2006

A Gaming Laboratory to Study Distributed Collaboration Processes.

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Monograph of the HICSS-39 Symposium on Case and Field Studies of Collaboration

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ISBN: 9056381504

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20 Years of Collaboration in the Military

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Abstract:

The US Army started using Collaborative tools such as Group Systems in the early 1980's. This paper traces the use and development of Group Systems across more than a 20 year period. Looking at early successes and failures, lessons are drawn on how apply collaborative tools in an organization. The role of Group Systems in preparing for Y2K and the development of the Army for the war on terrorism (Afghanistan and Iraq) is also examined.

Background

In the early 1980's the US Army Communications Command at Fort Huachuca, Arizona started supporting research being conducted at the University of Arizona in collaborative decision making. Early versions of GroupSystems were used for varied applications. Use was limited because the software was available only for use in a room at the University of Arizona. Because of the limited availability the Army uses tended to be one time meetings that were unique in their purpose. While the benefits of such meetings were easily seen even with early versions of the software, acceptance of collaborative decision for day-to-day activities was not practical.

AIRMICS (1982-1992)

In 1982 the Army Institute for Research in Management Information, Communications, and Computer Sciences (AIRMICS) became the research group for the newly formed US Army Information Systems Command (ISC). AIRMICS had been the research arm of the US Army Computer Systems Command which became the US Army Information Systems Engineering Command (ISEC). ISEC was a subordinate command under the ISC. The first Commanding General of ISC was Lieutenant General (LTG) Emmett Paige. LTG Paige was a visionary leader given the task of creating a unified information infrastructure. He was faced with moving a military culture from a communications focus to an information focus. He was extremely supportive of research and introduced AIRMICS to the group decision making research being done at the University of Arizona.

AIRMICS worked with the University of Arizona to demonstrate the power of electronic meetings. Typical applications involved brainstorming, ranking and voting. While these were powerful sessions there was not a repeatable application that was important enough to create a urgent demand for the software. The University of Arizona added an additional room that allowed larger groups and the software continued to evolve and expand. Demonstration sessions were held with many Army groups. However, the search continued for that application that required GroupSystems.

Program Manager Installation Support Modules

The first significant use of GroupSystems within the Army came when the approach was used to support the Program Manager Installation Support Modules (PM ISM). AIRMICS and the University of Arizona had identified the problem domain of software requirements definition as a potentially lucrative application of GroupSystems. Colonel (COL) Wayne Bird as PM ISM was charged with developing common application modules to be used at all Army installations around the world. COL Bird was using a structured approach that included bringing a small number of subject matter experts to a location for a 2-3 week requirements definition workshop. Because of the lengthy process it was difficult to get top people to attend and it also meant that the breadth of knowledge was limited by the relative small number of people involved. When the concept of GroupSystems was shown to COL Bird he immediately agreed to try it on his definition process.

The use of electronic meeting software allowed a much larger (25+ people vs. 6-8 before) and more diverse subject matter experts to come together to share their experience and knowledge in defining the module requirements. It was evident at the first session that the potential was being fulfilled. Having a larger number of people involved in the process produced a more comprehensive product. It also meant that there was better organizational buy-in since more organizations were involved in the development process. In general it was felt that the quality and quantity of work done exceeded what had been done in the requirement workshops. Even if all other things were equal the duration change would have been sufficient to change approaches. With GroupSystems the process was completed in less than three days or a 5 to 1 reduction in time spent in the requirement process. "In one of these sessions, for example, twenty people participated in producing a requirements document in three and a half days that participants who were experienced in similar non-supported sessions estimated would have taken four to six weeks without the tools. A project manager who was one of the participants estimated cost savings to be between $75,000 and $125,000. Another of these sessions took four and a half days to develop a functional description for a management information system. Future sessions recommended by management were estimated to produce savings of over $1,250,000, including personnel salaries." [1] While the application of GroupSystems was successful, the ISM project did not succeed because of applications development problems and change management issues.

Other Uses of GroupSystems

AIRMICS continued to expand uses of GroupSystems by implementing a portable electronic meeting facility. Breaking the bond of having to take people to fixed facilities at the University of Arizona expanded the number of groups able to experiment with GroupSystems.

Army Research Laboratory (1992-2004)

In the fall of 1992, AIRMICS became part of a new organization called the US Army Research Laboratory (ARL). AIRMICS continued to support research in collaborative decision making and electronic meetings. At this time, GroupSystems was accepted by many consulting groups in the Washington, DC area. The Department of Defense (DoD) was trying to do on a department wide level the same type of requirement analysis that COL Bird had done for the Army at the installation level. GroupSystems provided DoD with the same type of productivity improvements seen by PM ISM. It is interesting that the DoD project experienced a similar failure to produce lasting results in the form of implement systems. Since GroupSystems was now available as a commercial software product the ability to share the technology with various groups in DoD.

The portable systems initially developed by AIRMICS continued to be used to demonstrate the collaborative meeting technology and explore new ways to apply the technology. The portable system was taken to Germany to support simulation research and then applied to a project that developed the Army structure that was used so effectively in the invasion of Iraq in 2003.

Louisiana Maneuvers

In 1992 General Gordon Sullivan, Chief of Staff of the Army initiated a project called the Louisiana Maneuvers (LAM). LAM was named after a series of field exercises the Army held in Louisiana during 1940 when the Army Chief of Staff General George Marshall became alarmed by Nazi Germany's Blitzkrieg victory in France. The exercises help develop leaders and tactics that enabled America to be victorious in WWII. "General Sullivan intended to use the end of the Cold War, as the Army withdrew formations from Europe, to shape and hone a leaner, but more flexible and lethal, fighting force."[2]

The Louisiana Maneuvers Task Force was set up at Fort Monroe, Virginia with Brigadier General (BG) Tommy Franks as the Director. In his biography, General Franks says that "the job of the LAM Task Force was to explore the potential of innovative technology, doctrine, procedures, and training to ensure that this leaner war-fighting force would also remain the world's most powerful."[3] It might seem ironic that General Franks would develop the future Army that he would be called upon to lead in 2003 into Afghanistan and Iraq.

The need for an electronic meeting environment was pointed out by BG Franks when he described his job. "My position as a brigadier general task force director was similar to that of a vice president in a large corporation. Its board of directors was comprised of the chief of staff and the Army's four-star generals. And, as in the corporate world, we had no shortage of consultants – a group of two-star generals with expertise in all facets of Army operations."[4] The "consultants" were called the General Officer Working Group (GOWG). As General Franks said, the GOWG was made up of one and two star generals from around the Army. The first meeting of this group was held at Fort Monroe, VA and used a traditional meeting facilitator from a well known think tank. The result from the two day brainstorming session was a set of briefing slides with nothing to back them up except the memory of BG Franks. One of the senior members of BG Franks' staff knew about the work done by ARL using GroupSystems and he convinced BG Franks to visit the ARL office on the Georgia Tech campus in Atlanta (the former AIRMICS group). A simple demonstration convinced the general that this was a tool that he needed to try.

When the 15 generals walked into the conference room for the second LAM GOWG they were each faced with a computer. The first person that had to be convinced to use the tools was the facilitator from the think tank. While she did not hinder the process, she was not asked back to any future sessions. The experience level with computers covered the entire spectrum. Some generals were very experienced and took to the electronic process with ease. One of the generals had never touched a computer or typewriter. He was totally lost and embarrassed. It turned out that he had a computer in his office, but his secretary printed out all document including email and he never touched his machine. It turned out that exposing senior leaders to computers was a side benefit that General Sullivan wanted from the process. Today all Army senior leaders are totally reliant on secure computer connectivity. All generals carry Blackberries and are constantly in touch. GroupSystems worked as advertised and was used twice a year for all LAM GOWG meetings until the LAM Task Force was disbanded.

The results from the sessions were impressive. Instead of ending the meeting with only a few slides and no backup, BG Franks had all of the input from 2 days of intense activity by 15 skilled individuals. The group was able to move beyond brainstorming and ranking to use almost all the tools in the GroupSystems tool chest. Another side benefit of the approach was the ability to increase the size of the GOWG. As people became aware of the project more organizations wanted to have a voice in the products of the LAM Task Force. The GOWG grew to over 40 general officers and senior civilians. The acceptance of the process was evident by the fact that the final few meetings were held at the Army War College in Carlisle, PA where a fixed electronic meeting facility had been built and was being used for many group meetings and classes.

General Tommy Franks used Group Systems to shape the Army of the future, the Army that he led into Afghanistan and Iraq. The LAM Task Force was leading a wide ranging look at how to transform the US Army in light of the collapse of the Warsaw Pact. "The context for this wide-ranging reevaluation was the idea that America would no longer require a huge, expensive ground force based overseas. Instead the Army's war-fighting units would be stationed in the United States, and would be trained and equipped as a

Power Projection force, able to deploy quickly anywhere in the world in time of crisis or conflict."[5] The transformed Army worked as it was envisioned. Electronic meeting technology contributed to the development of the "new" Army.

Synthetic Theater of War – Europe (STOW-E)

Simulation was identified during the LAM Task Force work as a critical part of the process to transform the Army. A series of exercises were conducted called the Synthetic Theater of War (STOW). The STOW exercises blended real troops with simulated forces in a seamless fashion. In 1994 an exercise was conducted in Europe called STOW – Europe (STOW – E) that included NATO allies in the mix. Because of the success using GroupSystems with the LAM GOWG, ARL was invited to take the portable system to Europe to support STOW – E. While almost all applications of GroupsSystems in the Army to this point in time had been face-to-face meetings, STOW – E provided a different application. A critical part of the STOW –E exercise was visits by VIPs. Each VIP was assigned an individual to accompany the person and note questions and comments made by the VIP. As soon as the VIP left the guide went to a GroupSystems station and entered the information. This process not only captured the feedback and questions immediately, it also made them available to all parties in a timely fashion. This continuous use was also used to capture on-going problems and solutions as they were applied to the problems. The system was also used in face-to-face meetings each evening to capture what was happening and what needed to be accomplished. One of the major benefits of the use of the GroupSystems tools was that as soon as the STOW – E exercise was done everyone was able to leave. Everything needed for the development of an after action report had already been captured and much of the information had even been organized for distribution.

Other Users from LAM

The use of GroupSystems by the LAM Task Force introduced the technology to a generation of senior Army leaders. Several of the leaders used the concepts when they went back to their regular jobs. One of these leaders was General (GEN) Ric Shinseki. At he time of the LAM GOWG meetings GEN Shinseki was a Brigadier General assigned to the Pentagon. At the first meeting he attended he was pointed out to me as a key person to watch and someone that was going places in the Army. GEN Shinseki would turn out to be the Chief of Staff of the Army during Afghanistan and Iraq in 2003. While GEN Franks was the commander of the troops in the conflicts, GEN Shinseki was responsible for training, equipping and providing the Army that was going to war. So just as GEN Franks had to fight with the Army he help design, GEN Shinseki was an integral part of the design of the Army he led as Chief of Staff. In preparing for this paper I contacted GEN Shinseki by email and asked about his recollections of the process used during the LAM GOWG. He responded with the following thoughts:

> "Jim – I do remember you and electronic meetings from LAM TF work ups. I've used the concept myself a number of times in the years since. I found it particularly useful for brainstorming with groups that involved broad ranges in age; in intellectual agility and risk taking; in rank and experience, especially visible rank; and in the willingness to share thoughts. The electronic meeting leveled the playing field and teased out the thinking of most everyone at a work station. An old First Sergeant once told me that getting 10 to do the work of 10 takes real leadership. The electronic meeting gets 10 doing the work of 10. What does it require? Set up time to insure the system buzzes and whirrs, when needed; a good facilitator, who's been given a well thought through work plan to guide the brainstorming session; and participants who can type in some fashion. I thought electronic meetings got the best thinking out of an audience in ½ day when other concepts might take three. These are quick thoughts that go back many, many years."[6]

The insights from GEN Shinseki are to the point of what makes a senior leader want to use electronic meeting support such as GroupSystems. Even after some 10 years the uses and benefits are still fresh on his mind. The last time we had discussed this technology was over six years ago and even then it was GEN Shinseki that brought up the topic and proceeded to share with a group of Senior Army civilians how beneficial the approach was to group decision making.

Y2K

January 1, 2000 seems a long time ago and it might be easy to forget the level of concern and preparation that went into preparing for that moment in time. The Department of Defense was prepared and spent a lot of time and money getting ready for the event. One of the ways that DoD prepared for Y2K was the establishment of a DoD Decision Support Center(DSC) headed by Jeff Gaynor. Jeff brought together all the different military services and even our allies in a facility that was designed to monitor and respond to any negative event during Y2K. GroupSystems was an integral part of the tool box used by Jeff to monitor and if need be respond to events. GroupSystems was used in the DSC to capture and share information in real time. A more innovative use of the system was implemented in the Pentagon. Major Rachael Borhauer and Robert Harder developed processes that provided structured sharing of information across many offices within the Pentagon. Prior to their approach much of this information would have been coordinated by having Reserve Officers carry paper between offices for coordination and approval. The approach by Rachael and Bob provided immediate, simultaneous access to all offices involved in an action. One of the critical problems it addressed was to allow all people to know about a problem and yet quickly identify who were the real players and who didn't need to be involved. The time savings were significant and it also made sure that all the key players were involved to produce the best solution. Today this type of approach would be expected, but in 2000 it was new and innovative. This implementation was also interesting since the players were not sharing the same office space but were meeting in a cyber meeting room scattered around the Pentagon and Washington, DC. While no major negative events occurred during Y2K the application of GroupSystems was a success and influenced how future coordination was accomplished.

Acceptance

With over 20 years of varied uses what made the use of Group Systems or electronic meetings successful? While there are many points that could be made it seems that task, even participation, process, and outcome[7] remain as some of the most critical issues. The PM ISM application showed that there had to be an important task that was either going to be repeated many times or a single task that had such high visibility that the investment of time and resources demanded an approach like GroupSystems. GEN Shinseki pointed out the benefit of even participation. I have seen Generals get mad when anonymous comment said that one of their ideas was bad. They seemed to forget that no one knew it was their idea until they got mad and claimed the idea. There were many cases where the Sergeant had better ideas than the Colonel since they were closer to the problem. If there is no process then it is difficult to have a collaborative meeting. Using the approach for an ad hoc meeting doesn't usually work. However, innovative facilitators like Robert Harder are able to apply the technology in unique ways that create value in ways that produce truly valuable products. The LAM TF used GroupSystems while GEN Franks was the TF leader and continued to use the approach even after he departed. It had become institutionalized and was viewed as a critical part of the approach being used to transform the Army.

Barriers

Barriers to use of this type of technology can fall into short term or long term categories. A concern raised by users is the commitment to using the results of the group process.[7] Involvement of management in the process and a commitment to use the results of the group process, even when they don't agree with the results, is essential to long term acceptance of the approach. Another barrier to acceptance is the lack of qualified facilitators. Even as the technology moves from exclusively face-to-face to distributed mode, the need for facilitation in some form is still essential. While many barriers identified when the technology was in it's infancy[8] still apply, others have been addressed. The technology no longer requires a dedicated facility. Adequate examples of successes are available to help organizations identify ways to apply the technology for maximum benefit to the group.

Conclusion

The US Army was an early adopter of electronic meetings as a technology and has had several very successful applications over the last 20 years. Innovative applications have been done that have gone beyond the standard uses of the technology. However, senior level commitment and significant tasks where real benefit is easily seen, are critical to long term use of this or any new technology.

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Developing Large Scale Participant-Driven Group Support Systems: An Approach to Facilitating Large Groups

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1 Introduction

All organizations have untapped human capital. This is especially true in larger organizations where specialization and divisions of labor are the norm and the size of the group precludes an awareness of each member's skills and abilities. Facilitated meetings and collaborative systems have proven successful in leveraging a greater breadth of this human capital [1]. They do not, however, scale effectively to support large groups of over fifty participants, and fail completely with the very large groups of over 500 participants.

Group support systems (GSS) have been found to effectively support groups by providing a structured process to decompose problems, provide anonymous, parallel input and feedback, and evaluate alternatives [2]. Organizing and facilitating a meeting with a large group of individuals, however, poses numerous challenges. First, it may not be economically feasible to bring all of the members of the group together at the same time and same place. Second, it may be too disruptive for the organization to pull key personnel together for a proximal and/or synchronous meeting. Third, there may not be enough computer and network hardware for each participant to be able to utilize the GSS. Fourth, there are numerous political barriers to bringing a facilitator into a group deliberation. Finally, current GSS designs do not scale well to large groups. Information overload is a big problem as the group generates voluminous amounts of information that cannot be synthesized and utilized within limited time and cognitive constraints [3]. Participant-Driven GSS provides a framework to address these issues in order to facilitate large-scale, distributed, asynchronous group collaboration systems.

2 Problem Definition

2.1 Traditional Collaboration Engineering

Traditional collaboration engineering and facilitated GSS sessions are composed of proximal groups with generally less than 50 individuals. The collaboration engineering process follows two main stages: divergence and convergence. During the divergence stage, individuals on the team each work in parallel to brainstorm ideas about solutions to the task at hand. This stage of the collaborative process is participant driven and leads to a high level of user satisfaction, as users are able to work in parallel and see results from the group's creativity [4].

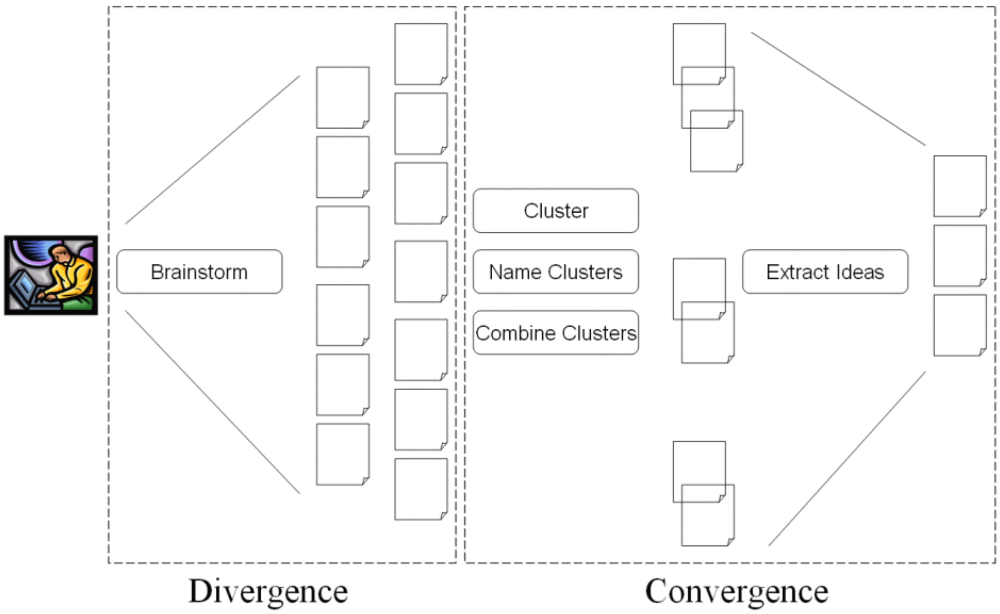

Figure 1 - Traditional Collaboration Process

The convergence stage focuses on synthesizing, organizing and sense-making of the brainstorming input. By doing so, the group can identify key issues and make the greater problem cognitively accessible. This process is labor intensive as a considerable amount of information must be processed and summarized. The volume of information creates further problems as the convergence process is performed serially through the use of a facilitator, creating a bottleneck in the collaborative process. Chen et al found that user satisfaction ratings drop significantly during this stage as users struggle with the serial process of consolidating the vast amount of brainstorming input [4]. Time constraints, larger groups and more data only exacerbate the problem..

