Internet Groupware Systems for Project Management: Experiences from a Longitudinal Study

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Abstract

This paper describes a longitudinal study of practical experiences with three different groupware systems over a period of three years. The findings are based on surveys conducted each year among the project participants.

The most recent groupware system, used in 2002, offers numerous services of which almost exclusively the central document database, the group calendar, and the to do list were used. From the user's perspective the main advantages were improved access to information and increased control of performed work. However system use consumed additional time and personal contacts among the users were reduced. Overall, users see more advantages than disadvantages and state that they would use a groupware system in future projects again.

The comparison of the observations of the last three years shows that user interface usability and reliability are decisive factors for perceived usefulness and system acceptance. Both user interface and technical reliability have improved with each new system.

1. Introduction

In recent years, an increasing number of Internet-based Group Support Systems (GSS) have been created to support distributed workgroups. The support of cooperative work processes with information technology has been studied by researchers in the areas of computer supported cooperative work (CSCW) [cf. Kies et al. 1998, Kamel/Davison 1998] and GSS [Fjermestad/Hiltz, 1998-99, Fjermestad/Hiltz, 2000, Nunamaker et al.1991, Nunamaker et al.1996-97]. The most widely used information systems for CSCW/GSS are groupware [c.f. Lewe/Krcmar 1991] and workflow management systems [Ellis et al. 1991]. In this paper we follow Greenberg's definition [1991] who uses the

term groupware for all kinds of information systems which support workgroup computing. Due to the increased use of standardized Internet-based applications these systems are not limited by organizational boundaries or to close relationships between cooperating enterprises. Their use is becoming more common in open, market oriented forms of cooperation.

GSS support people in their every day work processes. We can observe that "hard factors" such as performance, reliability, and design have improved over the years, however there are open questions regarding the system use: Do they really improve collaborative processes? Do they save time or kill additional time? Do people *like* to work with such tools or is it an extra burden for them? Are these systems as user-friendly as their marketing leaflets claim them to be? The research described in this paper was triggered by these questions.

Most literature on this topic focuses on specific moments in time. There are very few long-term observations of changes in GSS use. Our study fills this gap by describing user perceptions over a period of three years, enabling analysis of gradual development of GSS use. Therefore we employed Internet-based groupware over a three-year period (2000 to 2002) to support student team projects. We have to keep in mind that the improvements in systems design were accompanied by a rise in user expectations and users are more sophisticated in the use of the Internet nowadays than they were only three years ago.

This paper describes and analyzes practical experiences from more than 40 student projects with three different groupware systems. The findings are based on empirical surveys conducted each year in which participants were asked about their expectations and experiences. Our statements are based on a total of approximately 300 questionnaire responses. The study examines four different areas:
1.   Most popular services
2.   Effects on communication
3.   Advantages and disadvantages
4.   Development over time

The remainder of this paper is structured as follows: we start with a short introduction into the literature of Distributed GSS and project management. We then describe the three GSS and the research project background. We then explain how we developed questions and why we chose action research to answer them. The focus of the paper is on the presentation of the research findings. Finally, we draw our conclusions and propose some future research directions.

2.   Literature Review

GSS is defined as a computer-based information system to support intellectual collaborative work that consists of networked computers, special software, and typically a public screen [Nunamaker et al. 1991]. GSS provides techniques, software, and technology designed to focus and enhance communications, deliberations, problem-solving and decision-making processes of groups [Nunamaker et al. 1995]. There have been hundreds of GSS studies using a variety of research methods [Fjermestad/Hiltz, 1998-99, Fjermestad/Hiltz, 2000]. It is beyond the scope of this paper to discuss this large body of literature; rather we will focus briefly on Distributed GSS (DGSS), Web-based GSS, and collaborative GSS-supported project management in the remainder of this section.

2.1   Distributed GSS Studies

GSS researchers [Aytes et al. 1994] have suggested there is a paucity of distributed GSS (DGSS) studies, possibly because it is scattered among the dimensions described above and the many different research areas including: computer-mediated communication; computer-supported cooperative work; collaborative drawing and writing; and computer conferencing. However, a recent literature review by Beise et al. [2003] revealed a growing number of papers on DGSS and found 65 studies among the papers from HICSS 1999-2002. The review also found a variety of research approaches, methodologies, tasks, variables, and mediums. DGSS is beginning to develop as a body of research and knowledge apart from traditional GSS.

DGSS studies explore several different variables and have mixed findings, which may be because they employ different tasks, different temporal process structures, and different GSS. Relevant variables that have been explored include user satisfaction, group performance and task type. Another potential problem is that the operationalization of these variables differs across different studies. The complex nature of DGSS sessions makes experimental findings difficult to generalize and compare.

2.2   Web-based Group Support Systems

A search of the Web shows that there are an ever increasing number of Web-based '*GroupWare*' tools available; in fact David Woolley's web roster of synchronous and asynchronous communication and collaboration systems available for use over the Internet lists nearly 150 systems as of October 2001 [Woolley 2001]. However software reviewers point out the limitations of many of these tools. The first wave of Web-based "*collaborative*" tools, such as net.Thread [Net.Genesis 1996], Work Group Web Forum, and Web Crossing [Lundeen 1996], were described in PC magazine as follows: "*The Web-based products we tested ... did not prove to be as mature in power and ease of use as their legacy brethren, though they were fine as basic discussion tools*" [Pompili 1996].

2.3   GSS for Learning

GSS was not originally designed for educational activities; "GSS are general-purpose collaborative problem-solving tools that have been shown to improve the productivity of business projects" [Walsh et al. 1996]. Problems faced in classrooms also affect work environments. In the MIS field a number of researchers have used GSS in the classroom to enhance learning [Tyran et al. 1992, Tyran/Shepherd 2001] however the majority of the research has involved same-time, same-place classroom situations.

In laboratory settings, guided discovery is a useful method of instruction for aiding learners in developing expert-like abilities and it provides learners with actual problems as the basis for learning [Clark 1998]. Although learning groups are flexible in terms of how they solve problems, they often require the type of instructional help that is referred to as scaffolding. Scaffolding is an interactive learning process in which learners are assisted by others (teachers, tutors, peers) to acquire knowledge or skills that they could not acquire without immediate assistance. Scaffolding, which is temporary and task oriented, aids the learner in developing domain knowledge.

