if any new items have appeared.

As time progressed the developments to the notifications got more advanced. Carroll et al. saw that because notifications were not integrated with the participants work, they were not observed enough. This is because it required extra work to switch between the tool participants were working on and the notice board tool. Notifications were later integrated significant events with access controls of work activity. This way when users work on the project they will get notified whether a collaborator is available or if any contents has changed.

It could be argued that a well implemented notification could support workspace awareness. The advantage of a notification providing workspace awareness is that it will not rely on heavy uses of visualisation (Gutwin et al., 1996a). A notification with sufficient details could indicate to other members what they have done and give the impression of where they have been in the workspace.

A very important factor is that if a system appears to be unreliable then the notifications will also be perceived that way also. It is empirical that systems gains the users trust immediately otherwise they will not trust the notifications received from the system (Tiernan et al., 2001). With the lack of trust from the users they would simply ignore the notifications or if possible they would disable the feature on the system.

An experiment conducted by Maltz and Meyer (1999), which involved a demanding visual task where potentially beneficial cues were provided. The cues had different validities ranging from invalid cues to highly valid cues. When the experiment was into the second block of tasks only the participants who received the highly valid
cues continued to use the notifications. It was concluded that when designing a notification system, ensuring it is reliable and provides high quality cues is of upmost importance. Once a user perceives the system to be unreliable it will be very hard to persuade them back into using the system (Maltz and Meyer, 1999).

2.6. Proposed development

This project will look at the possibilities of prototyping a collaborative system that implements a useful notification feature that will help increase users awareness. Therefore overcoming the problems of ineffective collaboration.

This system would adopt a notification strategy that infrequently informs users of changes made to the shared work (Shen and Sun, 2002). This strategy is ideal for supporting asynchronous collaborative work. The proposed system should be on a web-based platform as the updates on the web would be noticed by all the users and will not require repeated distribution (Liu et al., 2001).

To distinguish how much of an improvement an enhanced notification function is to collaborative working there could be measures of how many errors and how long it takes to complete a task when using a standard notification function and the proposed one. The experimental hypothesis leads to the directional prediction that the enhanced notification will reduce errors, the time taken to complete the task, locating information and task easier, improve awareness, increase notification usefulness and confidence.
Chapter 3

Design of experiments

3.1. Design

The experiment had a repeated measure design. The independent variable was the notification being received by the users, with two levels (notification with non-targeted information and notification with targeted information). The dependent variables were time taken to complete the set tasks and the numbers of errors the participant made. The number of errors variable was recorded by counting the amount of errors in the final answers. Time taken was simply recorded by a stopwatch. Other dependent variables were ease of task, notification usefulness, awareness of collaborator and notification confidence. For these variables a Likert scale was used.

The participant was given a business scenario where they assumed the role of an employee working within the business. Participants had to read a passage of text (See Appendix A Quarterly Financial Reports) and then answer questions related to what they had read. The participants were recorded and told to carry out the think aloud protocol to understand their cognitive strategies.
Participants carried out the experiment individually. The experiment was conducted in a computer lab with just the participants and the experimenter to avoid any distractions of people talking or the participant seeing someone they knew. The participants sat facing the monitor where the tools they would need to complete the tasks were. The counterbalancing technique was employed to ensure that each condition occurred an equal number of times. Half of the participants completed the first task with the non-targeted notification condition (condition N) and then moving onto the next task using the targeted notification condition (condition T). The other half of the participants used condition T for the first task and condition N for the second. This was done to eliminate order effects. The experimenter decided to alternate between using the condition N first for task one and condition T first for task one. The order changed with every participant, for example participant one will use condition N first for task one then condition T for task two. Participant two then used condition T first for task one and condition N for task two. Both the notifications were pre-written and always used the same text. For condition T, there were two variants of the notification depending on the task (See Appendix B for Notifications).

3.2. Pilot test

A pilot test was completed before the real experiment was conducted. This was done to ensure that the task was not too difficult or too easy to avoid floor and ceiling effects. The pilot test offered the opportunity to get the instructions from the experimenter clear and correct. One participant was used for the pilot test. After receiving the instructions the participant carried out the pilot test.

At the end of the pilot test feedback was gathered from the participant. There were comments on the targeted notification condition, describing it as having too much to read. It required the participant to scroll down in the window where the notification
was displayed. The issue of people not noticing that there was more information if they did not scrolled down in the window was also raised.

From the feedback changes were made to the experiment. The way the notification displayed the additional information was adjusted so that it was shorter and concise. Participants could now see what had changed and what it was modified from and to. Extra emphasis was made to certain parts of the instructions as the participant felt that some parts of the task were unclear. An example was “All the prices and savings can be found in the report” to “All the prices and savings can be found in the report. When it refers to ‘this’ in the report it means quarter one”. This was said for the first task whereby the financial report was for quarter one. For quarter two, the experimenter said “All the prices and savings can be found in the report. When it refers to ‘this’ in the report it means quarter two”.

The pilot test allowed the experimenter to learn certain processes to be done so the participant would not get confused. An example is to close tools that were not needed anymore so that participants would not accidently open them.

3.3. Participants

There were 20 participants overall, who took part in both conditions. The age range of the participants were from 19 to 25, with a mean age of 21.7 years (SD = 1.2). All the participants were undergraduates with two exceptions, both being graduates at the University of Bath. There were 13 males and 7 females who took part in the experiment, with the majority of participants on science degrees, some studying Computer Science. Participants were a convenience sample recruited personally by the experimenter from the University. All of them were acquaintances of the
experimenter. There were rewards for the participants taking part in the experiments in the form of chocolate.

3.4. Apparatus and materials

Two PCs (RM One) were used to present the tools and information that were required to complete the task. The tools used were Microsoft Word, Excel, Confluence the University Wiki and MSN Messenger. A digital camera (Casio EXILIM Card EX-S770 Silver) was used to record participants’ voices. A mobile phone (Sony Ericsson K800i) with a stopwatch feature was used to record how long the participants took to complete each task. A questionnaire with a seven point Likert Scale type was used, with one being the best and seven being the worst (See Appendix C for Questionnaires). The questionnaire was filled in using a pen after each task.