2.2 Difficulties of Large GSS

One of the difficulties associated with facilitating a large group is that of physical proximity. Large groups are often unable to meet at the same physical location, as economic, scheduling and travel considerations may be prohibitive. One way around this limitation is to conduct a geographically distributed meeting where participants are able to collaborate from different locations. However, distributed meetings create other issues that range from technical system aspects to time zone coordination. As the group increases in size, the ability to hold a synchronous meeting becomes more infeasible. An asynchronous, distributed collaboration model will allow the support of geographically distributed groups where users are able to participate at varying times as their schedules permit.

A second difficulty associated with large group collaboration is information overload. As the size of the group increases, the amount of brainstorming input increases geometrically. The facilitator and the group members must synthesize a vast pool of information, increasing the potential of information overload. An increasing amount of time must be spent to coalesce the brainstorming input as the group size expands, leading to an overall increase in the time required to complete the collaborative process.

Another problem associated with large-scale collaboration is that of managing the flow of the collaborative process. A major role of the facilitator is to monitor the group and efficiently shepherd it through the collaborative process [5, 6]. This task becomes unrealistic with a large group. The facilitator simply doesn't have the tools to effectively guide hundreds of people through a complex collaborative effort.

3 PD-GSS to Accommodate Large Groups

Participant-Driven Group Support Systems (PD-GSS) provide structure whereby large groups are able to meet asynchronously via a web-based application. The phrase "participant driven" does not mean that the facilitator is completely removed from the process and that the practitioners are forced to conduct the collaborative work. Rather, "participant driven" means that more of the evaluative and subjective tasks are completed in parallel by the participants of the collaborative session rather than in a serial fashion with the facilitator. The system directs human efforts to the areas of the collaborative process that need work, where the human resources have the greatest payoff. The PD-GSS deconstructs the process and segments discrete units of work such that the group members are able to share the load of processing increasing amounts of data without suffering the negative effects of information overload. The PD-GSS framework provides an iterative process to leverage the skills and abilities of the participants to evaluate user input, group and categorize similar items, and identify "noise".

The conceptual design of PD-GSS relies on a few prominent features to enable successful facilitation of large groups. These features mitigate the difficulties of large group facilitation that were previously addressed. First, there must be a mechanism whereby the brainstorming input is monitored such that the quantity of "noise" in the system is significantly reduced. The PD-GSS design utilizes a peer review system that allows peers to edit and clarify brainstorming input such that brainstorming input is read and evaluated prior to being submitted to the overall brainstorming pool for the group at large. The review will use a template based on a "framing" structure to systematically evaluate the potential input. Schwarz [6] outlines a process to "frame" input to a group interaction in face-to-face groups that Adkins and Schwarz [7] are modifying for computer-mediated environments. The goal of this input filtering is to reduce the quantity of brainstorming input, increase the quality of the input, and not hinder the overall creativity of the group. In this fashion, the collaborative session can harness the experience and knowledge of the larger group while reducing the potential for information overload.

The convergence process is another key focus of the PD-GSS process. Instead of the group working serially through a facilitator, the team is able to continue working in parallel to synthesize the brainstorming input. To achieve this, the participants work in parallel at their workstations to perform the convergence necessary to synthesize the brainstorming input. This stage consists of users receiving units of work from the system and working in parallel with other group members. Depending on the current status of the collaborative process, the system may focus the human resources on clustering, evaluating, or ranking the categories of brainstorming input.

The design of the PD-GSS provides an opportunity for members of the team to work in an asynchronous, distributed fashion. Users are able to utilize web browsers and log on from any networked workstation. The asynchronous nature of the collaborative process scales well to large groups as geographical and time constraints are mitigated. The benefit from this design is that users are able to participate on their own schedule, enabling more thorough and reasoned ideas to be generated.

For example, after logging into the PD-GSS, the user will be directed by the system to the areas of the collaborative process that need work. The user may first be taken to a brainstorming module where the user is able to provide creative input to the group at large. After submitting the brainstorming input, the system recognizes the need for participants to perform reviews of the brainstorming input to rank the brainstorming input for collaborative filtering. Lastly, the system may recognize the need for group members to review a cluster of brainstorming input to determine if the cluster needs to be broken down into two discrete clusters. The user is then routed among various activities as time permits. The facilitator plays an integral part in the system by tuning the thresholds and controls regarding where human capital is needed in the process.

The overall objective of the PD-GSS system is to enable a collaborative framework that can be scaled to large groups. The PD-GSS allows the participants to be more involved in the entire process, increasing satisfaction levels and improving participant buy-in of solutions that are developed in the collaborative session. Additional process gains from using a GSS include synergy, increased learning, and more objective evaluation of the facts and current situation [2]. To scale to large groups, the PD-GSS reduces the burden on the facilitator by enabling the system to direct human capital where it is needed. The role of the facilitator in a PD-GSS is to monitor the collaborative work and to provide the necessary expertise to guide the system toward optimal use of human resources during the process by tuning various system parameters.

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Armadillos, Elephants, and Antelopes:
Three Cases of Distributed Software Development

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Abstract

In this paper we report case studies of three distributed software development projects. Each case involved a system with thousands of interdependent, fault-intolerant requirements and hundreds-of-thousands of lines of code. Each used a different development methodology. Each produced different results. In the first case, dubbed *Armadillo*, a CMM level 5 effort was promised, but a CMM Level 1 effort was achieved. After a 100% schedule overrun, the developers and customers jointly agreed that the code was unusable and the project failed. The second project, dubbed *Elephant* involved a CMM Level 5 effort using a waterfall methodology. This project had a 100% overrun of its planned schedule. The result was very high quality code which, nonetheless, only incorporated about 40% of required features, and included a number of features that were implemented in ways not useful to the users. The third case, dubbed *Antelope,* used a variation of the SCRUM agile development methodology. The team phased in SCRUM techniques one at a time and adapted each technique to their distributed circumstances. Once the methodology was implemented, the team rarely missed deadlines. Code was high-quality, and features were typically implemented in ways that the users deemed useful.

Introduction

Software development can be a high-value, but high risk undertaking. About 30% of software projects undertaken in the in the United States fail outright, and of the remainder, half finish with schedule and budget overruns that approximately double the original estimates (Standish Group, 1995). With the rise of outsourcing and off-shore development, many software development projects have acquired the additional risks that accrue to geographically distributed project teams – restrictive communication channels, differences of practice and policy, differences of language and culture, and time-zone challenges.

Given that organizations in the United States spend approximately $300 billion per year on software development (Standish Group, 1995), and given that a considerable portion of these expenditures are lost, even modest gains on the typical results could be of substantial value. Therefore, a great deal of work has been done to create software development methodologies that may mitigate some of the risks of software development, among them Capabilities Maturity Model (CMM) (Paulk, et al, 1993), and agile or extreme programming (XP) methodologies (Kent & Andres, 2004). While much has been written to explain these approaches and their benefits, to date, less has been written about attempts to realize these approaches in the workplace.

In this paper we narrate critical incidents of three large-scale distributed software development projects that took place between 2000 and 2004. Each project involved geographical separation among developers, testers, and the stakeholders for whom the software was being developed. Each of the projects involved a system with thousands of interdependent requirements, resulting in hundreds of thousands of lines of code. Each project required the development of capabilities that were not common in business information systems.

Each of the three projects used a different development methodology, and each had different outcomes. To protect the identity of the organizations involved, we use project code names in this paper – *Armadillo, Elephant, and Antelope*. The code names reflect some aspect of the development methodology.

In the next three sections we recount the critical incidents and results of these three software development projects. We then discuss the implications of these cases for practice and research.

The Armadillo Project

The Armadillo project was an off-shore outsourcing effort. A software company in the United States needed to create an Internet-based version of their flagship product. After soliciting external input from board members, bankers, and industry experts, and after internal consultations with the Chief Technology Officer (CTO) and the head of development, the executive management team took a decision to outsource the project to a large, well-known, and highly-respected software development company in India.

There were several reasons behind this choice. First, market conditions dictated that the project be completed quickly, and the in-house developers had little expertise in developing Internet-based systems. The off-shore development partner had thousands of technically skilled employees upon which they could draw to staff the project. The CTO conducted a due-diligence visit to the offshore site and reported that the personnel with whom he met had highly-developed cutting-edge development skills.

Second, the in-house developers were needed to maintain the current LAN-based product while development was under way on the new system. Third, the cost of hiring offshore developers was approximately ¼ that of hiring new in-house internet-skilled developers in the U.S. Fourth, the offshore development partner was willing to conduct the project in two phases – a fixed-price prototyping task to assess the scope and risk of the project, followed by a fixed-price development contract for the finished project, so the financial burden on the contracting company would be known in advance. Finally, the offshore developer had received a CMM Level 5 certification, indicating the highest level of professionalism and achievement. The in-house team had not yet reached CMM level 3. Thus, management judged that they were likely to receive a higher-quality product for less money by choosing off-shore development.

The Prototype Project

The companies signed an agreement for a two-month prototyping project, and a team of three engineers from the off-shore development team traveled to the customer's site in the United States. The customers and the engineers spent two weeks going over the features and functions of the existing LAN-based product. They agreed that the prototype should fully replicate the functions of one of the ten key modules in the customer's existing system.

The engineers returned to India, taking a copy of the original product with them to guide their work. However, they did not install the product at their site. They did, however, converse several times a week by phone and e-mail with their counterparts in U.S. to clarify concepts.

The prototype was delivered to the customer on its agreed delivery date. However, the prototype implemented only a fraction of the features in the original module. User testing revealed that it was unstable and prone to crashing. The initial product plan called for the new product to be implemented on top of a commercial off-the-shelf middleware and database system. However, the response times in the prototype were slow, and the cost of the COTS middleware product was expensive. The decision was therefore made to create a custom-built server from scratch for the final product.

Engineers of the customer company inspected the prototype code and reported to management that the code showed no evidence of professional programming practices. They reported that the code lacked structure, consistency, and internal documentation. Its implementation choices were reported to be round-about, unwieldy, and amateurish. Management raised these issues with the offshore development team. The offshore team assured them that short-cuts had been taken deliberately, knowing that the effort was a prototype. Management accepted this explanation over the objections of the in-house developers. Some in management confided that they believed the concerns expressed by in-house developers as strategic attempts to defend their turf.

The Full Project

Based on knowledge gained during the prototyping experience, the offshore company offered a proposal for completing the full project in 9 months at a fixed price.

The in-house developers could not match that schedule. They estimated that it would take 2 years or more to do the project in house. Two members of the in-house development team expressed concerns to management that the offshore team had badly underestimated the level of effort required to complete the project. Encouraged by the promise of a CMM Level 5 effort, the customer company signed a contract for the full product. The contract called for the developers to deliver the project in phases, and for payments to be made for the completion of each phase.

Two engineers from the offshore site once again visited the customer site for two weeks to gain knowledge of the customer's original product. Only one of them had been involved in the prototyping project. Meanwhile, the offshore company formed a development team of 15 programmers to build the new system, only 4 of whom had been part of the prototyping effort.

Two members of the in-house development team expressed concerns that the off-shore company had underestimated the level of effort that would be necessary to build the product. They pointed out that the two previous versions of the original product had required 27 and 36 person-years of effort to complete. The customer's management team discounted those concerns because a) they had a fixed price contract, so any extra effort would not cost the customer additional money; and b) the offshore team had sterling reputation in the industry for sophisticated development methodologies, high technical skills, and on-time delivery. They had done billions of dollars of business with highly-demanding customers in Japan who readily attested to their satisfaction with the offshore partner.

However, due in part to their well-deserved reputation, at the time the Armadillo project began, the offshore partner was undergoing rapid growth. They had hired 1000 new technical personnel over the past year. Unbeknownst to the customer, only one of the offshore people assigned to the Armadillo project had been with the company as long as a year. None of the development team had any project management skills. None were qualified to conduct a CMM Level 5 project. All but one were entry-level programmers.

The project proceeded in a dysfunctional cycle, from which it gained its code name, Armadillo. As a threatened armadillo will curl up in a defensive ball, so the off-shore team adopted a defensive posture and stopped communicating with the customer. The visiting offshore engineers would hold general discussions about some subset of the capabilities required for the current phase. They would then depart, ostensibly to create design documents for the customer to approve. In their next communication, they reported that the code for the modules under discussion were completed, and asked the customer to sign them off. In each case, the customer found that the features and interfaces were not implemented in ways that fulfilled user needs, and that it was not possible to run the modules because they had so many bugs. In each case, offshore representatives apologized and gave assurances that the flaws would be fixed. In the next round of development, the specific problems discovered in the previous round would be fixed, but none of the remaining functionality would work, and the fixes typically introduced new problems. In the mean time, visiting engineers would gather new high-level requirements for the next batch of features and functions, promise design documents, but deliver non-functional code instead.

The customer paid the first two installments as agreed in the contract, although the offshore team missed both deadlines. When the third deadline arrived, and the offshore team had delivered neither design documents nor working code, the customer's management exercised an option to terminate the contract. The offshore developer offered to correct all problems and complete the project without further payments until after final delivery of the product. The customer agreed and the project continued.

Little changed in the relationship between the customer and the offshore team. 18 months into the project, the manager of the offshore team notified the customer that the product was completed, and asked that customer representatives come to India for two weeks of acceptance testing. Customer personnel were skeptical because they had never seen functioning code, but they agreed to make the trip.

The Outcome

When the first customer representative arrived, he discovered that the system could be started, but activating any button, menu item, or other control on the interface caused the system to crash. The offshore project leader apologized, saying it was most likely an installation hiccup that would be corrected by the next day. He requested that the customer sign off the project at that time, given that it was so close to completion. The customer representative declined.

The next day, the customer representative found that each of the controls on the opening screen now functioned, but that all the controls on all the resulting sub-screens either did nothing or crashed the system. At that juncture he asked the project lead whether the programmers had done integration testing. The project lead was not aware of the concept, nor was he familiar with the concepts of unit testing, version control, peer code review, or bug-tracking. The customer representative established a simple bug-tracking system using a shared spreadsheet, and spent the balance of the week testing and writing bug reports. Each day, the off-shore project leader requested that the customer representative sign off the code as accepted, promising that the last few bugs would be resolved immediately, so there was no need to delay acceptance.

The following week, a second customer representative arrived. He undertook a formal code inspection and determined that a) fewer than half the features contracted for the project had been attempted; and b) the code was so badly written that it would not be possible to fix and maintain it. Over the next month, the offshore development team attempted to breathe life into the code. However, without a version control system, bugs and features that were introduced in one build frequently disappeared in a subsequent build because different programmers would work on the same module, and the last person to finish working on a module frequently overwrote all the work done by others.

After meetings between the leadership of the customer and offshore development organizations, the code was scrapped. The customer had paid approximately $350,000 USD on the project, and the off shore developer had incurred approximately $1 million USD in expenses. In a post-mortem review, key personnel at the customer site concluded that they had not assigned sufficient personnel to the project to manage it effectively. They also concluded that, while the personnel they assigned to the project were experts in their respective fields, none had sufficient experience with distributed software development and outsourcing projects to guide the project successfully.

The Elephant Project

The Elephant project, like the Armadillo project, was an offshore outsourcing effort. Like the Armadillo project, it was conducted under a fixed-price contract after an extensive prototyping phase. Like the Armadillo project, the offshore developer underestimated the level of effort that would be required to complete the project. Like the Armadillo project, the customer felt pleased to have negotiated such favorable terms.

Unlike the Armadillo, however, the Elephant offshore project leader had a high degree of technical and project management skills. He had a history of success with large-scale software development projects. He directed two experienced software engineers to rent an apartment next door the customer's offices to establish a permanent presence. He and the software engineers worked with the customer to establish the high level requirements for the system, and then he broke the project into 47 modules, and organized them into delivery in four phases.

This offshore project leader held a daily teleconference among the customer, the onsite engineers, some offshore engineers, and himself. He then required that the customers work with his engineers to write detailed specifications for all the modules planned for the first phase. When the first draft of each specification was complete, he negotiated with the customer about which of the features and functions would be built, and which would not be built, given the constraints of time and money under which he was working. The customer was reluctant to sacrifice any features and functions, given that they had contracted for a complete system. The offshore project manager took a hard line, insisting that the requirements be cut. The customers reported that very quickly they came to believe the project manager was actively working against their interests.

The offshore project manager required that, after agreement was reached on the specifications for a module and that the customer sign off agreeing to those specifications. Once the specification had been signed off, he steadfastly refused most changes. He made exceptions only when it could be clearly proven that a) a change would significantly cut development time; or b) a specification in question conflicted badly with a specification written later in the process.

After the specifications for each module were signed off, the offshore project leader required that customer personnel and onsite and offshore engineers worked together to create test cases for that module. The software system was sufficiently complex that a rough calculation suggested more than 200 million use cases might be possible, and many more test cases. The team agreed to test the most common use cases and the most critical and highest risk features and functions. By the end of the project they had developed 30,000 formal test cases. The project leader required that test cases be reviewed in detail by the customer and signed off as accepted. The specification and test-case writing required one year to complete. The test cases alone filled a four-foot file cabinet.

The offshore project leader established a web-based bug-tracking system, and designed a process for accepting, validating, prioritizing, fixing, testing, and signing off bugs. He created an on-line project management dashboard that displayed at a glance the progress on all elements of the project that were currently under way. He also adopted and implemented a version control system for software modules. He implemented twice-daily status reporting systems with his staff, and once-daily phone conferences with the customer.

When the specifications and test cases for all modules in the first delivery package were completed, the project leader convened a team of approximately 20 developers and put them through intensive multi-day boot-camp style training on the programming and project management tools practices that would be used for the project. He created a tight production schedule for the modules with milestones and intermediate deliverables. He also contracted with a third party firm for a team of 15 testers who would work in shifts around the clock to execute the test cases for each module as it neared completion.

The relationship between the project leader and the customer grew increasingly strained over the first 6 months of the project, and became adversarial. All exchanges by telephone were formal and polite, but the daily calls came to be confrontational as the project leader insisted that more features and functions be cut, while the customer insisted that more be added.

After six months, customer personnel visited the offshore development site and met face-to-face with the offshore developer's project leader for the first time. All parties reported being surprised at the degree of warmth, cordiality, and respect that instantly grew between them. During this meeting, the project leader revealed that his upper management had learned just how badly the project had been underbid, and they had insisted that the project be canceled immediately. He said that he considered it a matter of honor that the company should deliver what it promised to the customer, and he reported running battles with management to keep the project afloat. Shortly after meeting with the project leader, customer personnel met with managers of the offshore company, who confirmed that they were unhappy with the project and wanted to cancel it. By rigorously holding the line on the features and functions, and by denying almost all change requests, the project leader had gained management acquiescence to continue the project. People on both sides of the dispute concurred that the project manager seemed to be working in the best interests of both the customer and the offshore company

The customer representatives urged their own management to bring the project back in house at this point, citing the risks of continuing the project offshore without top-level support from the leadership of the offshore partner. However, customer managers did not have the budget to finish the project in house, so the project was allowed to continue.

As each module was completed, it was sent to the customer for testing and acceptance sign-off. Bugs were reported, and hard, but now cordial negotiations ensued about which bugs would be fixed and which would not, given the constraints of time and budget. Once agreed bugs were fixed, the project manager refused to make any modifications to the module except in rare cases where unexpected interdependencies with other modules caused severe performance problems. When all the modules in a delivery phase were signed off, then the customer signed off the whole phase, and it was deemed to be complete.

The Outcome of the Elephant Project.

Code inspections revealed that the code held to reasonable standards for structure, simplicity, and internal documentation. Error rates in the finished code were calculated to be .25 bugs per thousand lines of code (KLOC), considerably better than industry standards. Most modules were delivered on or near their projected due date. However, the module-by-module build-and-freeze approach appeared to have shifted focus away from the higher level systems view. Design choices made in some modules conflicted with design choices made in other modules. There were a number of aspects of the resulting system that the customers found unsatisfactory because, although each module functioned to specifications, they did not always work together in ways the customers deemed useful.

As the third phase of the project drew to a close, upper management at the offshore development company made the decision to discontinue the project. They refused to complete the fourth phase unless the contract was renegotiated. Although the contract assigned all the intellectual property rights to the customer, and foreclosed the option of withholding source code from the customer in the case of a dispute, the offshore development company withheld the source-code from the customer, and requested twice the agreed amount on the contract to help offset the expenses they had already incurred. The customer demurred, and a stalemate ensued.