2.4   Project Management

The project management (PM) paradigm has been shifting in recent years toward a more collaborative model [Cleetus et al. 1996, van Fenema/Kumar 2000, Jonsson et al. 2001, Maurer 1996]. Over the past decade, the project landscape has undergone a major change.

Due to international mergers, shortened time period of product to market, and consideration of labor costs, projects increasingly involve professionals distributed in geographical locations. Evaristo/van Fenema [1999] classified projects into seven types based on the two dimensions of single versus multiple projects and single versus multiple sites (see **Figure 1**).
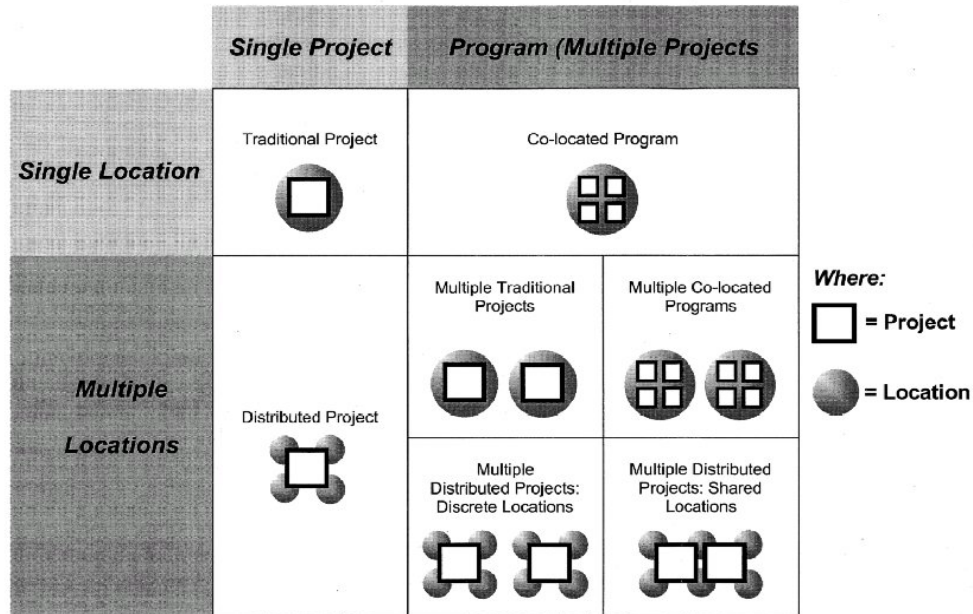

Figure 1: Evaristo and Fenema's Project Classification Scheme

Collaboration can consume a significant amount of project workers' time. Helbrough [1995] found that for a major business project between 25% and 30% of total project man-days was spent on collaboration.

2.5   DGSS and Project Management

Beise et al. [2003] found that several DGSS studies dealt specifically with project management illustrating that researchers are beginning to explore the use of DGSS for project management. Katzy et al. [2000] describe plans to develop an infrastructure to study virtual project management that includes DGSS tools and additional technologies for graphical communications among team members. Hess [2002] describes a prototype of a tool for planning and control in virtual corporations consisting of three modules: Order Management, Analysis and Master Data Management. Chen et al. [2003] propose a collaborative PM architecture consisting of four core components: Project Presence; Collaborative Support Levels, Project Knowledge Management, and the Project Cycle.

All of these describe future systems to study virtual project management. Only few studies of existing DGSS for PM have been performed.

3.   The GSS Systems and the Project Management Tasks

At the University of Applied Sciences Basel, Internet groupware has been used for the coordination of project work for the last three years [for a similar project see Pape et al.
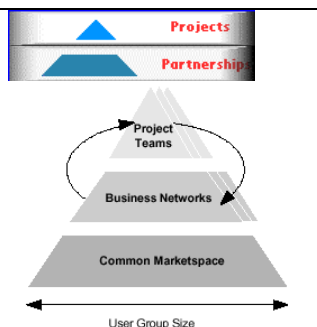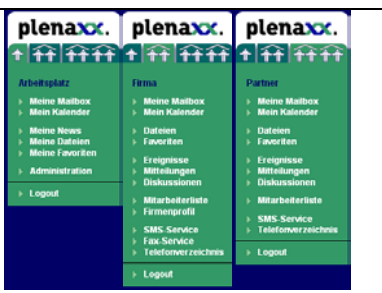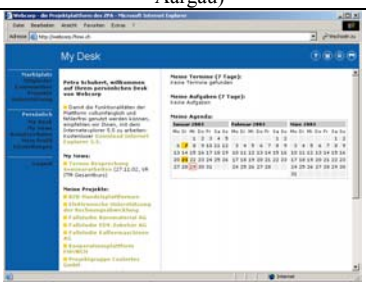
2002]. The Internet groupware platforms facilitate the coordination processes among the project participants (cf. Figure 2 for an overview of the organizational structure).

For three consecutive years three different systems were used. This was due to the fact that the system used in one year was not available in the next year. The first system, VEGA (1999/2000) [Schubert/Dettling 2000] was a prototype which was developed into plenaxx (2000/2001) [Leimstoll et al. 2001]. Plenaxx became a new economic venture and ran into financial difficulties during the late 2001 economic downturn. Webcorp (2001/2002) [Leimstoll/Wackernagel 2002] is a system independent from the previous two which is still in use today.

3.1 Introduction of the Three Different GSS

The following table presents an overview of each GSS – their providers, services and their visual appearance.