3.5. Procedure

The participants were asked to read through the consent form (See Appendix D for the Inform Consent) and write their name, e-mail, the date and sign it. The written instructions were given to the participants in paper form (See Appendix E for Written Instructions). The instructions were read through with the participants. Special attention was made to the savings section of the task. In the pilot test, it was indicated that this part of the instructions was not clear enough. The instructions were “This is where you enter the savings”, which has now been changed to “This is where you enter your savings but savings is not always applicable, if it is you will be able to find it explicitly in the report”. This made it clear to the participants that the information needed is not always available. Another change of instructions was from “You will receive a notification, if there are any changes made to the financial report” to “You will receive a notification, if there are any changes made to the
financial report. This notification is automatically generated and sent by the system and not by the collaborator”. This made it clear to the participant where the notification was coming from so they had a better understanding of how the system worked. During the pilot test it was also commented that it would be easy to just ignore the MSN Messenger pop-up. This made the experimenter provide additional emphasis that notification will be received by MSN Messenger and make sure the participants did not ignore it or to close it down before reading it.

The experimenter also described the equipment and demonstrated how to use it. The written instructions outlined the experimental procedure. Participants were told their voices would be recorded and to use the think aloud protocol and that they will be timed. When the participant had finished reading the instructions and listened to how to operate the equipment, the participants were invited to ask question to help clarify anything (See Appendix F for Spoken Instructions).

When the participant felt confident in using the equipment and fully understood the instructions, the experiment session began. At the beginning of each task the camera was started to record the participants’ voice and the stopwatch began. For task one, participants read “Quarter one financial report”. The financial report was on Confluence so the experimenter could modify the report and replicate the changes instantly. Using the think aloud protocol the participant let the experimenter know what they were thinking. The experimenter would also observe the strategies adopted by the participants whilst carrying out the tasks. The participants were asked to put their answers into an Excel file that was created by the experimenter. The Excel file would compute the calculations, which was required in the task. In doing this, it would remove the factor that some participants may not be as good as maths as other participants. An example of this is that a participant who does a sociology degree may take longer to calculate a sum than a participant who does maths. This would
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effect the time taken and could also induce errors. With the Excel file the participants simply had to enter the figures, which could be found in the financial reports. Participants from whatever degree would not be at a disadvantage.

Sometimes when the participants were not thinking aloud, the experimenter would use cues to prompt some responses from participants. An example of this was:

Experimenter: So what are you doing now?
Participant: I am looking for savings in Sugar now.

Any interesting points were recorded by the camera and also written down by the experimenter from the observation. As the participants arrive near the end of the first task, the experimenter would remotely send a pre-written notification on MSN Messenger. The notification condition used depended on what cycle was being used for that specific participant. Both notification conditions required the user to refresh the financial report so that the changes made by the experimenter on the financial report would be replicated on the participants’ financial report. Once the notification has been sent to the participant, the experimenter would continue to observe how the participants would react. Interesting observations would again be noted. The stopwatch was stopped along with the camera with the time recorded, once the participant was happy that they had finished the task. The Excel file was then saved in a folder corresponding to the participants.

The experimenter then asked the participant to fill out the questionnaire. There were two questionnaires with five identical questions and space to leave any other comments, one for condition N and one for condition T. To distinguish between the two questionnaires, the experimenter had “Task 1” for condition N and “Task 2” for condition T on the questionnaires. This was explained to the participants so they
would not get confused. Whilst the participants answered the questionnaire, the experimenter used the time to close the used Excel file and open the new financial report required for the next task on Confluence. A new Excel file that had the same features as the previous was opened. Changes were made to the original “Quarter two financial report” using the experimenters’ computer on Confluence. The next notification was written during this period of time. The process was also done for the first task before the participant arrived. When the participant was ready to continue the next task, the experimenter would start the stopwatch and the camera once again. The experimenter continued to observe the participant recording any interested points. When the participant was nearing the finish, the experiment sends the notification from their own computer via MSN Messenger. The participant would react to the notification and this would be recorded by the experimenter. Once the participant thinks they have finished the stopwatch would be stopped with the time recorded and the camera switched off. The Excel file was saved in a folder created for the participants. The participants were again asked to complete a questionnaire about the task.

After the experiment ended a brief post-experimental interview was conducted. This was to gather feedback on the positives and negatives of both notification conditions. Participants were encouraged to leave any other comments. Once the interviews finished and the participants had no more questions, they were debriefed and given their chocolate reward.
Chapter 4

Experimental results

From the experiment, a set of descriptive statistics was obtained. Table 1 shows all the dependent variables recorded from the experiment.

For all the variables a K-S test was used to determine whether the data were normally distributed or not. If the variable is found to be normally distributed a t-test was employed to see if the data was significantly different. A Wilcoxon ranked sign test would be used if the data was found to be non-normally distributed.
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Table 1  The mean and standard deviation of all the dependent variables for both conditions measured in the experiment.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Condition N</th>
<th></th>
<th>Condition T</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to complete task (seconds)</td>
<td>483.90</td>
<td>111.25</td>
<td>363.65</td>
<td>103.39</td>
</tr>
<tr>
<td>Number of errors</td>
<td>0.95</td>
<td>1.00</td>
<td>0.45</td>
<td>0.60</td>
</tr>
<tr>
<td>How easy did you find the task? (Ease of task)</td>
<td>3.40</td>
<td>1.43</td>
<td>3.15</td>
<td>1.23</td>
</tr>
<tr>
<td>How easy was it to locate the information you needed for the task? (Ease to locate information)</td>
<td>3.45</td>
<td>1.32</td>
<td>3.30</td>
<td>1.30</td>
</tr>
<tr>
<td>How useful did you find the notification about changes to the document? (Notification usefulness)</td>
<td>4.30</td>
<td>1.78</td>
<td>3.15</td>
<td>2.03</td>
</tr>
<tr>
<td>Based on the notification how aware were you of what your collaborator in Commercial was working on? (Awareness of collaborator)</td>
<td>5.20</td>
<td>1.61</td>
<td>4.05</td>
<td>1.93</td>
</tr>
<tr>
<td>When you were sent the notification of changes in the document how confident were you that it detected all the changes? (Notification confidence)</td>
<td>4.10</td>
<td>2.15</td>
<td>3.30</td>
<td>1.69</td>
</tr>
</tbody>
</table>

From the descriptive statistics it can be seen that the mean time taken to complete the tasks between the two conditions are relatively different. The variable error was the amount of mistakes made that the participants did not know they had done when submitting their final answers. Looking at this variable it does not seem to have any significant difference between the two conditions. However Figure 1 shows that there is a difference.
Figure 1 indicates a difference between the means of the two conditions. The 95% confidence interval of condition B is considerably narrower than that of condition A. However the range of errors was still quite large.