One of the people on the customer's technical team discovered that the developers had not obfuscated the compiled code, which meant that it could be successfully decompiled. The decompiled modules still retained the clean structure in which they were written, and retained most of the original variable names. The decompiled code did not include internal documentation, and only about 40% of the original feature set was in the third module. After some debate, the customer decided to complete the project in house using the decompiled code as a starting point. Over the next year, the customer completed enough of the project to put the software into production use. Both sides in the dispute threatened lawsuits, but none were initiated.

During post-project review, customer personnel concluded that they should have assigned senior staff full-time to the offshore site for the duration of the project, to build relationships with offshore management and developers, to gain further clarity into the status of the project, and to represent the customer's interests day-to-day.

The Antelope Project

The Antelope project was an in-house development project at a small, entrepreneurial start up company with tight funds and a short window of opportunity to produce a marketable software product. The company recruited a core team of four people with the requisite talent and skills to accomplish the task. The recruits lived in and around the Silicon Valley area. None of them were willing to accept positions if they were required to move away from California to the company headquarters because a) they regarded the start-up as too high risk to justify selling their houses and moving away and b) they wanted to maintain their professional networks and contacts in the Silicon Valley area. The company therefore decided to attempt a distributed software development team.

The developers decided very early on to implement some variation of an agile development methodology (Cockburn, 2001). Agile methodologies use very short development cycles and continuous consultation with stakeholders in lieu of the large-scale documentation of specifications and test cases like those used in the Elephant project. However, two of the basic principles of agile development are that a) programmers will be physically co-located, and b) programmers will work on tasks in pairs, rather than as individuals. Thus, the team would need to adapt the methodology they selected to accommodate virtual teamwork.

After some research, the team decided to use the SCRUM methodology (Beedle, et Al., 2000) as the foundation for their work. SCRUM is specifically designed for software development teams who work face-to-face. On this project, each developer was in a different city. They also decided that, given that none of them had ever used SCRUM, nor any other development methodology, they could not hope to appropriate the entire approach in a single go. Instead, they decided, they would adopt and adapt one element per month until they had implemented a complete development methodology.

The first element they chose to adopt was that no development cycle would last longer than 30 days. These 30-day cycles are called *sprints* in the SCRUM methodology. It is a rule of the methodology that any software started during a sprint would be completed and tested during that sprint. In consultation with the person filling the role of product owner, the developers decided which were the first elements of the product they should undertake. They also selected and implemented a version control system for their code.

At the end of the first sprint, each had completed a small piece of software, but none had tested or debugged their module. They therefore implemented a second short sprint during which they tested and debugged.

For the next sprint, the team adopted a practice of stand-up meetings at the beginning of each day. In this meeting, each person would address three topics: What did you do yesterday, what are you going to do today, and what are your barriers to success? Any conversation that deviated from these three topics was to be deferred to follow-on meetings. They implemented the stand-up meeting with conventional teleconferencing.

In the following sprint, they decided that they must reserve the last week of each sprint for testing and debugging, so they could deliver finished code at the end of the sprint.

The next element of SCRUM that the team added was a sprint planning day. Between each sprint, the team would take half-a-day to reexamine priorities and decide what should be accomplished. In order to accomplish this effort, the team chose a group support system that allowed each of them to see and contribute simultaneously to the same shared outline via the Internet. The product owner worked with the team to prioritize the features and functions that could be built during the upcoming sprint, and then the programmers selected the tasks they thought they could finish during the sprint, and committed to finish them by the end of the sprint. Programmer estimates of level-of-effort were recorded, and programmers tracked actual effort throughout the sprint.

Over the next several sprints, the team determined that level-of-effort estimates should be multiplied by a factor of two to account for interruptions, technology maintenance, learning time, meetings, testing, bug fixes, and unexpected difficulties. Thereafter, programmers made their best estimates of level-of-effort, but only accepted tasks project to fill half the number of work days in the sprint. The 2x multiplier held up well over the following year.

The next SCRUM practice the team adopted was to establish a *story backlog*. In Scrum a story is a narration of something a stakeholder wants the system to do. For example, “It should be possible to save report settings as templates, so that users who pull the same kind of report frequently don't have to configure every setting manually every time they pull the report. It should also be possible to share these templates with others when the user desires to do so. However it should not be mandatory. Some users may want to keep their report templates private, and others may not want to browse through hundreds of templates looking for the one they care about."

Under the SCRUM approach, any stakeholder who has a story to tell can submit it to the product owner. The product owner decides which of the stories should be entered into the backlog – the record of features and functions that have not yet been implemented. The product owner prioritizes the stories. During the sprint planning day, the product owner proposes a small subset of high-priority stories for the programmers to consider. Programmers choose from among those stories when committing to the work of the sprint. The programmers, the product owners, and other stakeholders discuss how a story could be realized, and then the programmer works through the sprint to accomplish it. It is often the case that a story would require more than one sprint to complete. In such cases, a shorter story is written for each sprint until the larger story has been fulfilled.

Stakeholders used a variation of the same shared outline software they used for the planning day to propose stories to the product owner. The product owner reorganized and reprioritized the stories the day before sprint-planning day. The task typically took the whole day because it fell to the product owner to integrate the interests and insights of all other stakeholders into the prioritization, so the task was accompanied by a number of phone calls and e-mail messages.

The next step in building the distributed project team was dubbed, "The Pizza Team." While it was deemed vital that the programmers test and debug their own code, it was not sufficient. Over time the team adopted a humorous refrain whenever a new bug was discovered, "But it runs fine on my machine!" To validate the quality of the code, it was necessary to install it fresh on computers that the programmers had not configured themselves, and to test how it ran.

The company's home office was situated near a large call center that housed the help desk for the web site of an international package delivery service. The company approached some of the help-desk personnel on the day shift and offered them a week or two per month of half-shift work at night for 50% more per hour than they were earning at the call center. The call center employees agreed on the condition that they also be supplied with pizza and sodas every night that they worked. The Pizza Team would convene for at least five evenings of testing toward the end of every sprint. They would install the latest build on freshly scrubbed hard drives, and then spend the evening trying to break it. They devised creative ways to find the flaws, and accorded high status to those who found the most bugs. They entered the bugs they found into the online bug-tracking system. The product owner and the programmers would jury the bugs and assign severity ratings to them. The product owner would collect related bugs and write a story for them which went into the backlog. The company devoted some effort to maintaining a lively, fun, sometimes silly atmosphere for the Pizza Team, so the night work would not seem to burdensome, given that all of them were still working full time for their other employer.

Once the test team was in place, the developers next formalized their process of estimating the level of effort required to complete their agreed tasks for a sprint. They broke down every task into subtask, none of which could be longer than a single day. They estimated the hours required to complete each subtask, and recorded their estimates in a shared spreadsheet. The spreadsheet contained several algorithms for calculating the degree of completion for each individual and for the sprint as a whole. The spreadsheet included a graph that projected a trend to a completion date, given progress so far. This allowed for mid-sprint corrections if a programmer took on too much, or if a task turned out to be more time-consuming than had been expected.

At this point the team also adopted a policy that, even if priorities shifted dramatically in the middle of a sprint, they would not interrupt the sprint to respond to those changes. They reasoned that, since a given sprint would be only a few days from completion when priorities changed, they would finish the sprint, and then address the changed priorities on the next sprint's planning day.

Finally, the team adopted a formal after-action review. They used their shared outline tool to brainstorm responses to three questions:

- What did we do right during this sprint?
- What should we change for the next sprint?
- What haven't we done yet that we want to do?

The team would then review and discuss every comment made in response to each of these questions, and decide how to adapt their procedures. This exercise typically lasted three to four hours.

The Results of the Antelope Project

Within about 10 months, the development team was practicing a fairly stable agile development methodology with each team member in a different city. The code produced under this methodology tended to be of high quality – stable, and with few bugs. Stakeholders reported that the coded tended to suit their needs and interests. When it did not, the product owner helped them write new stories to address the problems. Management reported feeling satisfied that the team rarely missed a deadline. Because the chunks they undertook were so small, delivery delays were also small. Most sprints finished on time. Two finished a day late. One finished a week late. By the 10th month, the team decided that they would not allow a sprint to run late. Rather, they would track progress daily, and if someone started falling behind, they would either work longer hours, pitch in to help, or remove some functionality from the sprint.

The programmers found that, for the most part they could work effectively without being co-located. They made extensive use of telephones and instant messaging when they needed help from one another. Occasionally, however, they encountered intractable problems that required face-to-face help. In those cases, they would converge on one city for a day or two, work together, and then go their separate ways again. The product owner also felt it was useful about every other sprint to conduct the sprint review/sprint planning day face-to-face. So, every other month the key stakeholders would gather in one city for that event.

The approach afforded the company the agility they hoped for when they adopted it. The company was in a volatile market niche where conditions changed almost weekly. The development trajectory of the project changed rapidly over the course of several sprint as priorities re-aligned, but these changes did not appear to disrupt the overall forward progress of the project.

The product owner maintained a system-level vision for the project, so the Antelope project did not experience some of the difficulties with respect to a module-level focus reported by the participants in the Elephant project.

As time passed, various members of the development team rotated out to other organizations. In several of those cases, they carried the distributed software development methodology with them to that new organization. As new people joined the company, they were indoctrinated to the methodology. As of this writing, none of the original four participants in the project remain at the company, but the practices they developed are still in use.

Conclusions

There are lessons with respect to transparency, adaptability, and self-improvement to be drawn from each of the cases reported here. Transparency is the degree to which the progress of the project was visible to the stakeholders. Adaptability is the degree to which stakeholders could respond to an identified need to shift priorities. Self-improvement is the degree to which the stakeholders are able to identify and correct deficiencies in their work practices.

The Armadillo case reinforces lessons that have long been a part of software development lore. It demonstrates yet again the importance of having a rigorous software development methodology. There no transparency for any stakeholders on this project. Neither the offshore development company, which had a sterling record of good quality work, nor the customer recognized the early warning signs that the project was in trouble. Among these were:

- The lack of a project leader with a history of software development success
- The absence of experienced programmers in the development team mix.
- The low quality code produced in the prototyping phase
- A lack of project management tools and practices
- The first time bad code was delivered in lieu of design documents

It would be difficult to characterize the Armadillo project as either adaptable or rigid. There was no formal process for either setting or changing priorities. Requests for changes frequently went directly from a customer representative to a programmer without any management consideration. Change changes were chaotic and uncontrolled. Further, with no transparency, even for the programmers, there was also no basis for identifying problems, and therefore no basis for process improvement over time.

The Elephant project was substantially more transparent than the Armadillo case. Internally, the offshore project leader's project dashboard used visual meter-dial readouts on progress toward intermediate and overall project goals. There was a Gantt chart for each development package, and it was used to compare actual to projected progress. There was somewhat less transparency between the offshore site and the customer site. The offshore project manager placed a high value on not missing deadlines. He was therefore reluctant to promise deadlines until he was very certain of achieving them. Thus, the customer rarely knew when a project cycle would be completed until a few weeks before delivery. There were also some mechanisms for self improvement in the Elephant project. The offshore project manager analyzed patterns from the bug database to determine whether the problems arose from vague requirements, inadequate programmer skills, insufficient quality control, and so on, and he took frequent measures to adjust the team's practices based on those analyses.

However, there was virtually no adaptability in the Elephant project. The development methodology was founded on the assumption that system requirements could be known and documented before the system was built. This assumption contravenes Boehm's Law, "System requirements cannot be known before the project is finished (Boehm, Gruenbacher, and Briggs, 2001)." As Boehm posits, all stakeholders in the Elephant project learned a great deal as the project progressed, and among the stakeholders, the balance of priorities shifted over time among software quality, cost, schedule, and the completeness of the feature set. However, insights and shifts of priority could not be accommodated, and the system was built mostly to its original, and of necessity, inadequate specifications.

Both the Armadillo and Elephant cases also illustrate Boehm's Maxim, "In software development, win-lose will go lose-lose very quickly" (Boehm, Gruenbacher, & Briggs, 2001). In both of these cases, the customer drove a hard bargain with the developer, and the developer was therefore unable to deliver code of the quality desired by the customer. Boehm points out that any of the success critical stakeholders in a system development project has the power to turn the situation from win-lose to lose-lose. If customers and users gang up on developers to derive too hard a bargain and demand too many features, the developer can deliver shoddy or incomplete code. If the developer and the customer gang up to keep costs down by making the system too Spartan, the users can simply refuse to use it. If the developers and users gang up to include lots of bells and whistles, the customer can cancel the project and refuse to pay. Thus, the project can succeed only if the stakeholders negotiate and re-negotiate in good faith over the life of the project to keep the situation win-win. In the Armadillo and Elephant cases, win-lose became lose-lose.

The Antelope project demonstrated transparency with its online story management and online daily progress tracking which were available to all stakeholders. It derived flexibility in that it only committed resources to a 30 day cycle, and at the end of each cycle, usable, tested code was delivered. This meant that the lessons learned and changes of priority could be taken into account for the next sprint. The empirical nature of the Antelope project, and the monthly post-mortem sessions provided the means for self-improvement, and were a big factor in the success of the project. It effectively changed the team's focus from a checklist oriented work day to a team based effort to monitor progress and efficiency in an effort to increase ROI.

The Antelope case further demonstrates that it is possible to conduct a successful agile methodology among geographically distributed developers, and without pairing programmers on tasks. That said, the original four participants in the project all reported that they could have been even more productive had they been co-located. However, given that this was not an option, the distributed team was acceptably effective and efficient.

The agile methodology reported here was the most successful of the three projects, but it is not our purpose in relating these cases to advocate agile methodologies to the exclusion of other approaches. There are risks and payoffs for any methodology. Under different circumstances or with different personnel, the Elephant project might have gone better, and the Antelope project might have gone worse. Rather, our purpose is to relate critical incidents for three different approaches to distributed software development teams, and to interpret the consequences of many choices made by each of those teams. It is our hope that practitioners of distributed software development may draw inferences from these reports that may improve the success of their practices, and that researchers may find useful insights that suggest further advances in distributed development methodologies.

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Definitions in Collaboration Engineering

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Abstract

Collaboration Engineering (CE) is an approach to the deployment of collaboration support that emphasizes on the design of collaboration processes. CE collaboration processes are designed to be transferred to practitioners in organizations. The aim of CE is to enable practitioners to successfully execute a specific collaboration process on a recurring basis without support from professional facilitators. Due to the recurring nature, and the focus on training just one process, CE intends to stimulate a more sustained implementation of collaboration support. CE is maturing as a research field. An important step in this process is to define the most important phenomena, processes and roles in the field. This paper will aim to do so. It will offer a deeper understanding of the scope of CE and therewith a basis for a more consistent research field.

1. Introduction

Many organizations now depend on collaborative work practices for their success [1]. A collaborative work practice is a recurring process that can only be completed through the combined mental efforts of multiple people. Examples of collaborative work practices include mission critical tasks such as software requirements engineering, operational risk assessments, tender evaluations, and project proposal writing. While collaborative work practices can create significant value, collaboration can be a mixed blessing. Conflicts of purpose, unreliable information, poor communication, inadequate reasoning processes, and distractions can hamper a group's efficiency, limiting the value it can create. These difficulties become magnified when, as is often the case in the global economy, the contributors to collaborative work processes are separated by time and distance.

To increase the efficiency and effectiveness of collaboration, many organizations have turned to collaboration support and supporting technologies. However, good technologies alone are not enough; the value of the technology depends on how skillful and purposeful it is used. Therefore, collaboration technologies, wielded inexpertly, do not necessarily yield group productivity [2]. Because the techniques for enhancing group performance may not be obvious and intuitive to non-experts, some organizations have come to rely on professional facilitators who can design and conduct collaboration processes on behalf of a group to increase the effectiveness and efficiency of a collaboration effort. Although research shows that facilitators can substantially increase the success of collaborative efforts [3] it can be difficult to sustain facilitation support in organizations. Successful facilitators must be bright, articulate people persons with a good grasp of group dynamics and a penchant for solving problems. Such people who work as external consultants can be expensive to hire, while such people who serve as facilitators internal to an organization often leave the practice of facilitation after a short time to take on new challenges [4]. Thus, given the scarcity and expense of facilitators, many groups that could benefit from facilitation support may not have access to it. Collaboration Engineering, a new approach to group process design, seeks to provide some of the benefits of a facilitator to groups who have no ready access to facilitators. Like all collaboration support, the aim of Collaboration Engineering is to increase the efficiency and effectiveness of collaboration efforts in organizations.

Collaboration Engineering (CE) is an approach to designing collaborative work practices for high-value recurring tasks, and transferring those designs to practitioners to execute for themselves without the ongoing intervention of a professional facilitator [5]. Collaboration engineers focus their efforts on recurring tasks that yield high value to an organization, so the organization can reap ongoing benefits from the CE effort. Collaboration engineers seek to package the best practices of master facilitators in a form that can be reused successfully by people who are not, themselves facilitation professionals [5]. A small-scale collaboration engineering project may require less than a day of effort. However, a large-scale CE project, where a collaboration process is designed, piloted, tested, refined, and transferred to practitioners and executed in the organization to become a sustained process, can take several years. For such large efforts, rigorous methodologies may minimize wasted resources and optimize the value an organization derives from a collaboration engineering project.

The collaboration engineering research community is currently using the Four Ways framework [6] as an organizing framework for deriving a rigorous approach to designing and deploying collaborative work practice designs. The Four Ways framework posits that an engineering approach can be characterized as:

- A way of thinking (concepts and theoretical foundations)
- A way of working (structured design methods)
- A way of modeling (conventions for representing aspects of the domain and the approach)
- A way of controlling (measures and methods for managing the engineering process)

In recent years, as Collaboration Engineering has begun to formalize, several papers have been published that address ways of thinking (e.g. [7-10]), ways of working (e.g.[5, 9, 11]) and ways of modeling (e.g. [5, 12, 13]). Several cases have also been published about efforts to apply CE principles to problems in the field (e.g. [4, 14-17]).

Like a process design created and executed by a professional facilitator, a CE design must make a group productive as it moves through a process toward its goal. However, the collaboration engineer faces a more complex challenge than does the professional facilitator. The professional facilitator will both design and conduct a group process, and has the skill to adapt the process on the fly if the original design is inadequate. In contrast, a collaboration engineer must design a collaboration process that can be conducted with repeatable success by non-facilitators. The design must mitigate the lack of facilitation expertise of the practitioners who execute it. Thus, a collaboration engineer's design must meet a more-complex set of requirements than must that of a professional facilitator, and it must meet a number of additional criteria.

To meet these criteria, collaboration engineers use thinkLets. ThinkLets are collaboration process building blocks that are predictable, reusable and transferable to practitioners. ThinkLets offer a set of facilitation techniques that can be combined in different ways to build a group process [5, 9]. The special conceptualization of the thinkLets makes them functional in different processes [13, 18], which will be discussed in this paper.

Thus, we can distinguish CE as an approach, with a specific scope, specific roles, and a specific instrument; the thinkLets. This paper will give an overview of the CE approach, with a (revised) definition of the approach, scope, roles and the thinkLets to reflect and communicate the current thinking and key terminology on these concepts to the community at large. This will help us to provide a common ground for Collaboration Engineering researchers and a basis for further theoretical advances.

2. Defining the CE approach

Collaboration Engineering is an *approach to designing and deploying collaboration processes that can be executed by practitioners to accomplish high-value recurring tasks.* In table 1 each element of this definition is further defined. Below we will further explain these definitions.

Collaboration comes from the latin word collaborare [19]. *collaborare* means "work with," from *com-* "with" + *labore* "to work." Collaborative effort is joint, with others, and thus must be directed to a goal, If effort was directed to different goals, it would be individual effort. Therefore we define collaboration as *joint effort towards a group goal [5]*. A goal is *a desired state or outcome [20]*. Thus, collaboration involves multiple individuals who combine their efforts to achieve some state or outcome.