Table 1: *Overview of Used GSS*

VEGA (1999/2000)	plenaxx (2000/2001)	webcorp (2001/2002)
Provider: Swisscom	Provider: Swisscom	Provider: Center for Process Design (ZPA, UAS Aargau)
List of Services	*List of Services*	*List of Services*
1. Documents 2. News 3. Links 4. Members 5. Archive 6. Discussion 7. Events 8. Voting	1. Documents 2. Mailbox 3. Links 4. Members 5. E-Mail alert/News 6. Events 7. Hotline/Help-System 8. Discussion 9. Calendar	1. Documents 2. E-Mail alert 3. To do list 4. Calendar/Events 5. Links 6. News 7. Project controlling 8. Web pages 9. Discussion

Explanation of Services
Archive: Area for final project documentation, "dead" documents Calendar: Member-specific calendar also displaying group events Discussion: Flow of conversation in main documents/response documents Documents: Document archive sorted by categories, "living" documents E-Mail alert: Members are informed about newly published documents and events Events: Event calendar, members can post events Links: Collection of relevant Internet links published by members Mailbox: Free e-mail service (similar to hotmail) Members: Member profiles and contact information News: Publication of news posted by members Voting: Rating of usefulness of contents

Most of the results presented in this article focus findings from the final year. Compared to its' two predecessors webcorp represents a new generation of groupware tools and is based on Microsoft Active Server Page technology. All user-related data is stored in a central database. In order to use webcorp users need a computer with Internet access, a Web browser as well as a username and password. Webcorp supports collaboration in different communities and projects. The community area allows users to share documents

and discuss ideas. The project area supplies additional functionality for project administration. Users have personal information areas called "MyDesk," in which they have specific access and can maintain a calendar, a project plan and a to do list. E-Mail addresses are accessible via dedicated E-Mail lists. Each new entry can automatically be e-mailed to subscribed users. A control tool allows the precise logging of the work time and the project budget.

3.2 Background of the Research Project "Learning Community"

During their second year the *students* consult for companies to help address real-world problems. Examples for project objectives are the development of a business plan for the launch of a new product, the cost analysis of specific services, or the evaluation of an existing Internet presence.

The majority of students are between 20 and 30 years old. Two thirds are male and one third are female. A *professor* coaches groups of four to five students and a company liaison (*principal*) instructs them and guides their work in accordance with company objectives. Students and professors are experienced Internet users. Students have access to PCs with Internet connections on which to work on the projects and most have Internet access at home. The relationship between the project participants is illustrated in Figure 2.
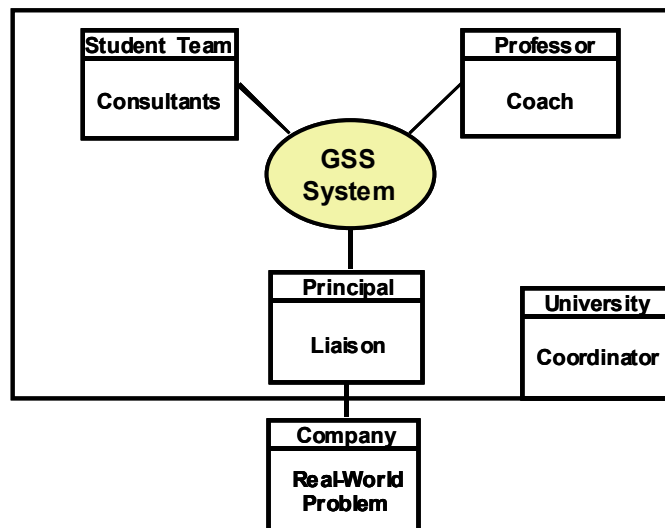

Figure 2: *Relationship Diagram of the Project Participants*

The project-related working processes are characterized by distance from the principal and asynchronous access to information. Students require coordination and collaborative support because they do the actual work and have to author a joint project paper. Exchange of jointly produced documents is of special importance and availability of the latest version of a document and avoidance of save conflicts must be guaranteed. The principal requires project progress transparency and an understanding of project steps. The University as the overall coordinator of the projects is confronted with difficult communication and collaborative processes with the broad, heterogeneous groups of users and teams.

A unique aspect of the "learning community" project is that students, professors and principals all interact within a GSS environment to jointly contribute to a project. The

GSS must therefore support a number of processes for communication, coordination, and collaboration within the scope of the consulting jobs.

4.   Research Model and Propositions

The longitudinal study was initiated by two driving partners: the UAS Basel (which is responsible for the student projects); and Swisscom (and later UAS Aargau) the provider of the groupware platform. As mentioned earlier we felt an obligation towards the project participants to guarantee a meaningful use of the groupware platform. This meant that we had to monitor expectations and experiences of the users during each project period (one period = one year of student projects). The feedback from one period was intended to have a positive effect on the development of the tool for the next period (cf. Figure 3).
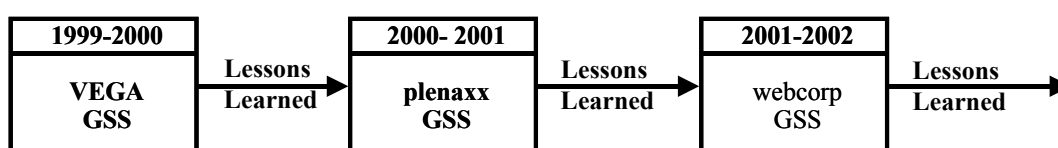

Figure 3: *Each Period Gives Input for GSS Improvement for the Next Period*

We had some initial expectations about the use of the Internet groupware system at the beginning of our research, which we studied over three consecutive years. We developed the following propositions:

Most Popular Services

Proposition 1: Services for the exchange of project-related documents are those which are most likely to be used by the project team members.

We wanted to identify the most frequently used services. We expected that the participants would use the platform mainly for documentation and archival purposes, due to the special nature of the projects.

Students are required to use document templates provided by the University. Project-related documents have to be archived in a way that each stakeholder – students, professors, and principals – can access the current version at any time.

Advantages and Disadvantages

Proposition 2: The advantages that can be gained using the tools (e.g. better access to shared documents) will surmount the disadvantages (e.g. time to learn how to use the system).

We asked project team members about advantages and disadvantages which they perceived when using the platform. We were convinced the use of the tool was helpful for the course of the projects.

Effects on Communication

Proposition 3: Even if the number of physical meetings among the project team members is high, Internet Groupware can effectively fulfill supporting tasks and improve communication.

This third expectation was targeted at the special setup of our projects. Since the students meet each other during the week a great deal of interaction takes place at school and is not artificially transferred to the electronic realm.

Development over Time

Proposition 4: The maturity of Internet groupware systems evolves over the years and has now (in 2002) reached a level of maturity where they can effectively support collaborative processes among project team members.