To find out whether there was a significant difference between these variables further tests were deployed on them. Time taken variable K-S (p>0.05), which meant that the data was normally distributed. The number of errors variable K-S (p<0.05) meant that the data was non-normally distributed.

A t-test was used on the time taken variable and revealed that there was a significant difference between conditions (t(19)=4.45, p<0.01, 1-tailed) significant. The Wilcoxon ranked sign test was used to test the number of errors variable and showed
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there was a significant difference between conditions ($Z=-2.35$, $P<0.05$, 1-tailed) significant. Both tests show consistency with the experimental hypothesis.

Another interesting difference found was participants’ perceived awareness of what the collaborator was working on. This was seen in the awareness of collaborator variable recorded with the seven point Likert scale, in Table 1. Inspection of Figure 2 suggests that participants felt that during condition N their perceived awareness was less compared to condition T. The 95% confidence interval of condition T is relatively narrower than that of condition N. This is consistent with the experimental hypothesis. However, further analysis is required to confirm this statistically.

The K-S test shows that this variable was also normally distributed ($p>0.05$). A t-test indicated that condition T significantly helped improve participants’ perceived awareness of what the collaborator was doing, ($t(19)=1.91$, $p<0.05$, 1-tailed).

Looking at the descriptive statistics for notification usefulness in Table 1, it can be seen that there is a difference between the means (difference = 1.15). Further analysis was used to confirm where or not there was a significant difference. The K-S of the variable ($p>0.05$) showed it was normally distributed. The t-test showed ($t(19)=1.26$, $p>0.05$, 1-tailed) which implies the perceived notification usefulness in both condition were the same.

The variable ease of task in Table 1 did not show a clear distinction as the statistics from both conditions were very similar. Figure 2 shows a small difference between the two conditions. The 95% confidence interval of condition T is slightly narrower than that of condition N and just a little lower. Analysis was used to discover whether or not there was a significant difference.
The variable was not normally distributed with a K-S (p<0.05), therefore a Wilcoxon ranked sign test was used. The test revealed that there was no significant difference on whether or not participants perceived the task to be easier in condition T (Z=-0.82, P>0.05, 1-tailed).

The descriptive statistics in Table 1 shows a minute variation between the conditions for the variable ease of locating information with the difference in means being just 0.15. After studying Figure 2, still no difference could be seen. The only notable distinction is that the 95% confidence interval is comparatively narrower in condition T. To help provide evidence that the variable is significantly difference additional analysis was needed.

The K-S of the variable (p<0.05) indicated that the variable was not normally distributed. The Wilcoxon ranked sign test then showed no significant difference between how easy it was to locate information in either condition (Z=-0.35, P>0.05, 1-tailed).

The notification confidence variable in the descriptive statistics in Table 1 had more of a difference between the mean (difference = 0.8). Analysis was performed on the variable to find out if there was a significant difference. The K-S indicated that the variable was normally distributed (p>0.05). The t-test showed that they were in fact not significantly different (t(19)=1.26, p>0.05, 1-tailed). This meant that participants were not more confident that the notification in condition B had identified all the changes.
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Dependent Variables

- Awareness of collaborator
- Ease to locate information
- Ease of task
- Notification usefulness
- Notification confidence

Condition N
Condition T
Chapter 5

Analysis of results

5.1. Discussion

Participants using the notification with more targeted information significantly reduced the time taken to complete the set task with a lower number of errors and increased their perceived awareness of what the collaborator was working on. These variables were consistent with the experimental hypothesis. However, there were no difference between ease of task, ease to locate information, notification usefulness and notification confidence between conditions therefore was inconsistent with the experimental hypothesis. The variables that arguably measured how effective collaboration is: were significantly different. Awareness is crucial for successful collaboration (Gutwin and Hill, 2003). With an increase in awareness it could have improved the performance variables. The reduced number of errors and time taken indicates an improvement in efficiency and accuracy. This finding is consistent with the work of several researchers.

Another explanation for the reduced number of errors could be that condition T explicitly indicated to participants what was changed, specifying which item of data was changed. This could have made it a lot easier for participants to find the
modifications. This gave the participants the opportunity to just use the notification to update the required data. Condition T also showed what the original information was. The majority of participants adopted the strategy of comparing their original answer they had inputted into Excel and seeing whether or not the original value was the same as the value that was changed, indicated in the notification. It was thought that this could have helped the participants trust the notification more. However, this was not the case. The results showed no significant difference whether participants trusted the notifications to detect all the changes between the conditions. A reason for this could be that condition T displayed all the changes made by the collaborator. Some of these modifications were to values that did not affect the task of the participant. Some participants were confused by this and ended up changing values incorrectly. Those participants asked in the post-experimental interview:

Participant: Why did the notification show changes that didn’t seem correct?
Experimenter: The notification showed all the changes not just the values for the task. The collaborator made changes to previous years’ prices, which did not affect you in completing your task.

Another participant seemed to fully trust the notification. The participant did not look back at the report after receiving the notification and made changes based solely on the notification. The participant commented “When I received the notification I didn’t even have to look at the Wiki as I was given the exact information I needed to update the spreadsheet”. A reason for there being no significant difference between the conditions is that condition N only notified participants that there have been modifications. Participants could have felt that by not specifying the updates they could not determine whether they were confident or not that it had detected all the changes. This could have raised the mean for condition N.
Another justification for the reduced time in condition T could again be due to the notification pinpointing the modifications made to the report. For example, the participants were told that there was a price change in the commodity sugar from £75 to £76 in quarter one. This is contradicted by the fact that participants did not find it easier to locate information in condition T. This could be explained by the notification confidence variable. A participant quoted “Have no way of knowing it found all changes”. Most participants did not trust the notification enough to just rely on it without double checking the report. However, from observing the participants it was seen that several of them modified their use of the notification. Instead the notification was used to help direct their search into regions where the changes could have occurred. When questioned in the post-experimental interview how they used the notification their response was:

Participant: “I used it to help me quickly focus my search into particular areas, so that helped cut down some searching time”.