'Designing a collaboration process in Collaboration Engineering means to *Create and document a prescription*. Each step of a completed collaboration process design should incorporate everything group members and practitioner need to do and say to complete an activity that moves them closer to their goal. Deploying a Collaboration Engineering process means *transferring it to practitioners to execute for themselves without the ongoing intervention of professional facilitators*. Deploying group processes can be done in several phases from piloting and training, to complete sustained and independent use in the organization

The main product or deliverable of a Collaboration Engineering project is a collaboration process design. A CE design (*noun*) we define as *a process prescription for practitioners to accomplish a high value recurring collaborative task.* A prescription is *A written statement defining a structured set of steps for attaining objectives, and the conditions under which these steps will be executed.*

Collaboration Engineering focuses on high-value recurring tasks. A task is said to be high-value if t*he organization derives substantial benefit or forestalls substantial loss by completing the task successfully.* A task is said to be recurring if *the task must be conducted repeatedly, and can be completed using a similar process design each time it is executed.* Collaboration Engineering focuses on recurring tasks because the CE effort itself consumes scarce resources. If those resources are devoted to improving recurring tasks, then the benefits of the improved design are realized each time the design is executed. The more frequently a task recurs, the more value an organization will derive from a CE effort. Likewise, CE focuses on high-value tasks, because the payoff from successfully completing a high-value task will exceed the pay-off for successfully completing low-value tasks, and so the organization will receive a larger return on the resources devoted to a CE effort.

Definitions related to Collaboration Engineering	
Collaboration Engineering	*Approach to designing and deploying collaboration processes that can be executed by practitioners to accomplish high-value recurring tasks.*
Collaboration	*Joint effort towards a group goal.*
Goal	*A desired state or outcome*
High-value task	*The organization derives substantial benefit or forestalls substantial loss by completing the task successfully.*
Recurring task	*The task must be conducted repeatedly, and can be completed using a similar process design each time it is executed.*
Designing (verb)	*Creating and documenting a prescription*.
Deploying (verb)	*Transferring a design to practitioners to execute for themselves without the ongoing intervention of professional facilitators.*
CE Design (*noun*)	*A process prescription for practitioners to accomplish a high value recurring collaborative task.*
Prescription	*A written statement defining a structured set of steps for attaining objectives, and the conditions under which these steps will be executed.*

Table 1 Definitions related to Collaboration Engineering

In table 1 we summarize the definitions related to the CE approach. Having defined the Collaboration Engineering we will now further elaborate on the implications of this definition on the steps in the CE approach. This will help us to further identify the scope, roles involved and the role of the thinkLets.

3. The Collaboration Engineering approach

From the definition of Collaboration Engineering we can derive four phases of the approach; design, transition, execution by the practitioner, and the objective of the CE process, sustained organizational use. However, prior to the design there are 2 more phases required, one in which the task and problem is analyzed, and one in which the organization and the collaboration engineer decide whether CE is an appropriate approach for the task. The CE approach then has 6 steps, which can each be decomposed in smaller steps, as displayed in fig. 1. We will shortly discuss each step in the process [21].

In order to judge whether the CE approach will improve the anticipated task an investment decision should be made [22], which involves 2 judgments. First the approach should be applicable and second it should offer sufficient added value. The first step in the investment decision involves a check whether the process is part of the CE scope. The second step addresses the added qualitative and quantitative value of the CE process.

In the problem analysis phase, the goal, deliverable and other requirements are established. The design should fit the skill level and domain of the practitioners. Very important in this step is to establish the variety of conditions and situations that the design must accommodate, such as for instance different groups, different topics within a domain, or different circumstances. The finished design must be sufficiently flexible to accommodate these variations.

In the design phase, the collaboration process design is crafted to address the requirements. There are 3 key steps in the design phase, the decomposition of the process in small activities, the choice of thinkLets and transitions for each activity, and the validation of the design. Note that these steps have a very iterative character, and also in later phases of the approach the design can be adjusted.

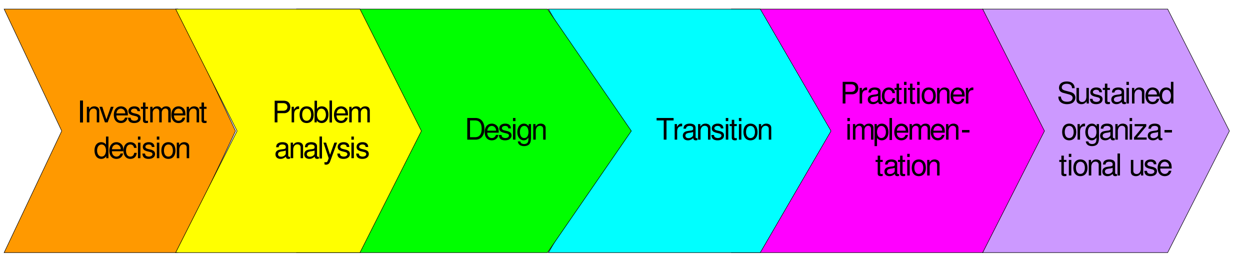

Fig. 1 The Collaboration Engineering Approach

In the transition phase, the collaboration engineer transfers the collaboration process design to the practitioner. This step will contain two important learning curves. One in which the practitioners learn to execute the collaboration process and one in which the first trials of the collaboration process execution reveal problems and difficulties that are used to adjust and refine the design.

When the transition phase is complete the process can be implemented on a full scale. This requires managerial activities, planning and organization. Furthermore, when the project involves multiple practitioners, it is often valuable to set-up a community of practice.

In the last phase the process is fully implemented, and owned by the organization. The practitioners conduct the process on a regular basis and learn from each other to improve their skills. When small changes occur in the requirements, practitioners can flexibly adapt the design to meet the new requirements, and in some organizations, practitioners train new practitioners, to be fully independent of the collaboration engineer.

4. The scope of Collaboration Engineering

The definitions described above make a large demarcation in the scope of Collaboration Engineering. CE has a rather distinct scope. This scope has 3 components: an economic component, a collaboration component and a domain of application.

Economic scope

Collaboration Engineering focuses on high value recurring tasks in the organization [5]. This focus has several reasons. First, the collaboration process design and the transition of the process to practitioner costs more time, money and effort than when an (internal) facilitator would design and execute the collaboration process. In the facilitation approach there is no need for training and the design does not need to be as extensive and as detailed documented as a CE design. Therefore, in terms of effort, a CE design, and transition is only economic when the collaboration process design is re-used. When the CE process creates value in terms of quality or efficiency, than the recurring nature will increase the benefit from the process, and thus the value of the CE process. Second, CE focuses on high value tasks. The economic gain in time and man-hours for a high value task is likely to be larger. High value tasks can require input from several people and they can involve difficult time-consuming activities. An improvement in the process to accomplish this task will therefore render larger revenue than a low value task. Also, the motivation of the practitioners for their training, and the support from the organization is likely to be higher for a high value task. Last, high value tasks are often performed by people with more expertise, who's hours are more expensive and thus a saving in hours will involve a larger saving in budget.

Collaboration scope

Not all group processes are collaborative tasks. Often a group process involves mostly one-way communication, such as a presentation, or a collective survey, where people are given information, or asked for information, but where there is no exchange of information. In this case there is no (need for a) group goal, and thus no need for collaboration. Collaborative tasks involve interaction, discussion, evaluation, shared understanding, decision making, consensus building, etc. Based on the patterns of collaboration [5] we can limit this scope to:

- Generate: move from having fewer concepts to having more concepts in the pool of concepts shared by the group
- Reduce: to select a sub-set of ideas for more attention from among the set of shared ideas
- Clarify: to create shared understanding of the words and phrases used to express shared concepts.
- Organize: Move from less to more understanding of the relationships among concepts the group is considering
- Evaluate: Move from less to more understanding of the value toward goal attainment of concepts under consideration in the group
- Build consensus: Move from more to less disagreement with respect to proposed choices

Application domain

Collaboration Engineering can be applied to many domains. However, there are some limitations to its implementation as also shown in the patterns of collaboration. First, CE is applied to knowledge intensive, processes that require cognitive effort. It does not involve collaborative physical effort. For instance, CE does not support the design and execution of a soccer game. Also CE is in the first place, goal and task focused. This is a difficult demarcation, because goal setting can be a goal by itself. There are more indirect approaches that train groups with skills, which can be used to solve a problem or achieve a goal. An example is to train teams in collaborative behavior, to increase the success of their strategy meetings. Collaboration Engineers would rather choose the approach to train a practitioner to support the strategy meeting directly to make it more efficient and effective.

5. The roles in Collaboration Engineering

In Collaboration Engineering we distinguish among 2 roles [5, 18]; the practitioner and the Collaboration Engineer.

- A collaboration engineer designs collaboration processes and transfers them to practitioners. This sets different criteria for the design. The collaboration engineer cannot expect the practitioner to be flexible. A practitioner does not have the skills to flexibly adapt the process to the situation. Therefore the collaboration engineer should create a very high quality, robust design. A collaboration engineer can be considered a master facilitator.
- A practitioner is a task specialist in an organization who executes a recurring collaboration process without on-going support from a facilitator or collaboration engineer. A practitioner is not required to have any general facilitation skills or experience and no experience in process design. He gets a short training to perform and execute only one specific collaboration process [5, 23].

Compared to traditional facilitation where the facilitator designs and executes a collaboration process, this approach poses a challenge. The CE design should compensate for the limited skills and experience of the practitioner and should therefore not only be reusable in different instances, but also predictable and transferable to the practitioner. This means that the design should, when executed correctly, produce the intended pattern of collaboration and result. Furthermore the design should be transferable in a short training, and thus have a low cognitive load. To make this possible ThinkLets are used.

6. The Collaboration Engineering ThinkLets

Collaboration Engineering therefore offers Collaboration Engineers thinkLets. A thinkLet is the smallest unit of intellectual capital to create a known pattern of collaboration [9]. A thinkLet provides a transferable, reusable and predictable building block for the design of a collaboration process. Currently, expert facilitators have documented over 50 thinkLets. ThinkLets serve several purposes[5, 13, 18, 23].

- To support the design of collaboration processes, offering support in the selection of thinkLets

- As a common language among users, offering labels and mnemonics for each technique
- As a script for execution of the technique
- As a research instrument to compare different facilitation techniques

The basic components of a thinkLet are rules. Rules describe actions that participants must execute using the capabilities provided to them under some set of constraints [18]. Rules thus are the basic instructions for the participants that need to be executed in order to create the pattern of collaboration and the intended results. Rules can be defined for different roles in the collaboration process, for instance, in a collaborative writing effort, authors and reviewers need to get different instructions. Rules are the basis of the thinkLets, and support three of its important functions.

The rules create the specific pattern of collaboration and a specific type of results. Altering the rules slightly can have a large effect on the results or on the collaborative behavior of the participants [8, 9].

The rules are also the basis for the script, they provide the key instructions. After executing the process several times, practitioners will develop their own style in executing the script [12]. However, if the practitioner changes the rules, different outcomes might be created.

Last, the rules are the basis for comparative research in collaboration support [24]. Through the distinct documentation of the rules, the slight differences of the facilitation techniques become clear and different experiments can be better compared.

To offer a common language, thinkLets need additional components that describe their metaphoric name, and offer mnemonics such as a picture and a short description of the metaphor in the name [13, 18, 23].

Other components in the thinkLet concept are used to describe what will happen, what kind of results can be obtained, examples, and support for the selection and identification of thinkLets[13, 18, 23].

7. Conclusions

As this paper summarizes and defines the key concepts of Collaboration Engineering, we will not summarize them again. Instead we will conclude this paper summarizing recent contributions to the field and a research agenda for the next steps in Collaboration Engineering.

The definitions and demarcations described in this paper summarize the progress made in Collaboration Engineering in the last 3 years. Since the positioning of the approach in 2003 {Briggs, 2003 #5}, our understanding of the role of thinkLets and the implementation approach with practitioners in the success of sustained collaboration support. ThinkLets are not only building blocks for collaboration process design, they are the language of Collaboration Engineering, the script of the practitioner, the design guidelines of the collaboration engineer and the research framework for academics. Large progress is made in defining the thinkLet concept in a way that supports each of these functions {Vreede, 2005 #214}{Kolfschoten, 2005 #118}{Santanen, 2005 #102}. On the other end of the spectrum, progress is made in further defining and understanding of the patterns of collaboration, especially of creativity (generate){Santanen, 2004 #121} and consensus building {Briggs, 2005 #212}. Finally first case studies have confirmed the effect of the approach on sustained collaboration support and transition {Agres, 2005 #103}{Vreede, 2005 #45;Vreede, 2005 #77.

For the way of thinking, we still need to find the underlying theory of several of the patterns of collaboration. Some theories have be proposed, others still need to be made. For some patterns, other domains can offer supporting theories. With respect to the way of working, theoretical foundation is required. For instance, to corroborate that practitioners will be capable of replacing the facilitator, and to prove the effect of thinkLets on transition, predictability, re-use, sustained collaboration support and "appropriate design". For the way of modeling, we need to validate the modeling approaches that are currently used by collaboration engineers, and we need to compare them with existing methods. For the way of controlling many evaluation frameworks can be borrowed from other fields, but we also need more detailed models to evaluate the effect of thinkLets; the patterns of collaboration.

This paper offers a set of key definitions for Collaboration Engineering, and their implications on the key concepts of the CE approach. These definitions will give the Collaboration Engineering community a common ground for further development of theories and to further detail the approach and the methods used. Further discussion among researchers and comparison with other fields is required to further establish these definitions, after which a call for action; to use the definitions and their implications in future work, is in place.

Acknowledgement

As this paper provides a summary of current research, it is important to acknowledge all authors that published on the topic of Collaboration Engineering and contributed to the development of this exciting research field.

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The Collaboration Engineering Approach for Designing Collaboration Processes

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Abstract

Collaboration Engineering is an approach to design and deploy collaboration processes that can be executed by practitioners for high value recurring tasks. A collaboration engineer designs collaboration process designs and transfers them to practitioners in an organization. Through the recurring nature of the task, combined with lower investment in training, the approach is more likely to be successful in organizations because it is easier to adopt and sustain collaboration support in this way. In order to be successful, collaboration engineers need to develop collaboration process designs that have many more functions and requirements than traditional process agenda's of facilitators. This paper presents an approach for the design of such collaboration processes, step by step, and a worked example is created. Last, the results of a preliminary evaluation of the approach are added.

1. Introduction

Facilitation and technology support for collaboration such as Group Support Systems (GSS) can improve the efficiency and effectiveness of collaboration in organizations [12]. However, research on GSS and facilitation has indicated that it is difficult to implement sustained collaboration support in organizations [1] for a number of reasons: First, a support facility for collaboration often does not support a core process, second, it therefore often has uncertain revenue, and third, it requires an extensive set of skills and competences that are difficult to develop and transfer [1, 6]. As a solution to these challenges, the Collaboration Engineering (CE) approach is developed. Collaboration Engineering is an approach for the design and the deployment of collaboration processes that can be executed by practitioners, for recurring, high value tasks. Collaboration Engineering is a combination of training and facilitation, of collaboration process, in which GSS can be used. The approach aims to foster sustainable collaboration support in the shape of transferable, reusable and predictable collaboration process designs that can be used by practitioners in organizations. Collaboration Engineering focuses on frequently recurring high value tasks that require collaboration support. The Collaboration Engineering approach prescribes that an expert, that we name collaboration engineer, designs a reusable, transferable and predictable collaboration process, which is than transferred to a practitioner, a domain expert in the organization. After this transition, which requires a (short) training, the practitioner can facilitate the collaboration process, without the support of a professional facilitator, and without having to learn extensive facilitation skills [6, 27]. Due to the absence of extensive facilitation skills and experience, the design created by the collaboration engineer should be of high quality. Therefore the challenge of CE research is to increase our understanding of the design and transition of collaboration processes. This paper aims to increase the understanding of the CE design process.

The Collaboration Engineering researchers are therefore developing guidelines to the design process that foster high quality collaboration processes. These guidelines assembled in the Collaboration Engineering approach are based on a four way framework [26] First of all the guidelines are based on a set of theories about collaboration quality aspects such as productivity [5], participant satisfaction [7], technology transition [6, 9], consensus [8], creativity [25], and other phenomena that indicate quality aspects of collaboration processes and the use of collaboration support. These phenomena shape the way of thinking. Second there are methods to measure these quality aspects and thus control the quality of a collaboration process around these aspects [15]. This is the way of controlling. Third, models are developed to document a collaboration process and to document the building blocks for such collaboration process. The documentation guidelines aim to make a collaboration process design transferable and reusable [18, 27]. These models constitute the way of modeling. Last, the approach needs a way of working, a step by step process to design and transfer collaboration process that allow practitioners to support groups in qualitative collaboration processes.

This paper focuses on the way of working in Collaboration Engineering, and specifically on the design of a collaboration process. The design of a collaboration process is described in literature as a critical success factor. [2, 10, 14, 24]. This paper will therefore describe a design approach for Collaboration Engineering. Such design approach will:

- Provide design support for (novice) collaboration engineers
- Increase our insight in the critical steps of the design of collaboration processes
- Provide a basis for the creation of design support tools

The remainder of this paper will first describe the basis of the approach, which is grounded in a variety of problem solving and design methods, addressed in the background. Next we will describe the design approach in detail. Last, we will describe the results of a preliminary evaluation of the approach, followed with conclusions, and suggestions for further research.

2. Background

As a basis for the CE approach, an approach to design and deploy a process in an organization for sustained use, we will refer to the process of Kettinger and collegues, [13, 16] that is used in the field of business process change. Business process change uses the process re-engineering life cycle to describe the process from envisioning to inauguration, to diagnosis, to (re-) design, to (re) construction and to evaluation. This approach will be the basis for the Collaboration Engineering approach. In Collaboration Engineering, we distinguish, similar to envisioning, an initial state in which the suitability of the approach and the investment is addressed. Next, the design team is established (inauguration) and goal setting, diagnosis and design can begin. After these often iterative steps, the design is finished, and transition, piloting and implementation can start. Finally evaluations are done to measure the success of the new process. This paper will focus on s (the step instrumental to) the design, which starts with the established design team to set the goal and requirements to the process, and ends with a ready design, that is additionally evaluated prior to transition.

Collaboration Engineering design focuses on recurring collaborative tasks. The process thus will be repeated several times. It is therefore valuable to invest in the identification and analysis of the task. The process will be reused in several instances of the task, this requires that the design can be instantiated in all different occurrences of the recurring task. To provide this flexibility and reusability collaboration process design for Collaboration Engineering are build up out of smaller building blocks that we call thinkLets. ThinkLets are reusable, transferable, predictable facilitation techniques, that create distinct patterns of collaboration [27]. They are documented according to a strict documentation format that allows the collaboration engineer to instantiate the thinkLet in different ways [19].

Like in the process re-engineering life cycle we start our design effort with a diagnosis step, in which the goal, requirements, and the deliverable are identified. Rather than focusing on the current situation, the collaboration engineer focuses on the desired outcome and on the goal of the collaboration effort. The requirements that need to be taken into account can be derived from the descriptive model of a GSS session, described by Nunamaker [23]. The components of this model are the group, the task, the technology, the organizational context and the process and outcomes. A bit more generic we can identify requirements with respect to the task and deliverables, with respect to the group and its context and with respect to physical requirements such as a meeting room and technology [24].

A collaboration process design describes a sequence of activities that leads to accomplishment of the task though collaboration in a group. To define this sequence the task should be assessed to come up with a first rudimentary approach. This decomposition of the process is a critical and difficult step. A commonly used technique for process decomposition is the SADT technique [22]. In SADT, both the process steps and the input and output are taken into account, when decomposing the process. For the decomposition of the collaboration process a similar technique will be used, in which both results and the process steps will be taken into account.