Our fourth expectation deals with the development of Internet groupware over time. In the year 2000 when we performed the first survey, Internet applications in general where still in a phase of "exploratory design". Users had to deal with slow applications which were error prone and mostly not very reliable. After three years of application improvement and much higher bandwidths we expected users to report a higher degree of satisfaction.

5. Research Design

This study was guided by the principles of Action Research (AR), a process by which a team of people, often coming from the same organization, pursues an organizational change strategy (for example, via a GSS-supported process improvement project) and the participants draw collective learning from a collective experience [Lau 1997, de Vreede 1995]. As a consequence the researcher intervenes and facilitates an aspect of organizational change.

There are two essential aims common to all literature on AR [Kock et al. 1997]: to improve and to involve. AR aims at improvement in three areas: *first*, improvement of practice; *second*, improvement of understanding of practice by its practitioners; and *third*, improvement of the situation in which practice takes place. Those involved in the practice being considered are to be involved in the AR process. As an AR project develops, it is expected that a widening circle of those affected by the practice will become involved in the research process.

Our study consisted of a longitudinal set of case studies (with pre and post surveys of expectations and experiences). The focus was the use of GSS for distributed project management and student team learning. The longitudinal study was carried out in three consecutive years with six intervention points (cf. Figure 4).
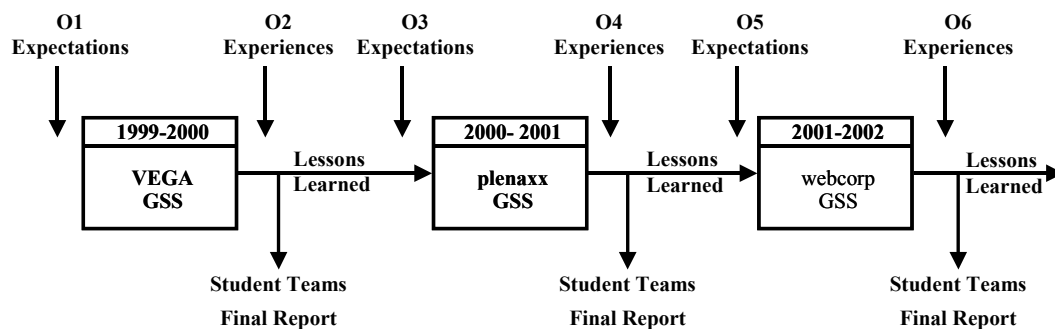

Figure 4: *"Learning Community" Project – Action Research Method*

Before the beginning of the first period in September 1999 we compiled a list of expectations with the help of an expert group of professors involved as coaches (01 Expectations). When we introduced the GSS environment in 1999, the UAS Basel and its professors were already experienced in the management of 15 to 20 simultaneous student projects. This fact is very important, as we wanted to study the *changes* before and after the introduction of the GSS.

After the first period (in May 2000) all participants were asked to complete an online questionnaire (02 Experiences). The feedback was processed and made available to Swisscom, the provider and development partner of VEGA [Schubert/Dettling 2000]. Swisscom used the findings for an improved version of the tool named plenaxx. At the beginning of the plenaxx period we interviewed selected project participants (students and professors) about their expectations regarding the use of the GSS (03 Expectations). Their comments were later compared to the results of the online survey at the end of the second period (04 Experiences). For the third period we standardized the questionnaire for both, expectations and experiences (05 Expectations/06 Experiences), which made them easier to compare. Most of the questions remained the same throughout all three surveys.

The following table presents a summary of the research design (Table 2). Table 3 gives some examples of questions in the questionnaires.

Table 2: *Summary of the Research Design*

Criterion	Content
Participants	Students (between 20 and 30 years), Professors (coach), Principals (company representatives)
Type of survey	Standardized questionnaire with mainly closed questions.
Time frame	Three consecutive years (1999-2002).
Time of survey (repeated measures design)	Once at the beginning of the project (*expectations*). Once at the end of the project 7 months later (*experiences*).
Target group	Approx. 70 students, 15 professors, 15 company representatives (principals) per year.
Structure of sample	The population is composed of all participants of the projects (a total of 300 questionnaires in three years).
Return rate of survey (02 *experiences*) 1999/2000	95 percent of the students 100 percent of the professors 100 percent of the principals
Return rate of survey (04 *experiences*) 2000/2001	76 percent of the students 91 percent of the professors 92 percent of the principals
Return rate of first survey (05 *expectations*) 2001/2002	82 percent of the students 93 percent of the professors 75 percent of the principals
Return rate of second survey (06 *experiences*) 2001/2002	92 percent of the students 93 percent of the professors 88 percent of the principals

Table 3: *Research Interests and Questions*

Research Interest	Questions and Attributes
Most popular services	Which services did you use most frequently? (Closed list of services)
Effects on communication	Did the GSS support the exchange of information with a) the professor, b) the principal, c) the school, d) the student team? Where did you access the platform? Were your experiences fulfilled regarding access (time, place, archive)?
Advantages/disadvantages	(Closed list with the possibility to add new entries) *Advantages*: Improved access to information, improved control regarding work, time gained, reduced expenditure of coordination, improved coordination of team, reduced number of meetings, improvement of team spirit *Disadvantages*: Additional time spent, technical problems, too heavy focus on tool, danger of information misuse, too few personal contacts, additional effort for getting familiar the tool, increased expenditure for coordination

6.   Findings

We decided to present most of the results of our surveys as a descriptive evaluation of data to give the reader access to participant experiences. The sample size is sufficient on the side of the students. Nevertheless, there is a possible restriction to interpretation for mean values in the user groups "professors" and "company representatives" (since there is only one of them in each project). The underlying sample size (n) is always named. Due to the varying involvement of the user groups in the consulting projects we expect that the level of acceptance and experience with the GSS will differ among the groups.

In each year there was a high rate of active users. In the final period of 2001 97 % of the students, 86 % of the professors and even 86 % of principals used the platform and the overall acceptance level was very high.

6.1   Most Popular Services

This section describes the behavior in the use of the platform. First, we analyzed the frequency of the overall system use. Second, we compared the use of specific groupware services. Where results were similar in all three periods we limited our descriptions to the last period.