This still seemed to have saved the participants a lot of time by not having to read the entire report again. Even though the notification in condition T could be helping participants refine their searches, results show that participants still did not find them particularly useful. A reason for this could be that it displayed irrelevant information. Participants could have perceived this as additional work for them because they had to work out what information is relevant for their task. This is more cognitively more demanding, which is a similar issue to the findings in Dabbish and Krauts (2004) work.

The perceived awareness of the collaborator was significantly different with an increase in condition T. With more information in the notification the participant could have had a better picture of what the collaborator was working on. Having the
information targeted could give the participant an idea of how the collaborator is working and where in the system because with regular notifications participants could keep track of the activities performed by the collaborator.

There was also no significant difference in the perceived ease of task. This could be due to the fact that the participants did not feel the notification in either condition were particularly useful. However, the variables time taken and number of errors contradict the result of this variable. Maybe it was difficult for participants to determine if the task was easier or not if they felt that they had to put in additional effort to work out which update was relevant for them (Grudin, 1988).

The findings of this study are consistent with those of Tiernan (2001). The results suggest that if the notification did not capture the trust of the participants immediately then they were likely to double check the report instead of using the notification to its full potential. The only difference noticed was that though participants did not trust the notification in condition T, they did not completely ignore it. As discussed they used it to help them focus in on their searching. This could mean that participants thought the notification have some benefits. The implication could be that if participants feel there are cues that could help them target certain areas of the report, they will use it cautiously.

In condition T, the notification provided feedthrough to the participants similarly to the MAUI (Gutwin et al, 2003). Replacing the heavy use of highlights with detailed updates in the notification. It could be argued that the notification is less distracting to the users than the colours on all the modifications in the workspace, as the visuals would draw their attention away from the task. With the notification the changes were displayed in a window that could be opened by the participants when they felt they were free to. However, it could be seen as contradicting Dabbish and Kraut
Effects of a Targeted Notification on Collaborative Work

(2004) because the notification windows pop up without taking into consideration how busy the participant was. Unlike MAUI, this study manages to support asynchronous collaboration as well as synchronous collaboration because the notification can be viewed when the participant is working on their own. With the MAUI, users could only see the highlights whilst working with the collaborator.

The result compliments the research by Carroll et al. (2004), which states that small changes are hard to find, hence takes more time. The study provides an answer to some of the problems found in Carrolls research and is consistent with work by Liu et al. (2001). This is indicated with the notification in condition T whereby there were less errors being made by participants. The result also supports the work of Shen and Sun (2002) as the consistency of the work is better in condition T. The notifications offer a continuous channel of communication by updating the collaborators of any new events.

It could be argued that the study could also support workspace awareness. This is achieved when the collaborator updates the report; because a notification is sent informing the participant which part of the report has been changed. These notifications could essentially help track what the collaborator is working through. For example if the collaborator is working their way down the document making changes the participant could use the notification to track how the collaborator is working. The participant could even start to predict how the collaborator is working (Gutwin, 1996b). The difference with Gutwin’s (1996b) work is that workspace awareness is supported in this study without the need for additional graphical views. The views however, give users a physical image of where the collaborators are. In this study the workspace awareness is not as informative as the tools discussed in Gutwin’s work. However, for co-operative document writing the need for such level
of awareness may not be necessary compared to the graphical tasks in Gutwin’s experiment.

The observation that social awareness and task-oriented awareness can be achieved by notification in Prinz’s (1999) work is not explicitly supported in this study. The results show a more general awareness, compared to the specific awareness researched by Prinz. The findings do not clearly show social awareness is achieved as the presence of the collaborator and what their task was, is not specified. However, this knowledge is implicitly available via the notifications, which is sent when the collaborator makes any updates. This means that receiving the notification could be interpreted as the collaborator is present in the shared workspace. Additional information gained from the notifications is the tasks the collaborator is attempting to achieve via the detailed updates. The updates inform the participants all the modifications the collaborator had made, therefore the participants can build up a mental image of what the collaborators goal is. Task-oriented awareness is supported as the notification informs the participants which parts of the work need to be updated to accomplish the task. For example if the collaborator changes a certain item of data, which was used by the participant, the notification will act as a cue to change the data accordingly.

5.2. Limitations

To fully test activity awareness a project should ideally be longer than 20 minutes, which was the time taken to complete the set task. This was also an issue pointed out in Carroll’s (2004) experiment. As time moves on the lack of communication and implicit information (Herbsleb and Grinter, 1999) will cause the awareness to deteriorate. It would have been interesting to see if such a case would have happened using the notification. In such a short period of time activity awareness is difficult to measure. If the duration of collaboration was longer maybe the participants would be
even more aware of the actions of the collaborator. The reason for this could be that the notification will continue to update the participants of their action and so they could build a picture of what the collaborator is doing. From this the awareness would increase. It could be argued that with the increased awareness, participants could start to understand what the collaborator’s goal is and start to predict their actions (Gutwin, 1996b). This could affect the findings because with this additional knowledge, the participants will have a basis to question the notification received. If the notifications indicate changes that the participant feels are reasonable then perceived notification trust and usefulness could increase. However, if the updates seem questionable it could decrease the perceived trust and so lead to a low perceived usefulness. If the experiment was conducted again it would be over a longer time frame with tasks that require participants to work on over such a period of time. There will be a lot of planning and designing for the task to ensure participants do not complete it quickly, so a set of meaningful results can be gathered.

Though the notification in condition T has been modified during the pilot test, participants still felt it was not clear enough and was still confused by it.

Participant: It said on the notification that there was a change in price but when I checked in the report it has not changed.

With such negative attitude towards the notification from several participants, it could have caused a significant decrease in the variables. Notification usefulness could have been a variable that was affected. This would directly affect the notification confidence variable. This is again reinforced by the finding from Tieman et al. (2001). Research would be necessary to help develop notifications that are concise and clear to avoid confusing the participants. This would be a step forward in
gaining the trust of participants. To help gain a participants’ trust fully, the notification must also display the correct information every time. This would ensure that participants will continue to use the notifications. With the increase usage and trust in the notification, it could be expected that there will be further improvements on the amount of errors and time taken variables. The justification could be that locating information will be easier as all information is correct and understandable. This will lead participants to perceive the notification as being useful and so could make the completion of tasks simpler.

