

# Enhancing Distributed Systems and Software Engineering Using Internet Based Collaborative Working Tools<sup>1</sup>

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## Abstract

Systems and Software Engineering is increasingly becoming a global phenomenon as development projects spread out across national boundaries. This phenomenon is due to

- Multinational corporations spreading work across their Divisions to make use of talent in different countries.
- The geographic distribution of customers, suppliers and their subcontractors in international (government) system acquisition programs.

The history of international cooperation is littered with failed projects. Even in projects which have been labeled as “successful” (Eurofighter, Concorde) “success” has tended to come with a high price tag. Consequently, as the number of international projects is increasing, the number of failures and their undesirable consequences can be expected to increase unless something is done about the situation. This topic is receiving a lot of attention in the business community and, of course, many of the steps towards improvement are not technological. However, technology does have some benefits to offer, and tools and technology to assist collaborative working provide some opportunities for overcoming the tyranny of distance. Nevertheless, there still seems to be a gap between what is needed and what exists.

This paper addresses the situation. Recognizing that teams of postgraduate students working on-line in a distance education environment face the same types of problems as distributed corporate teams, this paper develops requirements for collaborative working tools using:

- The experience of students working in on-line projects in two classes (subjects) in the Master of Software Engineering (MSWE) Degree at University of Maryland University College (UMUC).
- A literature search in the field of collaborative working tools.
- Experience gained in experimental programs in the exchange of data between designers working in remote locations.

## Keywords

Systems engineering, distributed systems, collaboration, software engineering, distance education.

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## 1.0 Introduction

The growth of international industrial distributed collaboration has been mirrored in Academia. Higher Education Institutions have embraced the distance education mode of teaching for various valid reasons. However, the growth in Academia has not been without its problems. The Academic environment is tougher than industry for reasons that include:

- The need for students in different geographical locations to work together (collaborate) online on projects.
- Student teams have to form, and produce a product within the constraints of the 14-week semester. The last day of the semester is fixed and schedule slippage may result in a failing grade.
- The composition of the teams is different each semester. Thus the same issues of personality, time zones, hardware and software incompatibly continuously arise again and again in different variations.

Consequently, the lessons learned in the online academic postgraduate semester environment can provide the basis for a set of requirements for the tools of the collaborative working environment [1].

## 2.0 The UMUC Experience

The UMUC experience is based on students working in on-line teams in several sections of two postgraduate classes:

- **MSWE 648 Software Maintenance** - students have to produce a document in a collaborative manner.
- **MSWE 617 Software Engineering Project** - student teams have to go through the entire software development life cycle starting with a concept and ending with a working documented software package.

Depending on the semester, there may be several parallel streams of activities in the class, the lecture, synchronous and asynchronous discussions, individual projects, and a team project. In both classes, the teams work in an on-line environment and do not meet face to face at all during the semester. The team project entails research and delivery of a report. In the classes under discussion, the students were required to prepare an asynchronous PowerPoint presentation for delivery over the Internet.

The students are provided with the WebTycho collaborative distance learning environment (UMUC's online classrooms). It provides a web site with areas for asynchronous discussions and file transfers. The instructor augmented the text mode materials with streaming audio technology. The WebTycho environment was overloaded and suffered from excessive downtime and slow access. The system's response was so bad at times that the students resorted to external techniques synchronous discussions and document transfers. As part of their final examinations, two open-ended questions were posed to the students:

*Q2 Discuss the five most difficult aspects of your team project?*

*Q10 Discuss the five easiest aspects of your team project?*

These questions asked the students to discuss the issues from two perspectives. About 60 useable responses were in the form of essays. After summarising the responses, it was found that the major factors contributing to the success of the globally distributed environment were:

- Having an organized framework for the product with well-defined interfaces between the subsections of the document.
- An understanding of the best use of synchronous and asynchronous communications.
- The use of the same tools for document and presentation preparation.
- A leader and well-defined roles and responsibilities.
- Self motivated team members.
- Respect and trust for other team members.
- A shared sense of purpose.
- Effective management of shared information.
- Timely communications. Many students preferred emails to the shared class web site.

As two sections of the class ran when the WebTycho environment suffered from massive malfunctions, backup communications were developed by the students to compensate. The WebTycho environment was text based, although the classes were enhanced by the addition of audio to the PowerPoint presentations via RealMedia. Students used PhoneFree and ICQ as well as WebTycho for synchronous communications. There was no use of,

nor no apparent need for, real-time video. **The major factor inhibiting collaboration in the distributed environment was incompatible and improperly functioning technology.**

The experience in MSWE 617 although not documented in a similar manner reinforces the findings from MSWE 648.