Last period: With a monthly average of 10.9 accesses per person the students use the Internet tool more frequently that either the professors or the principals. This is not surprising because the students carry out most of the work in the projects. The corresponding figure for the principals, on the other hand, is somehow surprising: it indicates that they accessed webcorp on average only five times a month. The professors used webcorp an average of seven times a month.

Last period: High standard deviations illustrate that behavior in the use of webcorp varies greatly among users. The frequency of use in the group of the students ranges e.g. from 1

to 35 access times a month. These extreme variations are by no means statistical outliers. 20 students use webcorp five times a month or less, 11 students use webcorp 20 times or more often. In the other two user groups the access rates are unevenly spread in almost the same manner.

Last period: Analyzing the degree of intensity of use of single groupware services leads to a clear picture (cf. Figure 5). On average, users access services for document management 5.7 times a month and services for the delivery of mail to members of the community 2.8 times. Other frequently used services are the to do lists (2.4) and the calendar (2.2). The intensity of use of the remaining services is very low: link collection, news board, project control and the Web publication services were used only once a month at most. The discussion area has never been used by any of the participants.
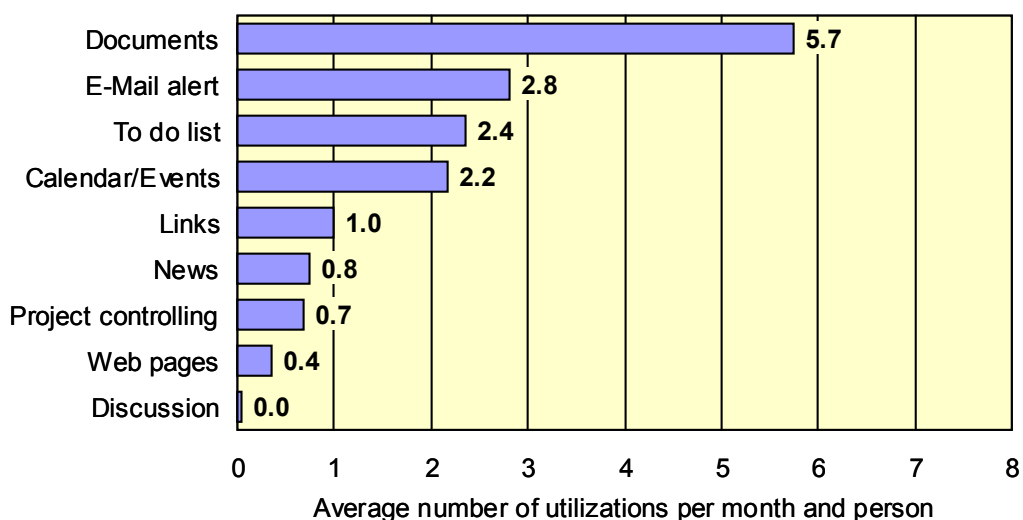

Figure 5: *Year 2002: Most Popular Webcorp Services*

Second period: Considering the most popular services in preceding years we find that popularity did not differ much between periods. In all three periods document management was the most used service. Figure 6 shows the frequency of use of plenaxx services (second period). Document management had an average use of 7.5 times per month. In 2001 participants still used the free mail services which plenaxx offered. Webcorp no longer offers this service as most Internet users already have a personal email account. The use of other services was very sporadic and irregular. Again, the discussion forum was not used at all. Neither was the calendar, an outcome that surprised us since we expected it to contribute to project coordination.
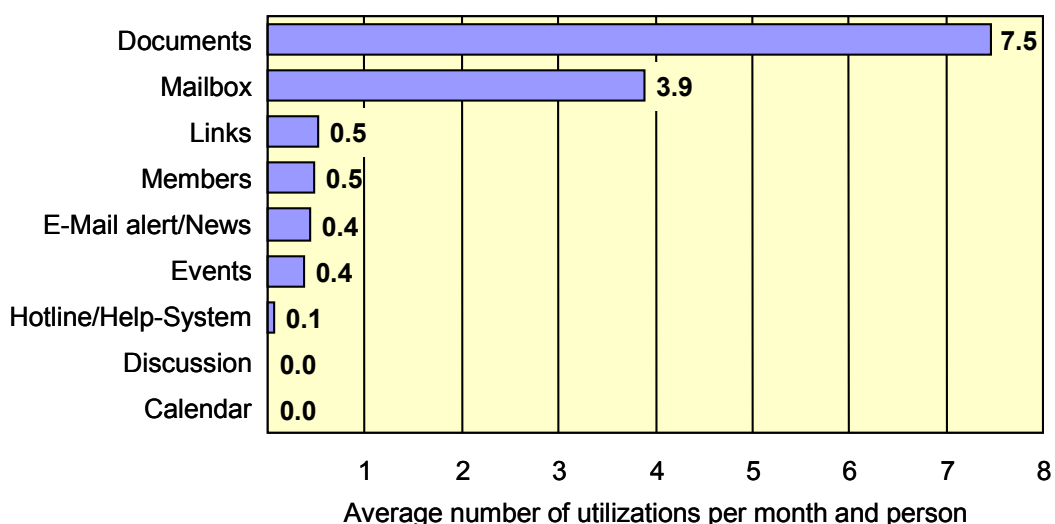
Figure 6: *Year 2001: Most Popular Plenaxx Services*

First period: Figure 7 shows the percentage of use of the GSS services in the first year. Document management is the most used, followed by the news service. In the first year, the discussion forum had at least some users. An explanation could be that the discussion threads in VEGA were easier to navigate than the document forum. Principals especially used this service to communicate with students.
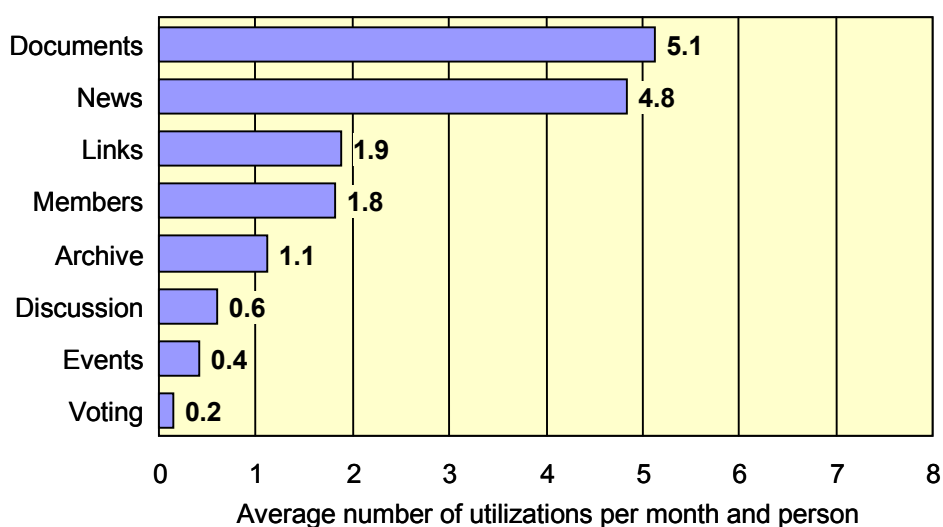