Maybe further development could be made on the notification as it is perceived to be not advanced enough. The only Information displayed is the detail of the changes made by the collaborator. This involved participants having to read and this could be identified as additional work and may not have helped participants locate the data they needed. To avoid this in future experiments, there could be a notification that will take participants directly to where the changes took place in the report. With such a notification it would cut out the need for participants to search for the changes as the links takes them directly to where the modification took place. Therefore, it could be that the potential benefit outweighs the perceived work. To determine whether this would significantly increase the ease to locate information another experiment could be conducted. The independent variable in the experiment could have three levels (the same two and another with the notification mentioned). The same dependent variables could be measured with an additional variable asking participants, which of the three notifications they preferred.

There was still a flaw in the design because task one had six changes for the participants to identify whereas task two only had five. This happened because there was not careful enough planning to control the changes. Though counterbalancing was used to eliminate order effects, so the condition used for task one changed with
every participant it could still be argued that it had an effect on the time taken and amount of errors variables in the experiment. It provided more opportunity for participants to make errors because there are more modifications to detect. The counter balancing technique did make sure both conditions were used for the two tasks. For example, condition N was used first for task one then condition T was used for task two and this alternated with every participant. This made sure participants did not only use one condition for task one or two. When designing for a similar experiment there must be additional consideration for keeping the tasks similar.

For the experiment a prototype system was used with a Wiki representing a collaborative system and MSN Messenger as the notification system. The systems were not integrated and depended on the experimenter to send the notification. This could have effected the time taken, number of errors and awareness variables. If a system was fully developed integrating both the system together it could have produced different results. It could be expected that the time taken and amount of errors will be reduced. A reason for this is could be that with an integrated system the notification would be sent automatically as changes are made. Participants would have more time to respond to the notifications instead of only being able to respond to them when the experimenter sent it, which was usually near the end of the task.

Only a notification with increased information was researched in this study. It could be expected that a notification containing the details of what activities the collaborator was trying to achieve would increase awareness.

### 5.3. Future work

As mentioned different types of notifications could help support awareness for such a task. Given that this difference would be theoretically interesting, future research
Effects of a Targeted Notification on Collaborative Work

might compare different notifications to determine this and investigate reasons for the difference. Future notifications could display actual parts of the text that has been modified by highlighting it with a different colour or as discussed, having a link to the changes in the report. The problem with showing full texts is that participants may feel overwhelmed. However, the highlights should help participants quickly find the information they need.

The collaboration in the current experiment was simulated. This could have had an effect on the awareness. Simulating collaborative work means that the participant was exposed to an artificial way of working. The notification was always sent when the participant was nearing the end of the task. It could even be argued that the participant could predict there would be extra work for them though they have reached the end. With a real collaborator notifications would not be sent just at the same times. People work at different speeds so the time in, which the participant receives the notification would be indefinite. With this idea in mind it would be interesting to research whether this will make a significant difference in awareness between collaborators. It could be that a human collaborator may give off additional cues such as leaving comments in the text itself, letting their partner know what changes they have made. An experiment could be developed with a two level independent variable (simulated collaboration and human collaboration). The experiment could be set up so that participants do not know if they are working with a real collaborator or not. Tools that allow participants to leave comments and highlighting will be available to see participants will use them. During the simulated collaboration a standard set of comments and some highlighting will be used to further simulate how a real collaborator may work. This will make it less obvious to participants that the collaboration is simulated. Dependent variables would be the same as the ones used in this study with an additional variable asking whether or not participants felt the collaboration was simulated or real. Expected differences could
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be that the condition with a real collaborator will have a greater awareness compared to the condition with the simulated collaboration with the majority of participants determining which is with the real collaborator. Other differences predicted is that the confidence in notification would increase and so increase other the other variables such as notification usefulness, ease to locate information and ease of task. This will lead to a reduction in amount of errors and time taken to accomplish the task.

If this system is seen to be useful, there should be considerations into developing it further. Possible methods to implement such a system could involve using the existing Wiki technology. Only a link is sent in the notification, which could direct the participant to a screen similar to the Wiki version control page. In this page the modification are highlighted with the original data still viewable alongside the updated version. This could help improve the users’ perceived trust in the system. Another technique of implementing the system is developing an algorithm that interrogates strings of data. The algorithm should run comparison checks on the original text with the newly updated text. Any differences found should be sent to the user. From the results found in this study the updates should be expressed to the user in a simple, concise and clear way to avoid any confusion. The notification could be set up so that only a group of users who essentially need the updates receive the notification. This is to avoid sending the notification to people who does not need them because they could get frustrated in receiving notifications that they do not need. Avoiding this will stop the frustration building up in users spreading negative comments to their peers, which could hinder the adoption of the technology (Lou et al., 2000).
The findings suggest that a notification with more targeted information does make a difference in time taken, the amount of errors and perceived awareness in a co-authoring task. However, further development such as a link in the notification taking the user directly to the changes with the original data still available but highlighted alongside the updated information is required. This could help in improving the usefulness and the perception that the system will provide users benefits. The system must consistently send out accurate information to build up trust (Tiernan et al., 2001). By achieving this, other users will be led to believe it will provide them benefit (Lou et al., 2000). Therefore, encourage adoption of the system. Results from the increased usage would mean more contribution making the completion of task simpler and quicker as everyone is sending out detailed notifications.

To attain such a notification, research into designing updates that will minimise the workload for users, whilst portraying a clear and concise message is required. To test this notification to decide whether it significantly improves awareness an experiment must be carefully designed. Special consideration must be made to ensure the experiment is long enough with challenging tasks to determine if any activity
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awareness breakdowns arises (Winograd et al., 1987). The experiment should use a fully integrated system with real a collaborator to observe if it results in any significant differences.

This study has shown that targeted notifications do not increase the ease to locate information compared to a non-targeted notification in co-operative document writing. Information alone will not improve on their usefulness or confidence. However, it can reduce the time taken to complete a task with fewer errors and create a higher awareness of what the collaborator is working on.
Bibliography


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Appendix A

Quarterly Reports

The values inside brackets denotes what the values were changed to during the experiment.

**Commercial - Quarter One Report**

**Overview**

This quarter spend has dramatically increased from quarter four. The large increase was mostly due to the direct commodity, dairy. Spend for the rest of direct commodity stayed relatively level with some fluctuations here and there.

For indirect commodities spend was similar to quarter four. There were the expected increases and some decreases in some of the indirect commodities, which help keep level spending.

Overall due to the dairy prices spend was heavily increased this quarter. It was fortunate that all other direct and indirect commodities were able to stay the same.