One of the main challenges of the design of collaboration processes and supporting methods is the choice of appropriate GSS tools [2, 11, 14, 28, 29]. The appropriate use of a tool involves a facilitation technique or method to use that tool. Since tools can be used for different facilitation techniques Collaboration Engineering research proposes to focus on the use of ThinkLets rather than the use of tools [20, 27]. Since ThinkLets create a predictable pattern of collaboration, and capture best practices of expert facilitators, the choice of a ThinkLet replaces several steps of a common design approach. Rather than finding alternative solutions, evaluating them and choosing the best solution, a set of thinkLet is available to choose among. These thinkLets create predictable patterns of collaboration, so the comparison and evaluation of alternative thinkLets is less cumbersome. The design challenge thus becomes finding an appropriate combination of thinkLets to solve the task. In order to do this the rudimentary process approach needs to be decomposed in small steps, that each describes a concise activity.

After the choice the process can be documented for transition. Such documentation should involve an extensive agenda, and a process model. Furthermore, it is important to document the goal, task, deliverables, assumptions and requirements of the design, so it can be evaluate properly.

Before the actual implementation, the design should be validated. Although thinkLets have a predictable outcome, and even some combinations of thinkLets have known outcomes [17], the logic of the sequence of thinkLets is very important and needs additional testing. Furthermore, it is critical to check if the design will meet all requirements such as the timeframe. This makes it necessary to validate the complete design. It is important to note that the design process as described appears to represent a "waterfall" approach. However, like in software engineering, it is clear that these steps are not sequential, but are iterative and incremental in nature, not only with regard to the previous step [4], insights and choices in every step can affect past and future steps and choices [21]. For instance, choices of thinkLets affect the choices made in the decomposition and validation might lead to revision of the requirement, and thus changes in the process. Further advancement in this research is made by the introduction of the spiral model [3], where risk management is also included in the design approach, through for instance in-between prototyping and simulation. For the size and extension of this design process, such approach would be too extensive, although this might be interesting in later phases of the Collaboration Engineering approach. In the next section we will give an overview of the resulting process, and we will elaborate on the tasks and objectives in each step.

3. Design approach

The resulting Collaboration Engineering approach for the design of collaboration processes is displayed in fig. 1. In this section we will explain each step of the design process.

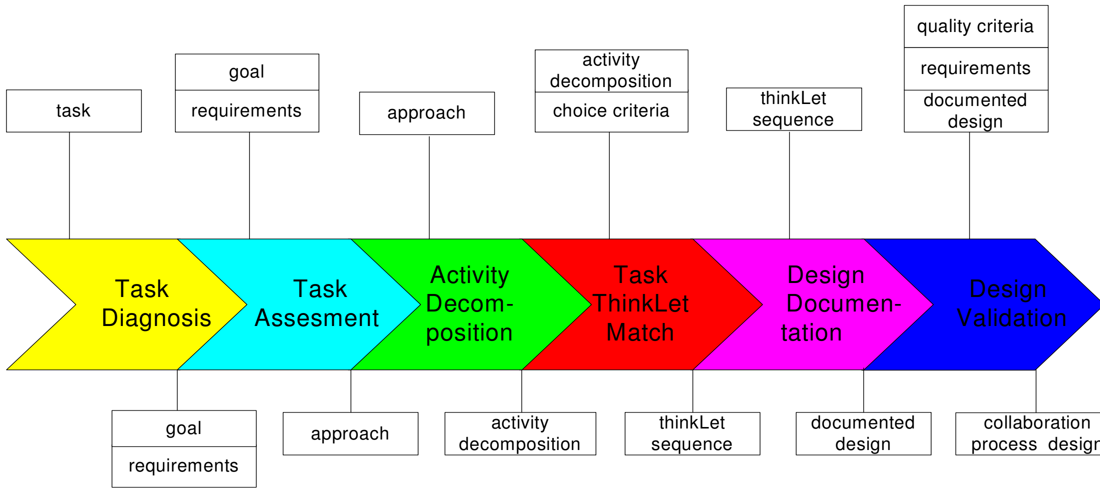

Fig. 1 Design approach

3.1 Step 1 Task Diagnosis

Using interviews with the problem owner and some of the relevant stakeholders will give insight in the goal and task. A goal can be to deliver a tangible result as for instance, to make a decision, to solve a problem, but it can also be a state or group experience, like creating awareness of a problem or solving a conflict. Deliverables therefore can be very straight forward, but in some cases require strong demarcation. In other cases it is important that specific requirements to the deliverables like the level of detail of a solution or the level of consensus with respect to a decision. Once the deliverables are clear, the other requirements can be defined which include group, context, technology and the skill level of the practitioner.

Task Diagnosis –Running example

- Goal: to have concrete, supported input for the committees lobby in EU
- Deliverables: a selection of a few clear and detailed goals and (policy) instruments to achieve them that the Netherlands has with respect to environment on an EU level.
- Collaboration to get a broader perspective of the expert opinion on the topic.
- Requirements: 20 experts in environment issues, academic education level, 3 hours, GSS support repeated in 3 session, total of 60 experts.

3.2 Step 2 Task Assessment

When the goal, deliverables and task are clear, the basic process needs to be determined. To do this we need to assess the task. A first step is to determine if the organization has already a pre-defined way of executing the task. If the traditional practice is functional and results can be improved by making it collaborative then it can be used as a starting point. If no process is followed in the organization, then standards in the literature might provide a starting point for design. If the process is first of its kind, then a new process for the task should be defined. This can be done by decomposing the deliverable and defining activities to accomplish each of the deliverables. Naming and sequencing these activities results in an approach.

Task Assessment –Running example

- Prioritized short list of goals with respect to environment issues with consensus about them and attached policy instruments
- Brainstorm goals, add policy instruments, prioritize, reduce, build consensus
- Sequence
    - Brainstorm goals
    - Reduce amount of goals
    - Prioritize
    - Build consensus
    - Add policy instruments

3.3 Step 3 Activity decomposition

Now that we have a rudimental process and deliverable description, the next step is to decompose both the process and the deliverables. Decomposition can be done based on both process and deliverables. In process decomposition the patterns of collaboration are used. Patterns of collaboration characterize a group activity as the members move from an initial state to a next state [27]. The patterns of collaboration are Diverge; creating more concepts, Converge; reducing the amount of concepts and creating shared understanding, Organize; relating concepts, Evaluating; creating more understanding of the relative value of concepts and Building consensus; increasing the commitment of stakeholders with respect to a proposal (consensus, [27]). Decomposition based on results is based on a further analysis of the deliverables and requirements to come up with the elementary activities required to create the results. Decomposition should lead to a level of steps where deliverables of each step cannot be decomposed any more. Decomposition depends on the requirements defined in the first phase. The requirements that play an important role in this step are for instance:

- **Time**: If little time is available for the task you might choose to use less detail and less discussion steps.
- **Project embedding:** It might be possible to assign participants to do preparation tasks before and "homework" after the collaboration session.
- **Group**: a low educated group might require further decomposition of activities than a high educated group that can handle more complex tasks.
- **Technology**: A GSS allows for more complex tasks than a manual supported process
- **Facilitation skills**: A skilled facilitator can handle more complex steps than a novice practitioner.
- **Task requirements and scope**: What does the problem owner expect as a result, a detailed list, a broad and creative output, quantity or quality, etc.

Decomposition requires some difficult choices. There are always several ways to achieve a deliverable and different approaches will have different advantages and disadvantages.

Task Decomposition –Running example

Process decomposition	Result decomposition

• Diverge goals
• Reduce and clarify (converge) goals
• Evaluate goals for priority
• Build consensus
• Diverge policy instruments
	• Selection of goals prioritized with consensus
	• A few clear and detailed goals
	• (policy) instruments to achieve them
	• Sequence
	1. Add instruments to final set of goals
	2. Create final selection of clear detailed goals with consensus and priory
	  • Build consensus on ranked selection of goals
	  • Prioritized selection of goals
	  • Select among goals
	  • Clarify and detail goals
	  • Brainstorm goals

3.4 Step 4 ThinkLet match

After the decomposition the activities can be matched with thinkLets. The choice of a thinkLet requires the consideration of different choice criteria such as the time frame, the deliverables, requirements, and other aspects such as alternation, preference and specific benefits of each thinkLet. Also important is the combination of thinkLets. The choice of one thinkLet can require a specific type of input that should be generated by the previous thinkLet and vice versa, the result of a thinkLet might not meet the input requirements of the next thinkLet. These transitions are very important [17].

ThinkLet match –Running example

Brainstorm goals
(Free Brainstorm)
Select among goals
(Fast Focus)
Clarify and detail goals
(Fast Focus)
Prioritize selection of goals
(StrawPoll)
Build consensus on selection of goals
(Crowbar)
Add instruments to final set of goals
(LeafHopper)

3.5 Step 5 Design Documentation

The documentation of a design is critical for its transferability. The following elements are important for the documentation of a collaboration process.

- Problem and process description

In this description the goal, task, deliverables, requirements, approach and decomposition is described. Furthermore the description can contain important facilitation instructions and a background on the task , the group and its context.

- Detailed agenda

The format of the detailed agenda contains a set of critical parameters that need to be defined for each step of the collaboration process. These are the activity name, the question or assignment to the group, the deliverable of the activity and the thinkLet details such as the pattern it creates and the variables that need to be instantiated such as criteria, categories, topics, scales, etc. The last important aspect in the agenda is the time for each activity. In this design introductions, breaks and other steps in the process should also be included.

- Facilitation process model

To display the process flow, and critical elements in this flow, a Facilitation Process Model (FPM) is used. A FPM focuses attention on the logic of the flow of the process from activity to activity. The FPM should be self-explanatory. The elements of the model are:

1. The sequence of activities
2. Decisions, criteria for the decisions and alternative paths of the process
3. The pattern of collaboration that will occur from the activity and the result
4. Transitions of data when needed
5. The time for each step
6. Step nr
7. Activity name
8. ThinkLet name

A FPM uses four symbols (see fig. 2) to document the flow of a process from thinkLet to thinkLet. This modeling convention represents each activity in a process as a rectangle with rounded corners that has been divided into five fields. In the left upper field, the sequence nr is indicated, corresponding with the agenda. The largest field contains a descriptive name for the activity that conveys what the team is supposed to do. The field on the left names the primary pattern to be instantiated in the activity. The thinkLet name for the instantiation appears across the top, and in the right upper corner the time for the step is indicated. Transitions are represented as a square on a flow arrow, and described. Decision points in transitions are represented as circles and the decision with criteria is indicated below. Outcomes or deliverables might be part of the decision and other ways are input for the next activity. An example is given below.

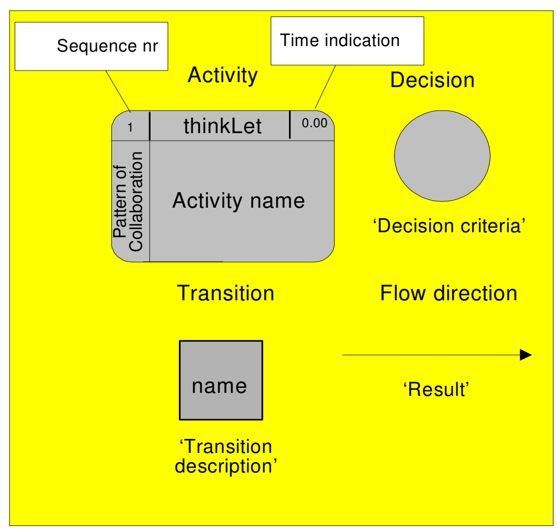

Fig. 2: The symbols of a Facilitation Process Model.

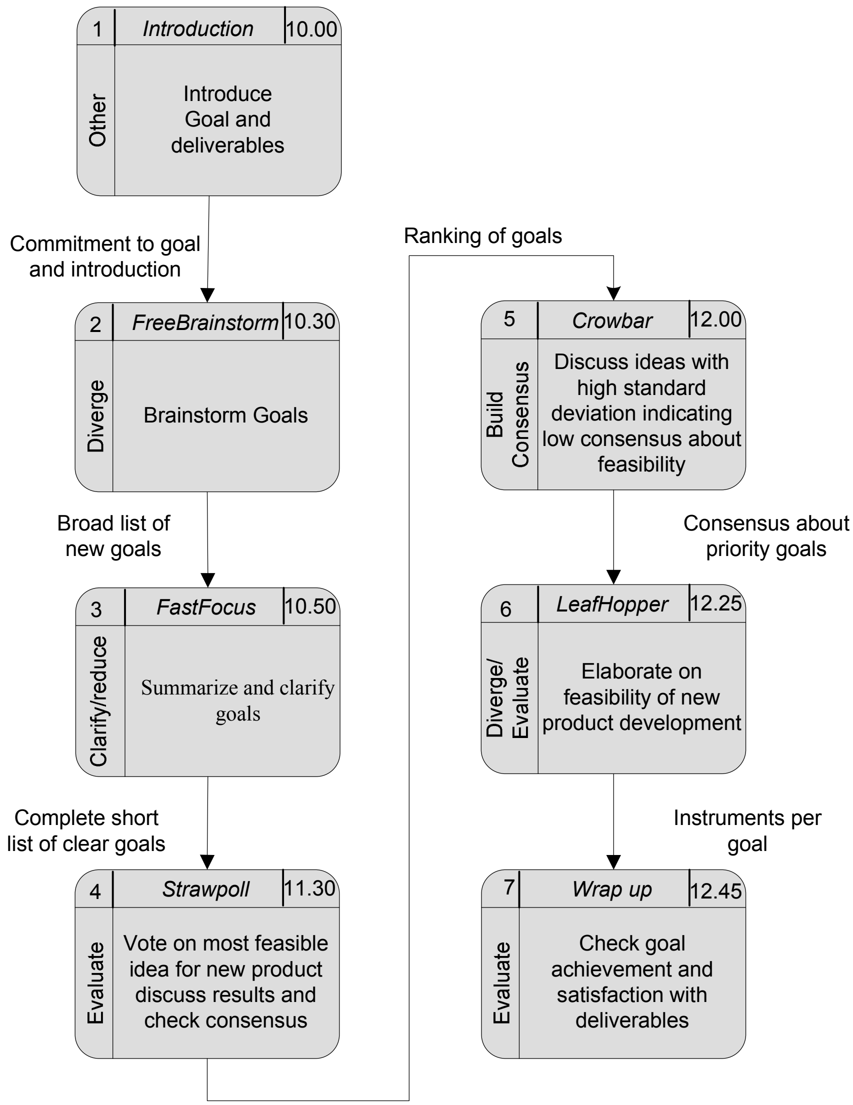

Fig. 2 Example of process overview.

Detailed agenda

	Task	Question/ Assignment	Deliverable	ThinkLet (Pattern)	Time
	Explain goal, program and scope, Introduce and exercise GSS, Introduce participants	See description	Commitment to goal, Introduction		10.00
1	Brainstorm goals	Which Dutch environmental goals need to be taken into account in the EU policy.	Broad list of goals	Free Brainstorm, Diverge EBS	10.30
2	Select among goals and clarify goals	Please identify and reformulate the most important goal on your sheet	Complete but short list of specific, clear, measurable goals	Fast Focus, Converge EBS and Categorizer Criteria Clear, Concrete, Measurable, Specific	10.50
	Prioritize selection of goals	Please indicate the priory of each of these goals on a 5 point scale.	Ranking of the goals based on priority	StrawPoll,Evaluate Criteria Priority of the goal, 5 point scale, low-high priority Vote	11.30
	Break				11.45
	Build consensus on selection of goals	What would be an argument to give it a high/low priority	Consensus about the priority of the goals	Crowbar, Build Consensus Vote, show standard deviation	12.00
	Add instruments to final set of goals	Which creative and original instruments can you think of to accomplish these goals	Specific instruments for each goal	LeafHopper Diverge Categorizer	12.25
	Closure				12.45
	Adjourn				13.00

3.6 Step 6 Design validation

There are four ways to validate the design: pilot testing, walk-through, act it out (simulate), and reviewing:

- *Pilot testing:* This is simply a small scale implementation of the collaboration process which might allows the team members to assess the effectiveness of the process. This validation will reveal whether the process can be done within the timeframe and with the given group and resources.
- *Walk-through:* A final assessment of the collaborative processes done by walking through the steps in the process with the client or a few of the participants. This validation will reveal moderation pitfalls and difficulties for the facilitator.
- *Act it out (Simulate):* By simulating the design, you try to answer the questions you pose, and consider if you can use those answers in the next step. Can the required participants also make those steps? Is all information available, and do the participants have expertise to answer what you ask them? This validation tests the logic of the design, and whether each step will indeed create the required deliverable.
- *Review:* As each facilitator has his own style, each will have different solutions for a collaboration challenge. Discussing the design with colleagues will reveal different perspectives and approaches to the design. The validation may help identify inefficient designs or inefficient parts of a design.

Validation –Running example

Simulation

- Possible goal: Forbid building of new energy plants based on old polluting methods
- Reduction: is it a clear goal?, is it specific, yes, is it measurable, no, it should have a timeframe, when should it be forbidden, what about existing plants?
- Clarify: what is "old polluting

4. Evaluation of the design approach

To evaluate this design approach we let 14 students at the University of Nebraska at Omaha design a collaboration process based on a case description. The group was a mix of graduate and undergraduate students that participated in a course on Facilitation, GSS and Collaboration Engineering. The students received a booklet with the design approach and a set of thinkLet descriptions. The case was a real project description of a GSS session run in the Netherlands by facilitators of the Delft University of Technology, but names of the organizations involved were changed. The students were graded for this assignment, and the assignment required them to use the design approach and to document their design strictly according to the guidelines. The students had to design a collaboration process according to the case description, and afterwards filled in a questionnaire.

Question	Average	Stdv	n
I used the design approach	4.14	0.86	14
I found the design approach useful	4.07	1.00	14
The design approach saved me time	3.57	1.02	14
I found the design approach easy to use	3.57	0.94	14
I fully understood the design approach	3.93	0.73	14
The design approach helped me to improve my design	4.07	0.62	14
Without the design approach I could not make a good design	3.64	0.84	14
The design approach should be improved	3.54	1.20	13
I strictly followed the proposed design approach	4.00	0.88	14

Scale 1-5 (1) being Strong disagree and (5) being strongly agree

The results show that the students used the information, followed the design process and found the approach useful; it helped them to improve their design. However they also indicate that the approach should be improved. Suggestions for improvement mostly involved adding more examples and elaboration. Some students indicated that they used the approach more as a guideline. The difficult steps in the process that were mentioned were the thinkLet match, the decomposition and estimating the time for each activity. The questions on ease of use, the need for the design approach, and whether the approach saved the students time were difficult to answer since the students had not used another approach or created a collaboration process design before, and therefore did not have a reference. Most students understood the approach, but examples, which were not included in their version of the approach, would have helped them. Some students indicated that without the support booklet they would have no idea where to start with the design of the collaboration process. Standard deviation is rather low except for the need of improvement.

5. Conclusions and further research

From the results we can conclude that there is certainly a need for a detailed design approach. The approach is useful and should be accomplished with an example as presented above. The design approach is flexible with respect to different size projects and different perspectives on process and task decomposition. The approach stimulates documentation of the design and validation of the design, which, together with the guidelines in the design approach, fosters a complete and transferable design. We based our choices in the design approach on different other design approaches and tested its usefulnes. Further research is required in the shape of an expert validation. In this validation, expert collaboration engineers are asked to reflect on the design approach and the given guidelines. Once the approach is further validated, it can be used to develop a design support tool and to further analyze the encountered difficulties in the design effort.

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Choice criteria for facilitation techniques

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Abstract

Facilitation is increasingly used to support collaboration processes. An important task of the facilitator is to prepare a collaboration process by choosing an appropriate sequence of facilitation techniques. At present little is known on how experienced facilitators make this choice. In this paper we collect data on the choice of facilitation techniques, using a questionnaire, a group session, and a series of interviews with experienced facilitators. Qualitative analysis of the results revealed a generic set of choice criteria. These were predicted effectiveness,(e.g. expected result) predicted efficiency (e.g. time required for a technique), task requirements (e.g. need for consensus), group requirements (e.g. group size) context and future steps (e.g. future of the participant group) and the facilitator's preference. The study confirms assumptions underlying certain choice approaches described in literature, but also shows the complexity of the choice indicating that many approaches are incomplete. This is an important base for further development of intervention tools and the training of facilitators.