Figure 7: *Year 2000: Most Popular VEGA Services*

The patterns of use of web services across all three years lends support to our first proposition:

P1: Services for the exchange of project-related documents are the ones that are most often used by project team members.

6.2 Advantages and Disadvantages

Last period: Employing GSS for project management entails advantages and disadvantages. To measure this users were asked to select three advantages/disadvantages that they expected for the use of a GSS tool for project management. The left bar of each pair in **Figure 8** indicates the expected advantages of users *before* using the GSS.
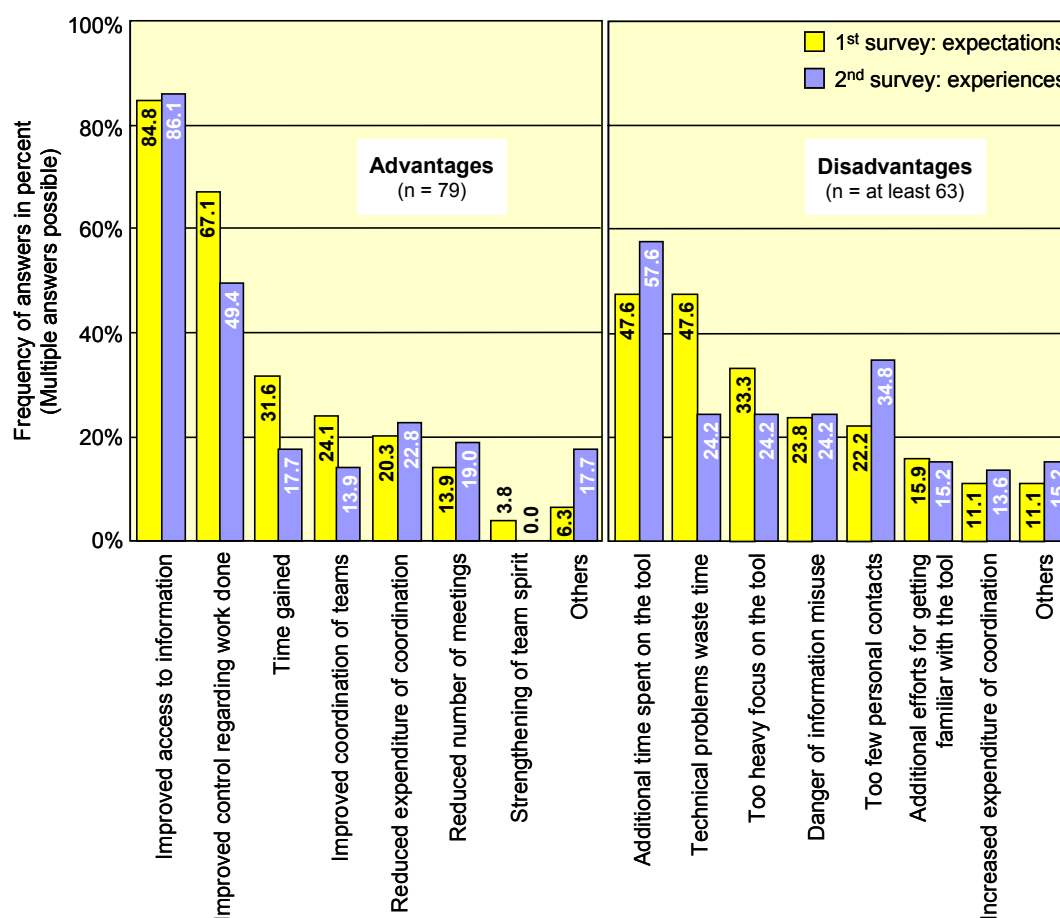

Figure 8: *Expected and Perceived Advantages and Disadvantages of Tool Utilization for Webcorp (year 2002)*

At the end of the project we asked the users for three advantages/disadvantages which they observed when using the GSS. The right bar of each pair shows the advantages and disadvantages which the users *really perceived* when using the GSS. The figure shows the percentage of people who selected a given advantage/ disadvantage, e.g. 86 % of the respondents appreciated the improved access to information. It is notable that experiences did not differ much from expectations.

The main expected advantage was *improved access to information*. As **Figure 8** indicates, initial expectations were met and even exceeded by the user experiences with webcorp. 86.1 % of the users stated that they experienced *improved access to information*

by using webcorp. In second place, users expected *improved control regarding work done*, which was not completely met by webcorp. The same applies to the hopes for *time gained,* where the improvements in time management were obviously not completely achieved. In the case of the criterion *improved coordination of teams*, *reduced expenditure of coordination*, and *reduced number of meetings* the actual experiences made with webcorp more or less matched original expectations. Only the advantage *strengthening of team spirit* was not perceived by the users.

The need to spend additional time working with the tool was the most mentioned disadvantage. This finding lays ground for future research on how this perception is may change over time. One supposition could be that while users get more acquainted with the use of electronic media in general they will not mention this as a disadvantage in future surveys. Today a popular opinion among Swiss students is that computers are time killers. Some exemplary user citations are "too time consuming", "not really necessary in the given context". This is what our respondents confirmed for the use of the GSS. Roughly 58 % of the users mentioned this disadvantage. Users had already foreseen this concomitant factor of using an electronic platform in the 1st survey, as their final report on experiences in terms of additional time spent to use the system, exceeded their earlier predictions. On the other hand the participants were afraid of *technical problems* that in the end seemed to be a smaller problem than expected (48 % foreseen versus 24 % experienced). The concerns regarding a *too heavy focus on the tool* remained mainly unconfirmed (33 % versus 24 %). *Personal contacts* were clearly reduced with of the use of the tool. In this category users were suspicious but expectations were not exceeded by experiences. The values for the remaining number of perceived disadvantages *danger of information misuse*, *additional efforts for getting familiar with the tool* and *increased expenditure of coordination* corresponded closely with the expectations.