**Direct Commodity Spend**

As mentioned in the overview we saw a dramatic increase in the price of dairy compared to quarter four. A reason for this could be the sudden decrease in dairy suppliers. This gave us less buying power because suppliers knew we had fewer suppliers to choose from. Now that there is a shift of power towards the suppliers they were able to push their prices above our usual contracted price. Our dairy buyers had no choice but to meet their demands as we needed to replenish our dairy stock quickly to continue to produce our products.
Meetings have been held to find ways in which we can tie down a certain price in case prices rise again in the coming quarters. It has put us off the spending plan this year as we were only hoping to spend £110 per unit of dairy a quarter. Ideas mentioned were to have a longer contract period with a set price and promise the suppliers we will procure a certain amount that is good for both businesses. We hope this way we can forecast spend for dairy in the near future. The buyers were told of the new strategy and have been working with the dairy suppliers already. We hope to achieve a consistent spend of £120 per unit for dairy in the next coming four quarters, comparing this to £140 (141) per unit of dairy this quarter. We predict that if we can achieve this with the suppliers there will be a saving of £10,000 (10,500) a quarter in such an unpredictable market. This would mean £40,000 (42,000) for the year. This would be a great saving for the business and will put us closer to the spend plan for this year.

Spend for the other direct commodities did not cause us any problems as they stayed fairly level with quarter four. This was what we thought would happen. The fluctuation in prices of the commodities was a minimum.

Wheat saw a slight drop in price compared to quarter four. We managed to procure wheat for £60 per unit this quarter, compared to quarter four's £61 per unit. We predicted this slight change in price as the previous quarters three and two last year were at £61 per unit and £59 per unit respectively. This decline in price saved us only £200 this quarter on wheat.

On the other hand sugar took a small increase in price but nothing too much to drastic compared to the dairy prices. For this commodity it was again expected as prices have been increasing and decreasing each quarter. Quarter four cost £73 per unit of sugar whereby this quarter prices rose to £75 (76) per unit of sugar. In quarter two and three last year the prices per unit for sugar were £73 and £72 respectively. This meant that the price rise this quarter was not such a big deal.

**Indirect Commodity Spend**

As the overview tells us not many changes were saw this quarter for indirect commodities. There were once again fluctuations in prices as there were with the direct commodities. The reason maybe for these price changes is due to the rising and falling of petrol prices.

For inbound logistic service the price stayed the same as quarter four at £1100 for the quarter. This has been a slight rise compared to quarter two and three of last year, which we saw a steady increase in price of £1040 and £1070 respectively. We are predicting that prices are still on the increase due to the circumstances surrounding the crude oil industry.

Our outbound logistics supplier managed to give us a lower price than we paid in quarter four due to the fact that we are long term customers of theirs and have built up a strong working relationship. With the discount this quarter we procured the outbound service at £860 (840) for the quarter. Looking back at quarter four which we paid £1000 this was a slight saving for us coming in at £140 (160). Obtaining a discount at these times has been
excellent considering the temperamental situations of the crude oil industry. All these savings will be needed to help us get back on track with the spend plan for this year.

**Action Plan**

Plan of action to reduce spend is to tackle the dairy problem. Due to the striking rise, action has already taken place. We know with the current situation of the dairy market we hope to be able to keep the prices consistent so no more surprises will catch us off guard. We will focus most of our efforts on this cause.

We have also taking into consideration of the fluctuation in prices in our other direct commodities and have seen it as a minor impact to the business. However due to the dairy problem we must attempt to lower these prices so that we can get back on track of our original spend plan. Our team in the division have been looking into technology using the Internet to perform negotiations with the help of the buyers. We have been notified that the system will help drive competition amongst the suppliers in the hope to lower the prices for the commodities. We shall experiment with this system for the direct commodities in the next quarter to see whether or not it can provide us with some savings. If all goes well we will implement the use of this system into the indirect commodities too.

For the indirect commodities at the moment prices have not risen a great deal but we can foresee the prices of petrol ever increasing. Some action must be done about it. A meeting will be held to decide some actions on that front.
Overview

This quarter there has yet again been an increase in spend. The bulk increase in spend was because of indirect commodities. Both inbound and outbound logistics services have risen.

For direct commodities spend was greatly lower than it was from quarter one. This was due to the fact that the direct commodity prices have been lowered and controlled. This has removed the element of surprise and we now know what we can expect.

Overall due to severe spend on indirect commodities this quarter we are no closer to the spend plan than we were in quarter one. However due to our quick response to the dairy crisis and good work on other direct commodities we have not moved too far from the spend plan.

Direct Commodity Spend

As mentioned in the overview this quarter spend on direct commodities were lower than they were in quarter one. The main reason for this was that we managed to overcome the dairy problem that we faced in quarter one. We were able to negotiate with the dairy suppliers so that we were able to keep the price constant for the whole year. This removed the chances of being hit by another sudden escalation in price. Originally we were aiming to only pay £120 per unit of dairy but the suppliers thought this was too low. In the end we managed to negotiate them to £121 per unit of dairy. We are pleased with the result. Though we are paying a lot more than we did planned to, which was £110 per unit of dairy. Facing the circumstances the dairy market is currently in, £121 per unit of dairy has been a good result. Looking at current prices for dairy which is at £142 per unit we have managed a saving of £10,500 for dairy this quarter. The saving was more than we predicted in quarter one as the dairy prices keep incrementing. With such savings we were hoping to be nearing our spend plan for the year.

The other direct commodities that were previously fluctuating in price have now been lowered. The system that we said we were going to introduce from quarter one has proven to increase the competition of the suppliers. As expected the price was reduced from the suppliers competing against each other to win the business of supplying us with their products. This has given us more security over the prices of these commodities.
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We were able to procure sugar at the price of £70 per unit. This has been the lowest for a year where the previous lowest price was in quarter one last year coming in at £69 (68) per unit of sugar. Comparing the price of how much we procured sugar for this quarter to quarter one, we managed a saving of £1500 (1800). This was a decent amount of savings that will go towards getting us back onto the spend plan for the year. We hope that we can continue to benefit from such good prices.

For wheat there was also a decrease in price compared to quarter one. We managed to procure wheat at £59 (57) per unit. Comparing this to quarter one, which we procured wheat for £60 there was a saving of £200 (600). The most important aspect is that we procured wheat equal to the lowest ever price. This was back in quarter two of last year. These savings are needed for us to try and get back on track with our spend plan for the year.