1. Introduction

Due to increased information access, a more complex society, and shared responsibilities, increasingly tasks will be done by groups rather than individuals. This makes collaboration essential to the creation of organizational value [1]. Although multiple individuals have more knowledge and experience than a single person, collaboration is fraught with challenges [2]. Therefore, good collaboration is nowadays an important competitive asset for organizations, and consequently, collaboration support is considered valuable. Facilitation as a means to support collaboration processes has developed over the years as a research field and as a profession. Facilitation is a dynamic process that involves skills and methods to support a group in achieving their goal [3, 4]. Facilitation is often combined with Group Support Systems (GSS), or training, as for example in Schwartz's developmental facilitation in which facilitation is used to train the group in effective collaboration [4].

Facilitation has the objective to increase the quality of collaboration and its outcomes. One of the most important tasks of a facilitator is to design or prepare a collaboration process [5, 6]. In a creative design or problem solving task the following general steps are distinguished: identification of the issue, analysis, finding (and evaluating) alternatives, choice and implementation [7-12]. These general steps involved in a design process can be used to describe the design of a facilitated session. An important step in the design process is choice, in which a decision is made on the approach to the problem. This step is based on and bounded by issue analysis and identification of alternatives in previous steps. Therefore, one of the key tasks of a facilitator is to analyze the issue at hand, identify alternative, appropriate tools or techniques to support a collaboration effort and to choose among these [13-16]. Although several taxonomies of tools and techniques are available and used [14, 17, 18], we are uncertain about their completeness. In order to make an optimal choice, both functional requirements and quality constructs should be taken into account.

There are many challenges involved in the choice of a facilitation technique. Several researchers made an effort to support facilitators and GSS users in the choice among tools and techniques [13, 19-21] This paper will examine the criteria that are used to choose among facilitation techniques. The objective is to give an overview of criteria that are considered in choosing between facilitation techniques. Research shows that facilitators use a relative small set of facilitation techniques on a regular basis. Novices use an average of 6 facilitation techniques and experts about 23 [22]. Compared to the size of libraries of facilitation techniques available in books and on the web, these are very small sets of techniques. Not knowing when a new technique can be applied successfully, can be one of the barriers to increase the toolset of the facilitator. Furthermore, despite the amount of techniques available, choosing the wrong technique can have severe consequences for the success of and trust in the facilitator [23]. This paper aims to provide an overview of the criteria on the basis of which a technique is chosen. Such an overview will:

- Give insight in the complexity of the choice for a facilitation technique when many alternatives are available, or when it is difficult to find a suitable technique for a complex situation.
- Enable further support of facilitators in the design of a collaboration process for instance through the development of more sophisticated choice support tools.
- Give insight into the aspects of a facilitation technique that should be documented in order to facilitate choosing between techniques.
- Offer a method to select facilitation techniques from large libraries like [18, 24].

The remainder of the paper is structured as follows. First we explain the problems in and previous efforts to support the choice among facilitation techniques. Next, we explain our research approach and the choice of respondents. We approached our study objective from one perspective, the facilitator, but used different research instruments to get a complete overview of the criteria. We compare the criteria that we identified with different sources in literature to come up with a choice criteria set. We end with conclusions and suggestions for further research.

2. Background

A facilitation technique is a work practice of a facilitator, used to make one step in a collaboration process. Facilitation methods often consist of several facilitation techniques. An example of a method to find a solution to a problem, is to first brainstorm solutions, cluster these, and then select among the clusters to find an optimal solution. This method thus consists of three steps: brainstorming, clustering, and selection. A facilitator might be familiar with several brainstorming techniques. He or she can then choose between several techniques for brainstorming, such as the nominal group technique [25], or Brainstorming, as described by Osborn [26]. The facilitator must choose based on the differences between these brainstorming techniques, and the facilitator's knowledge or experience with each. As described before, the amount of methods that facilitators have experience with is limited. A new method is extra difficult to select, since their specific advantages or disadvantages are unknown.. Therefore, we are interested in the complete process of selection of a facilitation technique, both as a selection among different (known) alternatives for one step and as a step in the collaboration process.

One of the first complicating factors with respect to the choice of facilitation techniques is the amount of techniques from which facilitators have to choose. Choosing among many techniques might be difficult as many considerations and deliberations play a role, while choosing among a few limits choice. A number of libraries of techniques are available in books and on the web (see for example [18, 24, 27]). However, for the use of most techniques some level of training and experience is required. The number of techniques a facilitator has experience with, thus influences the number of techniques to choose from. Research among 89 facilitators shows that novice facilitators use on average six different techniques, while experienced facilitators use 16 techniques and experts use approximately 23 techniques [22]. (The level of expertise was based on the number of sessions facilitators ran.) While most facilitators (75%) are eager to learn new techniques, increasing their library will by definition make the choice more complex [28].

Second, classification of facilitation techniques is difficult. Choosing techniques would be easier if a generic classification or taxonomy was available. Several such classifications are published in print or on internet. Examples are the IAF methods database [18], the classification on the basis of patterns of collaboration [29], and task complexity [14]. However, it appears to be very difficult to find a taxonomic classification that can serve as an excluding choice criterion [17]. To our knowledge, no classification scheme is available which supports the final choice among facilitation techniques.

Third, available guidelines or tools to support the choice among facilitation techniques are limited in some sense. Previous attempts to support the choice between alternative forms of collaboration support are focused on GSS tools. Antunes describes a tool that supports the choice of GSS tools based on a library of collaboration processes that are supported with GSS [20, 21]. The user is asked to compare his situation with the examples and therewith choose a GSS tool and a way to use it. Dennis et al [13] indicate that appropriate use of GSS tools can be supported with guidance, facilitation, restrictiveness and appropriation training. Although appropriation seems a valuable concept, the focus on tools involves some challenges. A small intervention of the facilitators can have a very large effect on the output and results [30]. The simplest tools like a chat functionality can be used in many different facilitation techniques. For many GSS and support tools, the appropriate use is however not documented. Therefore we suggest to focus on the appropriate use of facilitation techniques instead of tools. Santanen shows that comparing tool use or unspecific facilitation techniques can result in unfair comparisons, and thus conflicting results [31]. Thus, in order to support collaboration, facilitators should first select the appropriate facilitation technique, and then the supporting tool [17].

3. Method

Although prescriptive guidelines on the choice of facilitation techniques are available, few studies describe actual choice processes. In order to gather more information on the set of choice criteria and the how these are used in a choice process, we followed an incremental, interpretative research approach using three complementary data sources. Data were gathered in three phases.

For the first phase of data gathering, we draw on part of a questionnaire administered to 89 facilitators with different expertise levels. The results of this part of the questionnaire are not yet published, but for the approach of the questionnaire we refer to [22]. In the exploratory questionnaire about challenges in the design of facilitated collaboration processes, facilitators were first asked to indicate aspects of the group and the task that they considered during the design effort. Respondents were then asked to write down the criteria based on which they chose among facilitation techniques.

For the second source of data gathering we held a group session with experienced facilitators at the 2004 IAF Europe conference. A total of ten facilitators participated in the 3.5 hour session. Participants each had several years of experience as a (self-) employed facilitator working in Eastern Europe or the United States. In the session participants were asked to indicate to which extent they used information on the content of the problem and on the social system in the room, when preparing a session. They then sat down in subgroups of four people each and described a technique. For each technique they indicated when it could be used, and when not. Criteria to (not) use the technique were transferred to a whiteboard and discussed plenary. Although the group session resulted in rich information on session preparation and enabled participants to discuss choice criteria in their own wording, the question on the use of information addressed a general preparation process and did not focus on a particular session. We decided that in order to really elicit the choice criteria we would have to interview facilitators and ask them about the assumptions and reasoning behind their choices.

In the last phase of data gathering we therefore presented facilitators with a concrete and specific case description. The facilitators were asked to design a collaboration process for this case. They were then asked to choose techniques and verbalize their thinking process while doing so. This approach follows the guidelines of Verbal Protocol Analysis [32]. VPA 'has been used extensively as an effective method for in-depth examination of cognitive behaviors' [33]. The verbal reports generated using this method are a valuable and reliable source of information about cognitive processes [32]. The case concerned the development of a new ICT strategy for a university with a group of ten participants from different departments. Four hours were available to both analyze the problem and identify clear action points for the future. The case description was visible to respondents throughout the interviews which lasted from 0.5 to 2 hours each. A total of eight facilitators working privately or in Dutch universities and research institutes were interviewed. Each respondent had several years of experience in facilitating sessions using electronic meeting systems, paper and pencil methods, soft OR or modeling tools. Most interviewees combined experience in several areas. Each interview was transcribed into a written report.

The session report and interview transcripts were then analyzed using a grounded theory approach [34]. A central tenet of grounded theory is the close connection between empirical data and development of concepts to describe data. The analysis follows a four step procedure: exploration, specification, reduction and integration [35]. The exploration phase aims to characterize the content of transcripts, by identifying as many relevant concepts or keywords as possible for each section of the text. In this phase the researcher's ideas about relevant codes and ideas from previous research play the role of 'sensitizing concepts'[36]. For this study the concepts identified in first phases of data collection, and depicted in table 1 and 2, have the role of sensitizing concepts. In the specification phase, codes are compared and codes that are central are identified. The text segments that each central code refers to, are compared to reveal differences and similarities, in order to clarify the dimensions of each central code. The reduction phase aims to elaborate the central concepts further, by describing and relating concepts. Finally, in the integration phase, the relations between the concepts are defined. Observation units are described in terms of the central concepts and related to literature, to finally combine them in the choice criteria overview [35].

4. Results

In a first attempt to elicit choice criteria we included a question on this topic in a questionnaire that was returned by 89 facilitators with different experience levels [22]. The question had an open character, but followed a closed question in which the importance and availability of several aspects of the group and task in a collaboration process were determined. The responses of the participants were clustered when similar, resulting in the criteria displayed in table 1. Note that 58 respondents answered the question, and that many respondents indicated multiple criteria.

Choice criterion	# of times indicated
goal as stated by the client	11
predicted outcome of the technique	13
effectiveness and efficiency	2
task as stated by the client	6
time frame	18
logistics such as the room layout	4
group capability	11
group kind of people or culture	22
participation or expected willingness to participate	4
client acceptance of the technique	5
facilitator's skill/preference/experience	15

Table 1 Questionnaire results on choice criteria

The table gives an indication of the criteria that are mentioned most frequently, such as the timeframe and the type of participants. However, many facilitators indicated that they took "everything" into account, indicating that they could not identify a specific selection criterion. Often respondents mentioned the "goal" (of the collaboration process) as an important criterion, which is a very abstract concept. In addition the concepts that were considered important in the previous question returned. New aspects are the predicted outcome, and its effectiveness and efficiency, logistics, the participation of group members, client acceptance and the facilitator's preference or experience. The latter indicates that facilitators make many choices based on the techniques stored in their personal library, and their experience with these. However, personal preference and the "goal" are still rather general criteria, indicating that it is likely that the choice is based on more detailed and hidden assumptions. In the next step we tried to find these assumptions.

The session in the IAF Europe 2004 resulted in the following information. Most participants indicated that they wanted to know as much as possible of both content and social system in their preparation. One participant explained this as follows: 'I do most of my work outside of meetings, talk to separate people or sometimes groups, such as the marketing people or the salesmen. Then I combine the results in my head and talk about the resulting actions to the head of the organization to get his reaction. With this I go back to the stakeholders.' Two participants indicated that they wanted to know little of the problem content or social process. After discussing their choice with others close to their position, participants were asked to form small groups to discuss specific techniques.

In subgroups participants were asked to individually write down a recently used facilitation technique and explain it to others. When or why would this technique be suitable and when would you not use it? In a plenary round the following answers were discussed, as displayed in table 2.

Aspects that are listed in this analysis are more specific than the answers gathered in the first phase of data collection. Motivation and encouragement are for instance listed as criteria. These concepts are related to participation and client acceptance mentioned in the questionnaires, but more specific. Still many questions remained. Why is it necessary to control output, or to put people on equal footing? To be able to find these answers we need to probe deeper once a choice criterion is determined. To do this we need to interview facilitators and provide an even more concrete case, for which they can explain precisely why they choose a specific facilitation technique.

Technique	***When suitable***	***When not suitable***
Round robin (participants each give one idea in number of rounds)	Need to control outputs High emotion Encourage all individuals	Brainstorming ideas generation
Generating 'negative assumptions' (why it won't work) before brainstorming	When participants are full of negative assumptions, doubts or pessimism	When participants are enthusiastic, this phase is unnecessary
For each idea in a list, generate considerations pro and contra	Have different elements Dimensions	When new ideas or alternatives are needed
Panel brainstorming	Participants hear different opinions and arguments (base for consensus) 'Market' of ideas	Some participants remain silent
Profile tool (indicate and explain team role)	Simple, allow people to get a different perspective	If issues are not about relationships
Informal introductions when in a formal setting (location)	Warming up of the group To put people on an equal footing	Short meeting Formal environment
Summarise observations of effective behaviour	Efficiency Affirmation	Too early in the meeting
Write down the problem that brought you here	When we want to understand each other's standpoint and need a base, a motivation for our planned activities need for a quick and easy starter	When we want to leave the past behind
Issue analysis	General process is fun Problem solving Takes maximum of one hour	Accuracy Flexibility

Table 2 Results of the workshop on choice criteria

In the interviews we first explained exactly what we mean with the term facilitation technique. We then addressed the purpose of the interview and gave the respondent an opportunity to read the case. Respondents reacted very differently on the description. Some felt they had way too little information to design a session, while others immediately came up with a solution. We discussed the case until the respondent came up with an approach for the facilitation process. To fully describe the approach we addressed each step before, in, and after the session and which facilitation technique the respondent would use. Next we asked them why they chose this technique. To help the interviewees answer this question, we provided them with possible generic criteria. These were:

- The group need
- The task
- The facilitator's preference
- A standard procedure
- Their perception of good collaboration

When explaining why this was or was not the reason for choosing the facilitation technique, the respondent's choice criteria became apparent. The next section describes the criteria mentioned in the interviews.

5. Choice criteria from the interviews

5.1. Effectiveness

Facilitators indicated that it is important to keep in mind that a collaboration process is designed to achieve the goal stated by the client. Facilitation techniques should be chosen to make sure that each activity of the group contributes to goal achievement. If the effect of a facilitation technique is clear, because the facilitator has experience in using it, it is easier to make the choice for a technique. A facilitator can then better predict the effect of the technique and thus can better estimate if the technique will advance the group to its goal. Goal attainment is not a Boolean expression. The resulting group product can be more or less complete, and it can be more or less shared by the group members. A facilitation technique can for instance be used to elaborate and increase the level of detail in solutions, or to discuss results and increase shared understanding and commitment with respect to a solution.

5.2. Efficiency

Our case description indicated a limited time frame. Although facilitators deviated from the assignment in other respects, they all stayed within the timeframe, while lowering the expectations on goal achievement within that timeframe. This indicates that they considered this as a fixed requirement to the process. The selected facilitation techniques should use the available time and resources optimally. Some facilitation techniques take more time than others and can be used to accomplish a task faster, or with less effort. The available resources such as GSS support and the available room and materials can also influence the choice of a facilitation technique. GSS use for example was often indicated as a method to save time and increase efficiency.

5.3. Task requirements

As effectiveness is a characteristic of a specific technique, techniques need to be chosen in such a way that their combined effects meet the requirements of the task posed for the group. Task requirements are the demands on the process and the deliverable. Each step of the group process should have a result that is needed to advances the group's progress towards their goals. Examples of frequently considered task requirements are the level of detail needed for the result; when detailed results are required, elaboration techniques can be used. and the task size of the collaboration effort, which can set constraints to the technique used. Other examples are the need for consensus on results and decisions, which can indicate the need for consensus building techniques and the required level of structure of the task, that can be met using hierarchical methods or modeling techniques. Also important are the need for shared meaning and understanding, for which convergence techniques can be used and the need for evaluation which can be met with voting methods. Last, requirements with regard to content can require a specific domain related method.

5.4. Group need

A facilitation technique should not only meet the requirements to the results, it should also match the needs and characteristics of the group. Many of the facilitators we interviewed asked additional questions about the stakeholders in the case description, such as for instance their responsibility with respect to the problem and their relation with each other. Factors that can influence the choice of the facilitation technique are the size of the group (some techniques are not suitable for a large or small group), and group cognitive capabilities, which determines the maximum cognitive load and complexity of the facilitation technique used. The background of people and their culture also influence the choice of a facilitation technique. For instance asking a group of marketing specialists to draw their ideas can be very successful, but posing the same question to the board of a large multinational might meet with less enthusiasm, due to the difference in group culture. Another consideration is the motivation of the participants to collaborate. Some techniques encourage motivation; other techniques particularly require motivation of the participants, which should first be established. Some facilitation techniques are used to increase conflict or consensus, emphasizing either differences or similarities among participant goals in the process.

5.5. Context and future steps

The choice of a facilitation technique is also influenced by the context of the meeting and the intentions with respect to the results. Relevant context elements are for instance a deadline for the project in of which the collaboration process is a step that can create stress, other, non present stakeholders which can cause for instance incompleteness of information, previous steps in the project, and the history of the group. Future steps that are relevant are the use of the results and the future of the group, and whether they need to collaborate again. The choices with respect to the scope of the process can are influenced by these factors. The choice of a facilitation technique for teambuilding is for instance influenced by expected collaboration in the future, and in a stressful situation icebreakers or a pep-talk can help the group, to gain efficacy to perform the task.

5.6. Facilitator's preference

All facilitators indicated that they have a set of facilitation techniques that they use frequently. Experience in a facilitation technique makes the process and the results more predictable. Facilitators develop their own style and some of their skills are more successful than others. Personal preference is therefore an important choice factor for experienced facilitators.

5.7. Pleasant process

In order to motivate participants and to increase their satisfaction, facilitators try to make the collaboration process pleasant. Factors that contribute to the success of the process are a low cognitive load of the facilitation techniques, alternation in the techniques used, and the order of activities in the agenda. If many similar activities are done in sequence participants are likely to get tired or bored. In order to create a logical and focused collaboration process, the activities should fit to the previous and next step in the process.

6. Discussion

The criteria found in the interviews are much more detailed than in the two previous rounds of data collection. The previous section concludes the exploration and specification phase. In this section we address the reduction and integration phase in which we relate the constructs to the literature. In these phases we will develop the overview of choice criteria displayed in table 3.

6.1. Predicted efficiency

The facilitators mentioned choice factors like “this will be faster” or “this requires GSS support”. Such factors indicate a prediction based on experience. There is very little knowledge on the time required for a facilitation technique and this can be very variable, based on the situation. There is conflicting evidence on the effects of the use of GSS in a specific method, especially when the effect of a specific task in lab settings was measured [37, 38]. Thus facilitators’ choices are made on the basis of a predicted effect of the use of a specific technique. Efficiency is the degree to which time, effort, and resources are optimally used. Effort can be rather unpredictable when the facilitator does not know the group. Therefore facilitators will often strive to achieve a low cognitive load of the process. The effort of participants will be lower when participants are not motivated or bored. Alternation of facilitation techniques might solve this. The effect of resources and the time required can be estimated or predicted based on experience with a facilitation technique.

6.2. Predicted effectiveness

Effectiveness is the level of goal achievement. The effectiveness of a facilitation technique is thus the extent to which the facilitation technique advances the group towards its goal. For some facilitation techniques the effect is documented in a book or library [18, 24]. For some techniques the effects are researched, making them even more predictable [30]. Still facilitators indicated that they are careful or even reluctant to try new facilitation techniques, even when the effect is described by other facilitators; their personal ability to interpret and execute the documented technique is often a factor of uncertainty.