The perceived advantages in using the tool remain nearly unchanged compared to the previous years: *improved access to information* and *improved control regarding work done* are still the main advantages (realized as well as expected). The plenaxx users perceived the *reduced number of meetings* more strongly that the other two groups, which is a primary objective when using GSS. This advantage had obviously already been taken for granted in the third year and the attention towards this criterion moved a little more into the background when using webcorp.

The disadvantages show a more differentiated picture: while those participants who used VEGA or plenaxx most frequently stated *technical problems* and *additional time spent on the tool*, the webcorp users only complained about the *additional time spent on the tool. Time wasted with technical problems* was pointed out less frequently than in previous years. On the other hand *too few personal contacts* were more strongly perceived.

The overall rating of expectations versus real experiences is positive. The participants received what they expected and in some cases their expectations were positively exceeded; therefore there is support for our second proposition.

P2: The advantages that can be gained using the tools surmount the disadvantages.

6.3   *Effects on Communication*

A higher percentage of students reported that plenaxx facilitated their communication with the other participants (professors, company representative, school and students) than did VEGA; and a higher percentage of Students reported that webcorp facilitated their communication with the other participants than did plenaxx (cf. **Figure 9**). This indicates that the feedback from each period was effectively incorporated into the new tool.
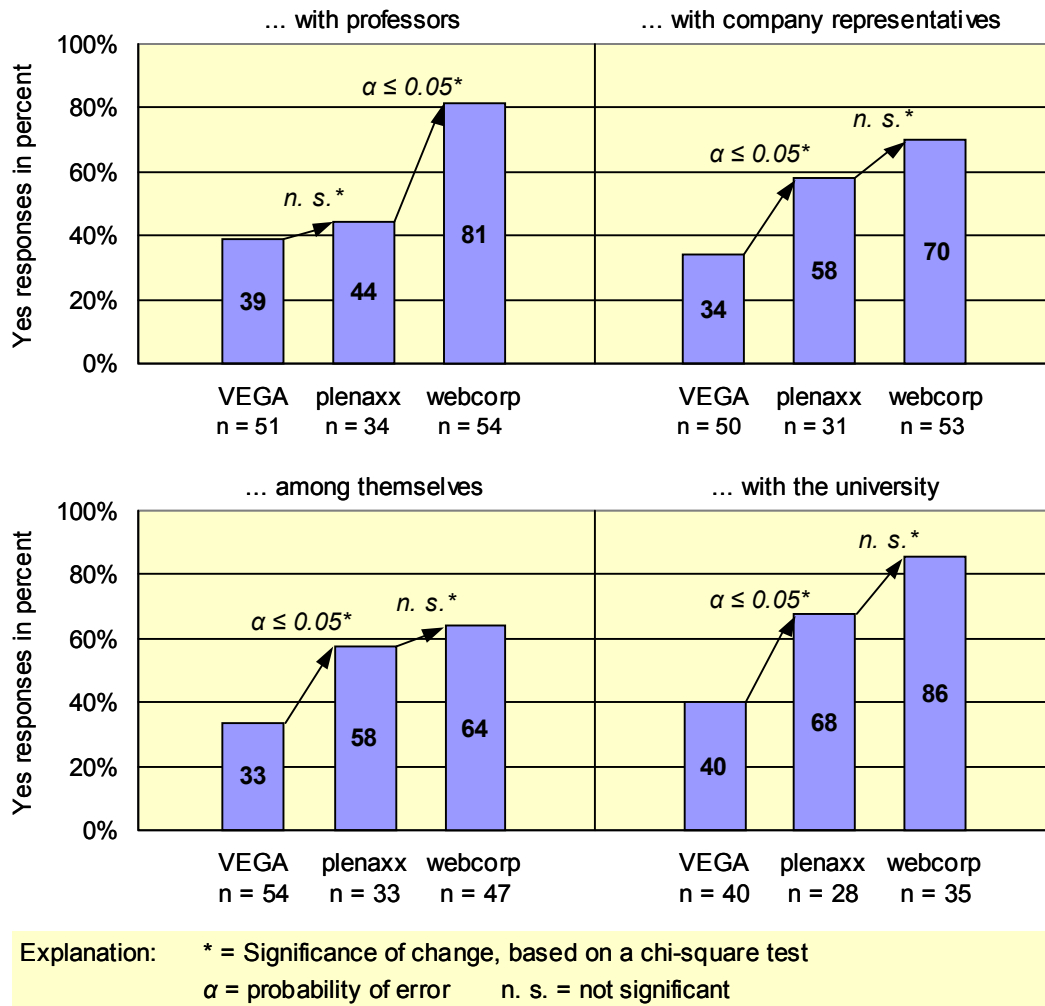
Figure 9: Reported percentages of yes responses to the question of whether the GSS tool facilitated communication each GSS tool

In general the findings indicate that the use of GSS lead to improved communication from year to year and that an increased level of acceptance of the platforms accompanied this. After the change to plenaxx in the second year many more professors and company representatives stated that communication with the students was beneficial. One year later, after the change to webcorp this high value remained stable. In 2002, a high percentage of professors also noticed an improved communication with other professors (58 %) and with the company representatives (50 %). Moreover, a considerable proportion of the company representatives (44 %) stated that the communication with the professors improved. These findings lend support for our third proposition.

P3: Even if the number of physical meetings among the project team members is high, Internet Groupware can effectively fulfill supporting tasks and improve communication.

6.4   Development over Time

The analysis of experiences with VEGA in the first year of this study showed that users called for a simpler system with optimized document management services and an integrated e-mail tool [Schubert/Dettling 2000, 23]. The platform "plenaxx" was introduced as an answer to these requirements. The corresponding analysis of the second

year indicated that plenaxx was indeed a simplified and better-suited tool [Leimstoll et al. 2001, 24]. The general satisfaction of the users was higher than in the previous year. Plenaxx became a victim of the Internet boom/bust and had to be replaced by the new platform webcorp. Webcorp provided a new platform in the third year that again showed an increase in user satisfaction [Leimstoll/Wackernagel 2002, 31].