**Indirect Commodity Spend**

As described in the overview there was an immense increase in price for indirect commodities this quarter. It was due to the issue that we have been monitoring for the previous quarters. We predicted that there would be a rise in petrol prices due to the situations happening surrounding the crude oil industry. We were working on a plan to try and ensure we stay on top of the issue but this sudden increase in price has caught us off guard.

For inbound logistics the prices have greatly increased in this quarter. This quarter we are paying £1600 compared to quarter four, we are paying £500 (550) more. This has been the most we have ever paid for the service. We knew from looking at the service price pattern there was going to be an increase. They were for last year £990, £1010, £1040 and £1070. This has set us now further away from the spend plan for the year.

Even our outbound logistics suppliers, whom we have a good relationship with put up their prices dramatically. This quarter we procured the service from them for £1300. This was a lot more than what we paid in quarter one, which was £860. Usually the outbound logistic supplier gives us a decent discount because of our long term service but this time even they had to raise the price this much. We did not predict the crude oil industry to get this bad so quickly. We only predicted a slight rise to about £940. This in conjunction with the inbound logistics have put us no closer to the spend plan for the year.

**Action Plan**

Plan of action to reduce spend is to continue with the good work of keeping the direct commodities price low with the continual use of the system. We hope the system will continue to provide a more competitive market for our suppliers to work in. To help bring spend for this year back closer to the plan we must try to aim lower for the direct commodities. We hope to procure wheat at around maybe £57 per unit. This would be a big ask and suppliers may not drop their prices this low but we must try otherwise spend this
year will be greatly off plan. The same goes to sugar, we want to procure sugar as at £68. This again could also prove to be difficult with the suppliers.

For dairy, we have now removed the heavy increases of prices and now have the knowledge that it is constant. We are hoping that after the year of the contracted period, prices will start to fall again and we can then remove ourselves from the annual contract and try and procure dairy at a lower price once more. This decision will come as the year nears its end so we have a better forecast of the movement in the dairy market. For indirect commodities we will have to perform such actions as we did for dairy to try and avoid such a great leap in prices again. Like dairy we will try and gain control of the prices we procure at instead of allowing them to catch us off guard again. We will try and negotiate a price which will be beneficial to both our businesses.

We will aim for approximately £1400 for outbound logistics service. For the inbound logistic service we will aim for around £1200, which will still mean that we are off from the spend plan for the year but considering the circumstances it will be the best that we can do.
Appendix B

Notifications

Notification to send for condition N for both tasks

Document has been updated.

Please refresh the page by pressing F5 on the keyboard.

Notification to send for condition T for task 1

Document has been updated.

Updates can be found in:

Direct Commodity Spend
Dairy price change from £140 to £141
Dairy intended price saving change from £10,000 to £10,500
Dairy future whole year saving change from £40,000 to £42,000
Sugar price change from £75 to £76

Indirect Commodity Spend
Outbound service price change from £860 to £840
Outbound savings change from £140 to £160

Please refresh the page by pressing F5 on the keyboard.
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Notification to send for condition T for task 2

Document has been updated.

Updates can be found in:

Direct Commodity Spend
Sugar lowest price of last year change from £69 to £68
Sugar savings change from £1500 to £1800
Wheat price change from £59 to £57
Wheat savings change from £200 to £600

Indirect Commodity Spend
Inbound service change from £500 to £550
Inbound service price change from last year from £1100 to £1050

Please refresh the page by pressing F5 on the keyboard.
Appendix C

Questionnaires

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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
</table>
| Task 1
| How easy did you find the task?                                         | Very easy | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| How easy was it to locate the information you needed for the task?      | Very easy | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| How useful did you find the notification about changes to the document? | Very useful | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Based on the notification how aware were you of what your collaborator in Commercial was working on? | Very aware | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
When you were sent the notification of changes in the document how confident were you that it detected all the changes?

<table>
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<th>Very confident</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Not confident at all</th>
</tr>
</thead>
</table>

Any other comments

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**Questionnaire**

**Task 2**

How easy did you find the task?

- Very easy
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- Very hard

How easy was it to locate the information you needed for the task?

- Very easy
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- Very hard

How useful did you find the notification about changes to the document?

- Very useful
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- Not useful at all

Based on the notification how aware were you of what your collaborator in Commercial was working on?

- Very aware
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- Not aware at all

When you were sent the notification of changes in the document how confident were you that it detected all the changes?

- Very confident
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- Not confident at all

Any other comments

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Appendix D

Inform Consent Form

INFORMED CONSENT TO PARTICIPATE IN

Investigation into how to make collaboration more effective.

An experiment investigating how to make collaboration more effective is being conducted by Raymond Hung in the Department of Computer Science at the University of Bath. (rh229@bath.ac.uk).

You are being asked to take part in this study by reading through a scenario and answering questions about it. The experiment will be recorded for analysis purposes only.

You will be reading a scenario and from that complete four calculations by entering them into a spread sheet.

Your responses will be stored anonymously to protect your privacy. If you wish, we shall send you a copy of any subsequent publications that uses any of the data from the study. Potential benefits associated with the study include a better understanding of what could possibly make collaboration more effective.

If you agree to voluntarily participate in this experiment as described, and for any relevant responses to be used in publications anonymously, please indicate your agreement by writing your name, e-mail address, then sign and date below. Thank you for your participation in this research.
Appendix E

Written Instructions

**Brief for the experiment**

You will be given a business scenario where you will assume the role of an employee working in the finance division. You will be working with a colleague in the Commercial division. The collaboration with the colleague will be simulated.

You will be using a collaborative system because you and your colleague who you have been working with for a few years has finally decided that emailing each other with information encounters too many problems. For example information would get lost and there were too many versions of the work, etc. Now that technology has advanced, a collaborative system has been brought into the business where you can store your work in a centralised location. Changes made to the work can be instantly updated so both you and your colleague will work on the correct version.

If the work on the system is updated, the system will automatically send out a notification informing the collaborators that the work has been updated.

You will be given instructions on how to use the collaborative system.