6.3. Task requirements

The task that is set for the collaboration process is one of the main factors that influence the process [2, 14]. Facilitators asked many additional questions about the case description concerning the task and deliverables. After a while they often made explicit assumptions about the requirements related to the task or the deliverables. The certainty with respect to the requirements is important and facilitators will try to make these requirements as certain as possible. One facilitator indicated that he used more predictable facilitation techniques when uncertain of the requirements posed by the client and by the group members during the process. We guess that using known facilitation techniques allows the facilitator to adapt the process to the group when things go different than planned, which increases the flexibility of the facilitator. Task requirements are considered on different levels. Most of the aspects we found relate to the patterns of collaboration as described by Briggs and de Vreede [29, 39]. Facilitators examined the need for the following outcomes: divergence and detail, shared understanding, structure and organizing, evaluation, and consensus and shared results. Other requirements that were mentioned were the time perspective and the scope of the task.

6.4. Group Requirements

The characteristics of the group give rise to very different requirements to the process [2]. For instance the group size sets requirements to the physical resources. In addition it influences the time for activities in which the participants cannot work in parallel, such as discussions. The capabilities of the group also influence the choice of facilitation techniques. For homogeneous groups capabilities can easily be estimated; take for example the capabilities of a group of medical doctors or the capabilities of a school class. But the capabilities of the stakeholders in a large building project are much more difficult to estimate. Facilitators need to analyze the problems and conflicts in the group in order to solve or avoid them in their design. A previous study shows that in the preparation of a session, expert facilitators more often examine aspects of a group than novices [22]. Many facilitators indicated that once you invite stakeholders to participate, you should take their stake into account. When participants have a limited stake in the results of the process, the facilitator can motivate them to participate and contribute. Note that motivation for effort and motivation for participation are different things.

6.5. Context of technique and process

When we look at the choice of a facilitation technique, there are two types of context to take into account. The first type is the place of the facilitation technique in the sequence of activities from the collaboration process. The second type of context consists of the collaboration process in the organization and in a larger project. The sequence of activities can be very important; facilitation techniques should create a logical sequence and thus match with the previous and next technique [40]. The context of the session is the project in which it is embedded and the organization culture relevant to the session [2].

6.6. Facilitator's best practices

A questionnaire among facilitators [22] indicates that from 80 facilitators 78% has a set of facilitation techniques that they regularly use. Although facilitators have often access to databases with facilitation techniques such as [18, 24], they tend to fall back on their favorite facilitation techniques. Preference, skill or experience are therefore frequently reasons to choose a facilitation technique.

When we look at the overview in table 3, we are reminded of the descriptive model of GSS research described by Nunamaker et al [2]. In this model on GSS factors related to the group, task, context and GSS are combined in a process with specific outcomes. In the design of a collaboration process, the facilitator combines his or her best practices with the requirements in terms of efficiency and effectiveness to design a collaboration process that fits to the task, group and context.

7. Conclusions

This paper presented an overview of choice criteria used by facilitators when selecting among facilitation techniques. The three different sets of data increased our understanding of the choices facilitators make. The data revealed a large set of criteria which are brought together in the overview in table 3. Clearly the appropriateness of a facilitation technique should be rated on several of the criteria. The choice criteria set can be used to make facilitators aware of the complexity of the choices they are faced with, and the assumptions underlying their design effort. However, in order to further implement the criteria set as a selection tool, additional research is required.

Although we indicated the hierarchical relations among the criteria, it will be important to find the causal relations among them, and the logic by which the choices are made. For instance, can criteria be classified into specific sets? Some criteria need to be applied in conjunction with others, such that all need to be satisfied before a technique can be chosen. For other sets of criteria only one needs to apply. Which choice criteria are dominant, and which are used for refinement of the choice?

The criteria overview can be used to make a documentation format for facilitation techniques. An example of such a documentation format is the thinkLet. ThinkLets are facilitation techniques described as patterns [17] according to a specific conceptualization. This makes the technique more transferable, reusable and predictable [39]. In order to use each of the selection criteria described above, the facilitation techniques should be described in detail for each of these aspects. Further development of the choice criteria set will provide added value for the practice of facilitation. In order to make new facilitation techniques useful for novices they should not only be documented in libraries, but it should also be possible to make a selection among them, and to predict their effect. This will enable less experienced facilitators to offer or use successful collaboration support.

In addition to understanding the relations between the choice criteria and improve the thinkLet documentation format, research should address conflicts between techniques. This research might help in explaining which criteria are more important, depending on the context in which they are used.

- Predicted efficiency
    - Fit with the set timeframe
    - Fit with the capabilities of (technical) resources
    - Fit with the possible cognitive load
    - Need for alternation and fun to increase effort
- Predicted effectiveness
    - To what extend will the goal be achieved
    - How certain is the effect of the facilitation technique
- Task requirements
    - Need for divergence and detail
    - Need for shared understanding
    - Need for structure and organizing
    - Need for consensus and shared result
    - Need for evaluation
    - Content requirements such as time perspective, complexity and scope
- Group requirements
    - Group size
    - Required motivation participants
    - Number of stakeholders
    - Group capability
- Context of technique and process
    - Order of activities in agenda
    - Embedding in organization
- Facilitator's best practices

Table 3 choice criteria for facilitation techniques overview

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Collaborative Tools and Effective Team Project Planning

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Abstract

Many researchers and managers agree that effective project planning requires shared access to planning data, collaboration support, and collaborative decision making processes to prepare useful project plan schedules control reports, and plans. A number of independent single user project planning tools have been marketed to ostensibly improve communication, task scheduling, and performance among the members of a project teams composed of many specialists and experts. However, to date there are few if any of the project planning tools that can be applied in a collaborative work environment. Further, applying the single user tools in a collaborative setting has been historically difficult. Critical planning data are traditionally identified and collectively discussed during collaborative group planning meetings and entered into scheduling and tracking tools by individuals working one-at-a-time for review at a later meeting. This process tends to limits the effectiveness of the meeting processes an d slows the development of a comprehensive project plan.

The authors have developed and demonstrated a collaborative planning process that attempts to address the shortcoming of the current project planning processes. This paper reports the results of applying this collaborative planning process using two different tools: GroupSystems, and a targeted ASP application and database developed to collect project planning data. The planning results achieved by combining the planning methodology and either tool illustrate how collaboration processes supported by multi-user collaborative tools can assist in resolving complex problems organizational teams face in developing, accepting and implementing project plans. .

The authors believe this work contributes to the development of a better appreciation of how group collaborative teams can utilize and improve technologically oriented data collection processes, obtain agreement on the "meaning and use" of the information derived from the data, and facilitate acceptance of plans based on the assembled and organized information. The perceived positive impacts of this organizational data collection process and collaborative information assessment and generation process appears to model the components and interactions of variables found in Social Cognitive Theory (SCT) explanatory frameworks. The organizational functioning is analyzed using the causal framework of social cognitive theory that recognizes the reciprocity and interaction among cognitive, behavior, environmental, and physiological/affective influences. It is hypothesized that complex organizational project planning processes are influenced by the structure of the collaborative processes imposed on the planning activity; the project's perceived task ambiguity and complexity; the project's participants perceived success of previous planning experiences; and learning which has occurred from a variety previous experiences and from the observation of the actions of others in the exercise. The field research efforts use a complex U.S. Coast Guard planning project to support this initial hypotheses. Finally, the paper describes a design for a template developed from the Project Management Institute (PMI®) Knowledge Areas section of the PMBOK Guide. The template incorporates widely accepted and published project processes and elements to be reconciled in the development of a successful project plan that reaches agreement on the "meaning and use" of project knowledge and improved acceptance of plans based on collected knowledge.

Collaborative Tools For Effective Team Project Planning

Introduction

Organizations and teams face many problems when they attempt to develop and implement project plans. There exists a long history of attempting to achieve complex goals and implement complex projects. This history is replete with concerns regarding the general state of planning and project management. There is a widespread desire to "improve" project planning. It is supported by the construction of numerous planning tools, steady enrollment in project management training and managerial experimentation with consulting services and techniques. Unfortunately, the success of these efforts is sporadic and unpredictable, with many complex "explanations" of failures and heuristic by untested wisdom prescriptions of requirements for project success. The failures and limitations of project planning fall into two primary camps broadly characterized as managerial "failure" analysis, and technical or project characteristic analysis. Management testimonials and anecdotal evidence indicate that many things contribute to the problems: poorly defined responsibilities, lack of group goals and vision, overly complex actions and demonstrated lack of ownership in the process. (Matson, 1996) Research has shown that complex plans often fail to integrate managerial or expert knowledge, and fail to contain evaluations of possible events or build stakeholder consensus. (Turban, 1993: 515-516) Research of project characteristics has indicated that complex issues related to numbers of tasks, task component hierarchy, arrival rate and work packages composed of groups of tasks, and uncertainty tasks all influence project planning and success. (Levy, et. al., 1997) Analysis has also shown that the number of tasks potentially included in each project plan depends more on the precedence between operations rather than the number of components or parts in assembly projects. (Ramos, et.al., 1998)

The two different failure sources and variances between prescriptions for success suggest that planning problems are highly complex. The authors posit that a "better" solution must simultaneously address managerial processes and task related issues to improve the overall planning success of complex projects.

This paper reports on the development and demonstration of a collaborative process and two different integration tools designed to address planning problems in the areas of information collection, task definition, and information display for electronically facilitated planning. The tools are used to implement a structured processes that collects, sorts and sequences information specifying the detailed steps to be executed in complex projects such as technology/systems development, systems analysis and design, disaster response and business resumption planning, product development, and business process reengineering.

The first tool used was a full functioning Group Decision Support Systems (GDSS) tool. GDSS technology supports group work, and encompasses systems and software that coordinate tasks varying from group task identification to the use of voting and group decision support for prioritization and resource assignment. A description of these tools may be found in McGrath and Hollingshead (1993). The Electronic Meeting Support (EMS) tools allow users to simultaneously enter ideas into personal computers, make ideas immediately available to other participants, develop categories for sorting and visualization of data, and utilize functions and features to support group assessment and decisions regarding the collected data. (Briggs, et. al. 1993) The GDSS research literature has broadly investigated how these systems function in associative work settings by assessing on the performance of GDSS in meeting environments. Use of the GDSS tools has subsequently been expanded to many organizational meeting environments.

Microsoft Project is a widely distributed and accepted data collection, scheduling, and presentation system. It operates in both a single user mode and on networks. It permits a single point of entry for project overview data, calendars, task and resource data, schedules, and project status/update information. MS Project offers a variety of visualization formats including calendars, Gantt and PERT charts and resource tables for managerial use.

The GDSS – MS Project data migration tool (custom developed) is a visual basic program that parses the output of a saved GDSS session (GSX file), saves the parsed data in a file format readable by MS Project (MPX file), and automatically opens MS Project with the parsed data file open for viewing by session participants.

The second tool is a custom developed application designed to collect information during facilitated meetings and generate Microsoft project plans from the results.

The work facilitates project planning by focusing on developing an extension to existing systems facilitating generation of Microsoft Project plans. The new system is a Web enabled application, running on a wireless local area network that has significant contrasts with the 1999 client-server system. The Project plans are generated on the desktop of the client. The custom application was optimized for collaborative project planning since it directly captures participant plan inputs and stores these data in a database. The tool used did not offer the features and functions available from a full functioning commercial facilitation tool (GroupSystems) and a fixed facility.

The planning agenda tab allows facilitators to develop detailed planning agendas for viewing by participants. The Documents tab allows documents to be uploaded for use during facilitated sessions. The voting tab allows for voting by participants during facilitated meetings on selected topics or issues.

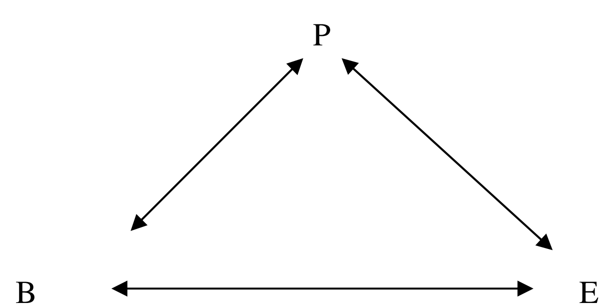
Theory

A framework is proposed that aids in understanding why integrating tools may have significant impact upon the project plans, project participants, and the organization seeking to accomplish a given project. The argument is somewhat complex. First, it is argued that the migration tools alone may be useful – as are the MS Project viewing tools and the GDSS tools. However, the tools function as “stand alone” products and do not suffice to deliver significant improvements without intervention. A user must plan to use GDSS tools in an appropriate sequence, assimilate the collected data, plan for a transfer into the MS Project viewing tool, and cut-and-paste the correct data in order to use the tools in their current configuration. The authors believe that integrating these tools and combining them with structured processes improves collaboration and planning success. Secondly, the authors believe the tools and processes must be applied in situations where interactive or complex task characteristics (such as task uncertainty, task interdependence and collectivism) require improved group collaboration and group acceptance for use of the outputs for improved success.

This work employs a social cognitive theory framework to explain the impact of this structured experience. Major concepts of Social Cognitive Theory (SCT) evolve from recognition of the reciprocity and interaction among cognitive, behavioral, environmental, and physiological/affective influences. It postulates that the actions of a person in a given situation depend on environmental interaction, with a primary emphasis on social cognitive factors. The framework states that people learn from a variety of experiences, including observation of the actions of others. (Flora, J. A.; & Thoresen, 1988) This theory has been applied to organization level functioning, and illustrated in complex managerial decision making experiments in simulated organizations.

The diagram presented below presents a triangle connecting primary variables. It illustrates the interactive relationships among variables included in the Wood and Bandura presentation of the theory. (Wood, & Bandura, 1989) It shows the reciprocal influences of behavior, cognitive, and other factors and environmental events postulated to influence each other bi-directionally. The theory further argues that the different sources of influence do not have to be of equal strength, nor do they have to occur simultaneously.

Figure 1
Diagram of the bi-directional interaction among behavior (B), cognitive and other personal factors (P), and the external environment (E). (Wood, & Bandura, 1989)



SCT has been applied to many activities and domains including learning theory. This paper will review the learning theory application of SCT to familiarize the reader with the theory, and then extend SCT to the project management domain. The SCT explanation of learning does not require that a person's actions be dependent upon an individual's knowledge in the early stages of the learning. This robust learning theory has been applied to a variety of different environments that vary from gender development to career preferences, and extended into the analysis/managerial decision-making processes. Social cognitive theory postulates that gender-linked knowledge emerges from children's social and observational experiences. As children develop stronger gender-linked preferences, their knowledge of the various attributes linked to gender increases. This is but one of the many factors that influence their development including proximal social influences of parents, teachers, and peers as well as the mass media and cultural institutions. (Bussey, & Bandura, 1992; Bandura, 1986)

The theory postulates that initially, behavior is self-regulated on the basis of anticipatory outcomes mediated by the social environment. However, as children develop, their personal standards relating to gender-linked conduct are based on increasing experiences, social knowledge, and cognitive development. Eventually, their conduct is motivated and regulated primarily by the exercise of self-reactive influence. In summary, during the course of development, regulation of behavior shifts from predominantly external stimulus and sanctions to gradual substitution of internal mandates rooted in personal standards. (Bandura, 1986)

In a similar fashion, the theory and its constructs have been used to explain entrepreneurial career preferences through assessment of the effects of observational learning vis-a-vis perceived parental role model performance. The theory appears to be a viable conceptual framework for developing theories of entrepreneurial career selection. Research has demonstrated that individuals with parent entrepreneurial role models perceived to be a high performer were significantly different from individuals with a role model perceived to be a low performer, and from individuals without a role model. (Scherer, et. al., 1989)

Self-efficacy

Self-efficacy also serves an important function in this theory. Research indicates that self-efficacy beliefs affect thinking patterns that may be both helpful and hindering. In general, the stronger the perceived self-efficacy, the higher the goals individuals may set for themselves and the firmer the commitment to the goals. (Bandura, 1986) Social cognitive theory incorporates this concept by placing cognitive, vicarious, self-reflective, and self-regulatory processes in a central position when assessing the importance of human agency.

The theory offered is one of emergent interactive agency. (Bandura, 1986) Individuals make causal contributions to their own motivation and action within a system of triadic reciprocal causation. Action, cognitive and affective personal factors, and environmental events all operate as interacting determinants of human action. Self-generated influences may therefore be seen as a contributing factor. The way the self-efficacy construct is hypothesized to function is very broad. Thoughts may influence the way people predict the occurrence of events and create means for exercising control over events that affect persons' lives. Individuals perceive predictive rules that may require processing of multidimensional information containing ambiguities and uncertainties. When developing predictive rules it requires a strong sense of self-efficacy to maintain a task orientation in the face of demonstrated errors in judgement. Individuals may draw on their general knowledge to generate hypotheses, develop weights, and integrate these data into complex rules, test judgements, remember what works, and what doesn't. In addition, peoples' perceptions of efficacy influence the types of anticipatory scenarios constructed. Those with a high sense of efficacy visualize successful scenarios that provide a positive guide for future task performance. (Bandura, 1989)

Relating Learning Theory to Organizational Environments

Stajkovic and Luthans (1998) extended the concepts of SCT and self-efficacy research into the areas of understanding and predicting organizational behavior, and understanding of the complexities of human resources management in the modern workplace. They expand upon the working nature of bi-directional reciprocal influences that operate through five basic human capabilities: (1) symbolizing, (2) forethought, (3) vicarious learning, (4) self-regulation, and (5) self-reflection. It is argued that organizational members use these basic capabilities to self-influence themselves in order to initiate, regulate, and sustain their own behavior. Stajkovic and Luthans (1998) apply self-efficacy to an individual's convictions (or confidence) about his or her abilities to mobilize the motivation, cognitive resources, and courses of action needed to successfully execute a specific task within a given context. Before one selects choices for actions and initiates effort, information about the person’s perceived capabilities tends to be weighed, evaluated, and integrated. The overall efficacy expectation perceived by one determines how much task-related effort will be output, and how long that effort will be continued. Thus, persons who perceive themselves as highly efficacious will extend their efforts and perhaps meet with overall success. Those who hold perceptions of low self-efficacy may cease their efforts prior to task completion, and fail.

Finally, Stajkovic and Luthans (1998) describe the modeling behavior associated with SCT and its application as a structured training program that can be used to enhance a person's self-efficacy. Managers can apply modeling to develop effective strategies for helping employees coping with cognitive and behavioral intricacies of a particular task or activity, and deliver the training to each individual via a skill based (efficacy increasing) training program.

According to Stajkovic and Luthans (1998) the strategies would incorporate clear specification by first explaining and enacting the steps, then having trainees repeat the instructor's actions step-by-step with monitoring and feedback. This mastery in skill and strategy would tend to improve an individual's beliefs about their capabilities to successfully execute that task at a later time. The requirements for this include:

1. *The task product (what is expected as a result of this task).*
2. *Number and nature of activities (what activities are involved; different activities needed).*
3. *Sources of information cues (where necessary task information could be found).*
4. *Optimal sequencing requirements among behavioral activities (e.g., greeting the customer first and then asking what the customer needs).*
5. *Nature and frequency of temporal changes in the sequencing requirements among behavioral activities (determining whether the sequence among activities changes, and if it does, how it changes for different circumstances).*
6. *Necessary performance means (e.g., what technology is necessary for successful performance).*
7. *Applicable utility of the available performance means (determining whether available means are appropriate for successful performance).*
8. *Developing and evaluating alternative courses of action and information processing*. (Stajkovic and Luthans, 1998)

Finally, Gibson (1999) developed an analysis and hypotheses regarding group efficacy indicating that contingency factors of task uncertainty, independent work and collectivism moderate perceptions and effectiveness of work groups. The reported group relationships are not as straight forward as those of individuals. It appears that group efficacy is distinct from beliefs that individuals hold about themselves or their group because efficacy perceptions arise from group interaction and collective cognition. Thus, according to Gibson, perceptions of efficacy are developed as group members collectively acquire, store, exchange and manipulate information about group information. The information is combined, weighted and integrated through interactive processes to form the group efficacy concept.