As before, document management services were reported to be the most important features. The e-mail tool, which in the first year was separate from the platform, was an integrated service in plenaxx and webcorp and enabled the users to send messages to community members without keeping track of current e-mail addresses. The "notify members" option supplied a push mechanism that informed participants of new documents and ongoing events. In webcorp it is also possible to send short messages to the community members. Overall, the webcorp platform produced a higher perceived benefit for the project teams than the former platforms.

In the second year the number of *students* who used the platform decreased from 95 % (VEGA) to 88 % (plenaxx). In the third year this figure recovered and reached 97 % (webcorp). On the part of the *professors* the percentage of active users increased from 54 % (VEGA) to 70 % (plenaxx) and finally to 86 % (webcorp). Moreover, in the third year *company representatives* were also motivated to use the platform, with the percentage of users in this group rising from 29 % (VEGA) and 46 % (plenaxx) to a final high of 64 % (webcorp).

The increasing acceptance in the use of a groupware system may be due to several factors. The introduction of the webcorp platform users could quickly be convinced of the usefulness of the system. Benefits could already be identified in early stages of the process of getting acquainted with the platform. This is also shown by the fact that actual experiences often did not differ much from initial expectations towards the system. Another possible reason for the increased acceptance on the part of the professors is the existence of a competence center for e-business at the University, which increasingly penetrates daily business. On the side of the company representatives the increased acceptance may be due to progress in the diffusion of Internet technology in Swiss companies [Leimstoll/Schubert 2002].

The transition from VEGA to plenaxx made communication for students much easier (**Figure 9**). The differences in the evaluation of VEGA and plenaxx were statistically significant in the case of the communication of students among themselves, with the company representatives and with the university. Only the communication with the professors was not improved significantly from the students' point of view. In the latter case the null hypothesis of homogeneity cannot be rejected based on a chi-square test with a required significance level of 5 %.

The use of webcorp lead to an even larger proportion of the students perceiving a facilitation of communication with all user groups. This change, compared to plenaxx, is not statistically significant in the case of the communication of students among themselves, with the company representatives, and with the university (**Figure 9**). It could be an accidental side effect. The null hypothesis of homogeneity cannot be rejected based on a chi-square test with a required significance level of 5 %.

However, the communication with the professors changes fundamentally with the use of webcorp: compared to 44 % in the previous year now 81 % of the students state that webcorp facilitates the communication with the professors (**Figure 9**). This is statistically significant at the 0.05 level and show almost a 100% increase.

The overall trend towards a simplified tool continued over the three years of our survey. Based on the findings, usefulness and usability have been rated higher in the last case of

webcorp than in the previous years. This is clearly reflected in a higher acceptance of the webcorp platform. We can thus find support for our last hypothesis as well.

> P4: The maturity of Internet Groupware systems has evolved over the years and has now (in 2002) reached a level of maturity where they can effectively support collaborative processes among project team members.

7.   Lessons Learned

Some statements about GSS dominated our findings:

- User focus is on the central document container

- The main advantage is an improved access to information

- Internet groupware can facilitate communication among group members on distributed teams across organizational boundaries

- Usability and reliability of the user interface are factors, which are decisive for the perceived usefulness and acceptance by the users.

The study illustrates that project participants are to a great extent ready to use an Internet-based groupware system for the support of their consulting jobs. The focus of their use is on the central document container, followed by the e-mail distribution lists, the to do list, and the calendar. A series of further webcorp services were only scarcely used (e.g. discussion, calendar, voting, project controlling). For some of these services this may seem surprising since they are considered to be important for project management. Our explanation is the following: some of the GSS services compete with real-world circumstances (students see each other each day) and others have not been used because people are already using competing services (e.g. their personal PDA, project controlling tools, free Web page publishing). One user put it this way: "*We used the GSS very little. Since we meet each other daily and don't live millions of kilometers apart, the GSS was basically unnecessary.*"

On the one hand, the main advantage is an improved access to information. The overall rating shows that webcorp facilitates the work in the eyes of the participants and that they perceived various gains in efficiency and effectiveness positively. The comparison between expectations towards the system and perceived experiences were mostly in accordance with one another.

The webcorp platform is especially well-suited to support the communication and coordination processes of the learning community. However, there are some possible limitations to the generalization of this longitudinal study. We have to bear in mind that the main population of the survey was students. They meet each other on a daily basis and are not representative of distributed knowledge workers. For the company representatives the project was secondary compared to their regular duties. It is thus likely that the principals did not deal intensively with the GSS. As a consequence a portion of the users were not completely familiar with the platform and could not truly assess its potential.

The empirical study about the use of an Internet-based groupware tool allows conclusions about the maturity of technology and the acceptance of the Internet medium within the world of student groups. It has to be taken into consideration that the students were mostly between 20 and 30 years old and thus not representative for the active population of employees. It should be assumed that students have a more than average qualification for the use of electronic media and have more experience than an average person. Their

acceptance is likely to be higher. We will have to wait a few more years before the dissemination of the Internet reaches the same level in everyday business life that the students experience on a daily basis.

8.   Future Research

For the last three years the surveys were focused on expectations and experiences of users. We had to rely on their assessments of the frequency with which they used the groupware tool. This year we are going to extend our research into a quantitative analysis of the use of the platform with the help of log file analyses. We intend to compare the real number of accessed services with the appraisal given by the participants and thus we will be able to verify their statements.

We draw the following conclusion for the further development of groupware systems: the system should be very intuitive and easy to use so that users who do not access the platform frequently (maybe only once a week) can easily navigate in the system. For frequent users (daily use) performance is of highest importance and an excess of additional services should not impede speed.

The use of Internet groupware apparently requires a great learning effort. Nevertheless, this effort seems to be worthwhile for a well-engineered system. Three quarters of the participants indicate that they would use this platform for future projects. This statement is even stronger in the group of company representatives. 89 % intend to use an Internet groupware tool in the future.

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