**Your task**

The business buys:

- 500 units of diary
- 300 units of sugar
- 200 units of wheat

Using the quarterly reports from your colleague, you must calculate: -
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- The total spend for the direct commodities – to do this enter price paid per unit into Spreadsheet.
- The total spend for the indirect commodities – to do this enter price for the service into Spreadsheet
- The savings (if any) in the direct commodity - to do this enter the savings for the direct commodities into Spreadsheet
- The savings (if any) in the indirect commodity - to do this enter price for the indirect commodities into Spreadsheet

You must then create a graph for the calculations above using the Spreadsheet and upload it onto the system.
Appendix F

Spoken Instructions

Experimenter: For the task you will be entering the information into an Excel spreadsheet. You won’t need to do any calculation because Excel will do it all for you. All you have to do is find the unit price for each commodity from the report and enter it into the spreadsheet. For example if you found that for the dairy commodity it was procured at £100 then all you have to do is enter 100 for the dairy commodity.

Demonstrated where and how to enter the value into the spreadsheet.

Experimenter: The same goes for sugar and wheat. Let’s say you found sugar at £45 then just enter 45 for the sugar commodity.

Demonstrated again where and how to enter the value into the spreadsheet.

Experimenter: You enter the savings for the commodities here but savings is not always applicable. If it is you will be able to find it explicitly in the report. You will not have to do any comparison. All you need to do is take the figure and enter it into the spreadsheet. All the prices and savings can be found in the report. When it refers to ‘this’ in the report it means quarter one.

It was explained that when it says ‘this’ for task 2 it meant quarter two.

Experimenter: For indirect commodities, it’s not unit price you have to enter. All you have to do is to take the price you find in the report and put it straight into the spreadsheet. So let’s
say you find that inbound logistics was procured for £1000, just enter 1000 for inbound logistics. Again the savings for the commodities are entered here. Again savings is not always applicable; if they are you will be able to find it explicitly in the report. You will receive a notification. If there are any changes made to the financial report. This notification is automatically generated and sent by the system and not by the collaborator. This notification will be via MSN Messenger so when you receive a pop-up window read it, don’t ignore or close it. Once you are happy that you have completed the task click this button here and the task will finish. Your voice will be recorded during the task so could you think aloud of what you are thinking and what you are going to do. You will also be timed during the task.
Appendix G

Comments from questionnaires

Task 1

“It will be good to highlight updates in another colour, font”

“Needs highlighting that’s similar to MS Word ‘Track changes’”

“When the notification arrived, I was forced to re-read the whole document and compare figures to those I’d already put in the spreadsheet for any changes”

“It didn’t tell me what the changes were only that it had changed”

“The notification was useful in that it told me it had changed so I could re-check and get the right data, but not useful in that it didn’t say what had changed”

“Wasn’t sure why there was a change and wasn’t sure when the changes were implemented or in effect”

“If the report had track changes it would be an easier task”

“Notification was pretty pointless other than informing me there had been a change. I had to read whole document again and compare with what I put in spreadsheet to identify what had been changed. Found it very difficult”

“More effective would be a track changes thing”

“Would have been nice to know what had changed when the notification came through. I had to re-scan the document, but it would have been better to have highlighted where the changes were.

Task 2

“Have no way of knowing it found all changes”

“Notification useful”
Effects of a Targeted Notification on Collaborative Work

“I just assumed all the updates were in the notification so didn’t bother checking for them in the document”

“I was confident if had found the changes and got them right after comparing the notification to the document for the first few”

“Sentences were too long, not concise enough”

“Perhaps if the document highlighted recently changed sections to attract the users attention”

“When I received the notification I didn’t even have to look at the Wiki as I was given the exact information I needed to update the spreadsheet”

“Would be useful to change the colour of the font in the report when changes are made”

“If was a good notification, except the wording in the inbound services. It was confusing and I had to check the original for the changes. Otherwise the notification was very useful”
Appendix H

Quotes from post-experimental interview

Awareness
“...more aware of what the person from Commercial was doing when I received the notification telling me where the changes were”
“I had no idea what the other person was doing”
“The notifications didn’t help know what the guy in Commercial was doing”

Ease of task
“The task was really hard when there was no information in the pop-ups”
“The notification with more information on it made the task a little easier”
“The task was easy just time consuming”
“The wasn’t too difficult”

Ease to locate information
“It would have been more easier if the words were highlighted”
“The notification that did not show any information did not help at all”
“The notification with more details helped find the data but was a little confusing”
“The notification showing more information helped me find the data quite easily”
Effects of a Targeted Notification on Collaborative Work

**Notification confidence**

“I didn’t really trust the notification and had to re-read the whole report”

“I was pretty confident the notification found all the changes when I compared a few with the report”

“Can’t tell if really if it found all the data”

“It came from the system so it should have got all the changes”

**Notification usefulness**

“It would have been more useful if the changes were highlighted”

“I did not find the notification with no detail useful at all”

“The notification with extra information was pretty helpful”

“I used it to help me quickly focus my search into particular areas, so that helped cut down some searching time”
Appendix I

Ethics form

UNIVERSITY OF BATH
Department of Computer Science
13-POINT ETHICS CHECK LIST

This document describes the 13 issues that need to be considered carefully before students or staff involve other people ("participants") for the collection of information as part of their project or research.

1. Have you prepared a briefing script for volunteers?
   Yes, I did have a brief for the participants that helped them understand the task and what was required of them.

2. Will the participants be using any non-standard hardware?
   No.

3. Is there any intentional deception of the participants?
   No.

4. How will participants voluntarily give consent?
   Yes, an informed consent was used. It informed participants that if the project was to be published they would be informed.

5. Will the participants be exposed to any risks greater than those encountered in their normal work life?
   No.

6. Are you offering any incentive to the participants?
Yes, they were rewarded with chocolate.

7. Are any of your participants under the age of 16?  
   No.

8. Do any of your participants have an impairment that will limit their understanding or communication?  
   No.

9. Are you in a position of authority or influence over any of your participants?  
   No.

10. Will the participants be informed that they could withdraw at any time?  
    Yes, participants were told they could withdraw any time if they felt uncomfortable with the experiment.

11. Will the participants be informed of your contact details?  
    Yes.

12. Will participants be de-briefed?  
    Yes.

13. Will the data collected from the participants be stored in an anonymous form?  
    Yes.

NAME: _________________________________________________________

SUPERVISOR (IF APPLICABLE): ________________________________

SECOND READER (IF APPLICABLE): ______________________________

PROJECT TITLE: _________________________________________________

DATE: __________________________________________________________
Appendix J

DVD contents

- Audio files
- SPSS data file
- SPSS output file
- Excel file
- Answers to tasks in Excel file