### 3.0 The literature search

Information on support tools for collaborative work can be found from two major sources:

#### 3.1 Academic Literature

A considerable amount of work has been done in evaluating the interface between computer-based collaborative tools and their users. Some valuable information is available from sources such as

- The evaluation of different channels of communication (voice, computer, video) and user effectiveness in impoverished environments [2].
- The establishment of a set of requirements for effective collaborative tools [3].
- A report on long-range collaborative product design work [4].
- A report on a range of experiences with implementation of groupware in work environments [5].
- The European “SEDRES” Project [6]. It is interesting from several points of view but perhaps the most significant is that it focuses not simply upon the technology of transferring information between tools, but on the business case for doing this [7,8].
- A PhD thesis which provides a valuable source of information [9] has two features of relevance to this discussion
  1. The development of a framework for comparison and evaluation of CSCW tools.
  2. A detailed review of seven such tools (plus commentary on several others). The tools evaluated in detail are:-

Rendezvous,  
GroupKit,  
Dialogo,  
Suite,  
SEPIA,  
MEAD,  
SOL

If one is to draw an overall conclusion from this work it is that the tools evaluated differ greatly in their capabilities in different areas. They are intended to serve different user needs, and matching the needs of any one application to the tool is an important activity.

#### 3.2 Vendor Literature

There is a considerable amount of groupware commercially available (as well as freeware and shareware). Reading the literature on these products give a good indication of the kind of capabilities they provide for the user. Examples include:

- Microsoft products including NetMeeting [10].
- TeamWave [11]. This is a product of the Group Technology laboratory at the University of Calgary. They have another product, Group Kit, which supports those who wish to write their own groupware tools.

The deemed essential capabilities currently available include:

- **Video.** Users at each end of the exchange can see a video image of the other on screen. This capability is seldom well implemented, suffers severely from bandwidth limitations and has been shown by several workers to be ineffective and unnecessary for effective collaborative work. Nevertheless, these comments reflect current technology, and may well not be valid in the near future.
- **Audio.** Voice communication is very important for effective communication in a groupware environment. In many groupware environments it is implemented as part of the software package but this is frequently less effective than simply using a standard telephone. Nevertheless, the computer-supported audio channel is usually cheaper, and quality is improving.

- **Text Messaging.** The ability to carry out a conversation by typing in text messages is useful but not as effective as voice. At the present state of the art it is often employed in desperation by users, mainly because the quality of software-delivered audio is often poor, but this is expected to change as links improve in the future. Text has the benefit that it is easier to store and configuration-manage. It has its place, but is best as a supplement to other capabilities.
- **Shared Whiteboard.** This is, potentially, the most powerful groupware communication tool, but is very seldom well implemented. In attempting to use many of the shared whiteboard tools currently available one is forced to conclude that establishing what the user actually wants to use the whiteboard for is an exercise that has not been carried out.
- **Shared Applications.** Again, potentially a very useful capability. There are two considerations here.

Where all users are using the same application (eg, a specific word-processor) the system can work well. Where they are using different applications, the sharing is more difficult and is frequently implemented as a shared image (i.e., a frozen bit-map). This is frequently awkwardly implemented.

Groupware support tools are showing signs of helping people who need to work together but are located remotely and there have been some success stories [12]. Further improvement can be expected from:

- Increasing bandwidth availability.
- Increasing attention by tool developers to what users actually want to use them for.
- Increased experience by users of what works and what doesn't, leading to a more knowledgeable customer/user base.

#### 4.0 Requirements for effective collaboration of the Internet

The requirements fall into two basic categories; human and technological.

The human requirements for collaboration are the same as those needed for successful teamwork [13]. In addition, the humans must be trained in the use of the technology, so that the technical environment becomes as familiar as the current office environment. A corollary is that, the simpler it is to use, the more effective it will be. It should be borne in mind that the purpose of communication is in support of collaboration, which requires the generation of shared meaning [14].

The major technological requirements are for reliable information management and communications.

#### 5.0 Conclusions

The current generation of groupware provides some of the technical functionality required by the users. Tools are only as effective as the users. The human element has to be trained to work in the distributed collaborative environment, which is both synchronous and asynchronous. Today's groupware packages are in the main technology based looking for users.

#### Authors

Joseph Kasser D.Sc. has been a practicing systems engineer for 30 years. He is the author of "*Applying Total Quality Management to Systems Engineering*" published by Artech House. He participated in the review of versions 0.1 and 0.7 of the SEBOK [15]. Dr. Kasser is both a DSTO Associate Research Professor at the University of South Australia (UniSA) and a Distance Education Fellow in the University System of Maryland. He performs research into improving the acquisition process and teaches systems and software engineering subjects. Prior to taking up his position at UniSA, he was a Director of Information and Technical Studies at the Graduate School of Management and Technology at UMUC. There, he developed and was responsible for the MSWE degree and the Software Development Management track of the Master of Science in Computer Systems Management (CSMN) degree. He is a recipient of NASA's Manned Space Flight Awareness Award for quality and technical excellence (Silver Snoopy), for performing and directing systems engineering. Dr. Kasser also teaches software engineering via distance education.

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