Gibson's results support a contingency approach by indicating that when task uncertainty was high and task interdependence and collectivism was low, group efficacy was not related to group effectiveness. This was partially explained by the fact that groups had difficulty combining and integrating information under these circumstances. However, research indicates that when groups know requirements to perform a task and members can actively share information about their groups, the groups' beliefs are better aligned with effectiveness.

Moving from Data Collection to Information and Knowledge Acquisition in Project Management

Meredith and Mantel (1995) broadly describe the many processes required to develop and plan tasks that will lead to accomplishment of a specific project goal. They summarize the general thinking in this area and note that most fields have their own literatures which divide projects into phases and processes that are all fairly similar in function. In general, all of the fields introduce phases for control and clarification, and require that significant task detail be provided in each phase so the plans can map how a project is to be done without smothering a manager in too much detail. These authors characterize the planning preparation and task generation processes as being described formally, but as not occurring formally, and never being as straight forward and systematic as they seem in theory. Meredith and Mantel's (1995) colorful description of project plan's untidy development is that it is a "tortuous", and "iterative process yielding better plans from not so good plans," with bits and pieces developed by individuals, informal groups, and iterative improvements taking place in "fits and starts." (Meredith and Mantel, 1995: 197-200.)

There is limited work on task generation concerns in the project management literature. Most of the analysis and research effort in project management focuses on tracking, sequencing, resource assignment, and follow-up concerns. There are significant problems in these areas if one simply calculates the numbers of plans and variation in ways project "could" be completed when there are a large number of tasks. These issues have been addressed for the specific project management problems associated with identifying tasks and assembling the tasks so they can be used for coordination and management purposes. Tool surveys have identified the numerous tools available, assessed the uses, satisfaction, and training with regard to the tools. (Fox, Spence, and Wayne, 1998) Results of the survey seem to indicate that project managers themselves are generally satisfied with these tools, but the results do not indicate that usage levels are high. Interesting enough, the surveys have not been extended beyond the project managers to the project planners or individuals responsible for identifying and completing the integrated task projects.

There are significant problems associated with complex task identification and planing problems that illustrate why tool development and research is continuing in these areas. For example, several computational problems exist for complex planning tasks on large projects. The problems are associated with the numbers of tasks and the objective of obtaining a simple number representing the number of different plans that could exist for performing the tasks. This is demonstrated with an assembly task problem where new findings have shown that the complexity of the problem depends on the typology of the precedence between the operations and not on the number of operations, components or parts. (Ramos, Rocha and Vale, 1998)

Other issues addressed during the attempts to improve multi-project management show that the amount of effort involved is not similar to the summation of the task effort, especially in high-tech companies where innovation may create uncertainties in the duration of project tasks. Work must often be performed in functional departments. Thus, arrival of the work to those departments is not controllable because of uncertainty inherent in the work performed in previous locations. This unpredictability causes queuing to take place in some departments. This has a significant impact upon costs, delays, and overall project performance of all projects in the organization. (Levy, and Globerson, 1997)

An example of the traditional solution to the complexity of various projects has been the published Plan-Do-Check-Action (PDCA) model which attempts to introduce a cyclic control process into projects after all the tasks have been identified and assigned. This methodology has been faulted for lacking timing information and showing the sequence required in the events. New proposals for modification of this process/tool introduce the Plan-Implement-Do-check-Action (or Assess)-management (PIDCAM) cycle as a time dependent method that does not incorporate sequential winding through the more traditional PDCA cycle. However, for this enhancement to be useful, tasks must be delegated to the specific lowest organization levels with appropriate responsibilities and competencies. (Platje and Wadman, 1998)

Integrating Collaboration Processes, GroupSystems and MS Project

Knowledge acquisition has long been one of the touted benefits of electronically facilitated meetings. Weatherall and Nunamaker (1999) note that "Electronic Meetings are excellent for idea creation, since all ideas are recorded, anonymity increases creativity, remote participants can conveniently give their input and the parallel entry of data reduces the time required." (Weatherall and Nunamaker, 1999: 118) Although currently available electronic facilitation applications excel at acquiring knowledge from human experts in facilitated sessions, there is room for improvement in the way the acquired knowledge is used.

As an example of the benefit, Leventhal (1995) applied GDSS and its potential benefits to the Joint Application Development (JAD) processes. Leventhal noted that GDSS tools used to automate JAD workshops greatly facilitate the generation, analysis and documentation of information, and aid in the building consensus. JAD techniques maximize user involvement in specifying requirements by providing a team-based structure for managing the interaction between users and designers and building consensus on proposed functions and features. The use of the JAD technique ensures that both user priorities and technological constraints will be considered when tradeoffs are required.

Leventhal (1995) notes that attempts to automate the JAD workshop thus far have ranged from the rather primitive use of word processing tools to the more sophisticated use of CASE tools. The conclusion reached by Leventhal is that neither approach has been very successful. The text capture capability of word processing tools does little more than automate the role of the "scribe," who is responsible for note taking during the JAD session. Also, CASE tools are so exacting in their data input requirements that it is not practical to use them on a real time basis. Leventhal identifies support needs as a set of tools that supports the information generation, analysis, and documentation functions of the JAD workshop. The conclusion reached is that GDSS tools meet this need, and that GroupSystems provides capabilities supporting a wide variety of meetings, but lacks some capabilities important to the JAD process.

The GroupSystems product is designed to identify and collect undocumented knowledge. Stout suggests that significant value is added by use of teams in acquiring knowledge. (Stout, 1997) The collaborative planning migration tool (CPTeam) and process facilitate the acquisition of knowledge, and migrate GroupSystems output into Microsoft (MS) Project plans. The combination of the CPTeam tool and GroupSystems collaborative meeting facilitation process provide output results that are perceived by the plan developers as scalable, reliable and usable. The collaborative process and tool combine to break down the complexity found with numerous levels of knowledge and improve participant's understanding of the interconnected nature of work tasks. The straightforward structure of MS Project facilitates reconciliation of situation specific shallow knowledge and knowledge deep in organizational memory. The CPT tool and process connects GroupSystems and MS Project tools to more easily acquire and represent knowledge. It is argued that Turban's areas of difficulty are largely resolved – knowledge expression and numerous participants are reconciled by GroupSystems, and machine transfer and structure are provided by MS Project. CPT is the essential integrator of the data represented by the different conceptual frameworks and technical formats found in GroupSystems and MS Project.

The Broad Hypothesis

The initial hypotheses are constructed using a rather complex planning and task-outcome perspective. It is argued that tasks identified, assigned to responsible managers or organizations, sequenced and prioritized with allocated resources are essentially project "knowledge." Projects composed of these data, collected and reviewed/discussed via a structured and accepted process, may be more readily understood and accepted by participants. It is also recognized that not all projects, tasks, or individuals are equal and that projects and tasks vary significantly with respect to their complexity, and uncertainty. Thus, these variables are conceptualized as moderators of the success of the definition efforts. It is also essential to incorporate attributes of an effective process for the data collection and assembly attributes into this hypothesis. It is argued that plans will be significantly more likely to be used and completed if they: (1) use collaborative electronic meetings to collect knowledge from the managers and experts with critical planning task knowledge, (2) use a well developed process (methodology) optimized for knowledge collection, and (3) provide a complete but simple representation in a widely recognized format. With the current state of computer facilitated meeting tools, GroupSystems is viewed as excellent candidate tool for knowledge collection. Microsoft's Project application is currently a very widely used project planning application, containing generally accepted viewing formats, terms, and definitions of key project planning data. To harness the power of each of these tools, it may be necessary that specific cases be identified where predefined planning templates can be built to more easily collect knowledge.

Setting the Planning Exercise Objectives

The project planning experiences described in this paper assisted project participants and managers in defining and collaboratively planning complete projects. Understanding when and how to use the GDSS (and its many components) is an important issue. The GDSS literature documents many potential "benefits" for a task from the use of the GDSS if the situation is appropriate. These benefits have been divided into several components: (1) process support, (2) process structure, (3) task structure, and (4) task support. Process support describes the communication media and channels that are included in GDSSs that facilitate communication among members. Process structure refers to the mechanisms, techniques, agendas, and rules that direct the timing, sequence and composition of the communication activities. The tools and databases provided to participants are described as task support. Finally, the term task structure refers to specific rules or models included in GDSSs that enable group participants to analyze the task information available to the participants in the group. (Nunamaker, et. al., 1993)

It is relevant to incorporate this detailed conceptualization of how the collaboration process and tools may impact the group into project planning processes and to assist the managers in focusing on how applying information sharing and communication support technologies may potentially beneficially impact the outcomes of group efforts. This secondary collaborative project planning objective is to obtain the assistance of managers in analyzing highly complex project situations, and collaboratively identify significant variables or data that may be collected or processed that will (or won't) be helpful in a given situation, and when a specific collaborative tool and process should or should not be used. (Nunamaker, et. al., 1993) For example, project participants' understanding of the applicability of the tool and process is improved when the members of the project teams are able to visualize and experience how a tool can provide mechanisms to collect additional task or resource data, or how communication rules could be constructed to direct the timing and sequence of communication activities at one point in a group's project definition or clarification task. In contrast, group members may also see when tools such as a project plan, Gantt chart resource list are appropriate to enable group participants to recall or analyze data generated by the participants in the group at a different time.

Primary goals of the experience were to use the GDSS – CPT migration – MS Project technology to:

1. Initially collect the major tasks or components of the project.
2. Group the task into like task areas, and according to departments, or management.
3. Identify and document known sequences and precedence.
4. Identify and document know start and finish requirements.
5. Provide opportunities for feedback and questions that refine and expand or tasks as participants “see” specific circumstances and combinations of tasks.
6. Set priorities, make tradeoffs, suggest better task sequences, use alternative tasks.
7. Discuss with project members how to introduce new methodologies or resources into a project or organization that is facing time pressures.
8. Permit project participants to experiment and to begin to internalize the project overall sequences and the requirements and interactions among the various tasks.

The expected session outcome was to have project participants internalize and use project planning techniques.

How the Process and Tolls Were Applied to the Project Planning Tasks

The GDSS and migration tool were applied in a six phased process using sessions to control the phases. The first phase collected basic tasks for a project to construct a detailed and relatively complete initial task list. The second phase used the categorization process task experiences to construct a responsibility assignment similar to a work break down structure for the tasks, and sequenced the tasks within the different categories. The third phase prioritized and defined the relative criticality of the tasks. The fourth phase defined attributes of the tasks such as duration, start, stop and resource required to perform a given task. Finally, the fifth phase produced the project plan for “viewing” by the participants. The sixth (final) phase sought to collect additional specific attributes of tasks “planned” for a project. Added task attributes in priority and criticality designations, which aid in managerial decision making during a project’s execution. [Note: there are many possible other attributes available in the MS Project tools.]

The goal of phase 1 - identifying and fully defining the tasks and their characteristics was to improve the management and communication of task related information. This process is very similar to previous conceptualizations of the use of GDSSs to prepare student to perform systems analysis activities. [Money, 1995] The project literature appears to indicate that the information about the specialized activities that must be performed to complete a task by others have a significant impact upon the understanding the group members have of the interaction with their own tasks. Therefore, the primary goal of many project planning activities is to exchange information between/among members. The form of this information will have significant effects on the performance of the group. Zack and McKenney (1989) identified three conditions that describe the task-related states of information that may be encountered:

- Ambiguity: lack of information and a lack of framework for interpreting that information.

- Uncertainty: lack of information, but a framework exists for interpretation when the information is available.
- Equivocality: multiple interpretations for the information and/or the framework, and potential disagreement among the interpretations. (Daft, R. L., and Lengel, 1986)

The project data are collected to help analyze the requirements of a task to determine what the project members in a group must do to manage information flows under these varying states. Determining what a GDSS supported group would need to do to collect or analyze the appropriate project and task requires an understanding of the appropriate use of the various components of the tool.

As was shown in the Systems Analysis (SA) project with students [Money, 1995], equivocality requires negotiation among group members to reach some form of group consensus or group understanding, and techniques which provide the capability for exchanges of greater and more detailed information are preferred. (Connolly, et. al. 1990) Ambiguity and uncertainty require that a group member (or the entire group) find the additional needed information and the interpretative structure or context. It is argued that the tool and process will be most useful if it enables the group to rapidly collect the data and develop some structure that enables the group to "understand" and use the information. The capability will be more important if members of the group supply different data, hold varying views, or hold divergent concepts about the meaning of the collected data. In this case, developing a common understanding and approach to the solution of a problem or completion of the work is essential for overall project success.

The laboratory and field research conducted by the researchers at the University of Arizona (and replicated by others) provides some support for this general set of hypotheses regarding the impact of task uncertainty. Laboratory experiments of idea generation (a task used to reduce uncertainty), found that an interactive style was more satisfying and generated more ideas than verbally interacting groups. (Gallupe, 1991 cited in Jessup & Valacich, Eds., 1993) Similar results have been achieved with groups in field studies which used interactive styles to generate ideas, options, and analysis perspectives but used a supporting or group assisted approach to address states of equivocality. (Nunamaker, et. al., 1993: 142)

Further support of the impact of this task based moderating variable has been provided with data published by the Wilson and Morrison (1999) which sought to develop a task based measure of perceived effectiveness. They examined the fit between task and technology to predict the tasks based differences in perceived effectiveness between alternative CMCS (computer mediated communication systems) features. Their overall goal was to assist in selecting those features that are most effective in supporting the performance of specific group tasks. The task domains of the groups included in the Wilson and Morrison study were software development (using a 3GL), database development, and general communication. The study results showed that the measures of perceived effectiveness (of the CMCS) did distinguish between different task domains. Thus, potential variations in support capability do appear to exist, and the task characteristics could be considered as significant moderators of the GDSS – CPT migration – MS Project technology.

Results from a Case Study Combining the Process, GroupSystems, Migration Tool and MS Project for a Real Organization [U.S. Coast Guard]

A case study involving a government regulatory agency was used to demonstrate the data migration tool and validate the facilitation process. The business case was to develop a plan implementing a detailed international treaty in the United States. Complete compliance with the treaty was paramount since significant penalties and United States “loss of face” would result if the international governing body found that the U.S. did not fully comply. Since the treaty involved a large sector of the transportation industry, consideration of industry concerns was also important. The treaty contained very specific required compliance dates for various components. A working group was chartered which consisted of subject matter experts from various Coast Guard (CG) sectors. The goal was to collect the knowledge of these experts and use the result to synthesize a plan to implement the treaty.

The preliminary work included conducting a GroupSystems brainstorming session with the working group. The group developed 57 specific tasks required to implement the treaty. To obtain input from affected industry stakeholders, after the first session, a listening session was conducted via Web TV. Additionally, written comments were solicited via a notice in the Federal Register. The combined input from those venues was 441 comments, most of which in some way related to the 57 original tasks. At this point, the project stagnated for several months - the magnitude of reconciling inputs and applying each of them to the very different draft tasks apparently stifled the working group. The working group seemed to be overwhelmed by the project magnitude, complexity, and the need to develop a "group" acceptance of the overall plan.

The project was reinitiated after discussion with the manager responsible for submitting a report of the treaty implementation actions and project plan to Coast Guard command. A GDSS room was scheduled for two days of rigorous GroupSystems facilitated sessions, and each of the additional comments was reviewed, categorized, and reconciled. Using GroupSystems Categorizer tool, the 441 comments were then review and used to suggest additional new tasks, and added in a GDSS session to the original list of 57 tasks. A final facilitated meeting was then scheduled to "turn" the resultant 85 tasks into a project plan.

In the project planning sessions, the participants first reviewed all of the tasks and made some additions (6 new tasks) and title revisions to clarify the meaning of the tasks. The participants then began assigning task ownership and identifying the responsible party/organization unit for each of the 91 tasks. The group then developed ownership "buckets" for each available resource, into which the facilitator dropped each task during a chauffeured GroupSystems categorization session, identifying the responsible party. Secondly, participants assigned the relative priority of each task within the buckets during a voting session. A second vote was then held to determine whether additional resources were required to complete tasks assigned to each responsible party. Thirdly, representatives from each responsible party/unit collaborated to identify and add as comments, the duration, start, stop and specific resources required to perform each task. These data were then edited for format (required by the data migration tool and to produce usable output from the GDSS system), and the output of the session was converted into an MS Project file using the CPT migration tool. The file was opened using MS Project to display a Gantt chart of a project plan showing tasks, durations, assigned resources, and start dates. Participants were able to view the source data (results of the all morning sessions) as well as the completed project plan simultaneously on separate video projection screens.

The planned afternoon session was designed to further refine and develop the required information. Participants attempted to identify and agree on the mandatory tasks. Despite a lively discussion and several attempts at voting, participants were not unable to come to a shared consensus on which tasks were mandatory, nor were they able to agree upon an alternative method to prioritize tasks. A methodology for prioritizing items was finally decided upon by the group, prioritization data were collected for all the tasks, and modifications were made to the MS Project plan by adding a priority flag to the MS Project file in order to incorporate the agreed upon prioritization data.

Deliverables from the session held to produce the plan included an MS Project Plan in hard copy and electronic formats (including special columns for prioritization, additional resources and whether tasks are mandatory), and GroupSystems reports listing all of the morning session results. The members of the working group, since they would ultimately be responsible for implementing the plan, expressed comments indicating they shared a "common" vision and perceived that they had some stakeholder ownership of the project plan. The project plan appeared to contain responsibilities that were clearly defined and resources that were required, fostering accurate accountability for task implementation. Through participation in the meetings and review of the meeting reports, managerial vision and expectations appeared to be fairly well defined. Finally, each of the "buckets" containing specific action items could be completed relatively independently, and the plan delivered can be constantly be updated by its owner or a member of the organization's administrative staff. In summary, the goal of collecting data from diverse sources and individuals, refining and manipulating that until it represents knowledge, and finally representing it in an MS Project plan appeared to have been met.

Questionnaire and Perceptual Data

Questionnaires were distributed to the group after the plan creation session, and again after the final session used to set priorities and for the tasks in the project plan. The questions were used to ascertain the levels of perceived task uncertainty [conceptualized as lack of information uncertainty, decision outcome uncertainty, and alternative criteria uncertainty] and task/job variability. Ten uncertainty questions used were combined to form 3 scales. The questionnaires also included a set of "outcome and output" assessment questions about the process, tools, and results; and an area for open-ended comments about the tools and the process.

The low number of participants included in these planning meetings (10 in session 1, 11 in session 2) does not support statistical comparisons. However, some observations can be made about the data collected. First, perceived uncertainty on all of the scales is not particularly high, and task variability is relatively low. Thus, the original difficulties experienced by the project planning participants may be attributed more to the volume of work, requirements for responsibility assignment and sequencing of the tasks, and complexity of the overall environment. Observation of the mean differences between the 1st and 2nd session scores seems to indicate that after the second planning session there may have been a shift on both the uncertainty and task variability measures, with the group perceiving a somewhat greater level of uncertainty and greater variations in their jobs and tasks after the second session. No explanation for this shift was readily forthcoming. It is possible that the planning document's lists of tasks, schedules and overall knowledge of the complex project requirements have now "sunk in" and the significant magnitude of the overall project is now better understood.

On the other hand, the process questions, tool questions, and opinions regarding the outputs received favorable responses on both sessions. There was a drop in the mean for these items, which represents a more positive response toward the process, tools, and prioritization work after the second session. Thus, the feedback for the entire process was favorable, and appeared to become slightly more favorable after the second GDSS meeting session and the passage of one week between the two sessions.

Discussion

In general, the GDSS – CPTeam data migration tool – MS Project combination of tools and data collection processes appears to have strong and practical project management value. The success and effects experienced in the planning sessions appeared to be consistent with the framework of a social cognitive learning theory explanation. The explanation offered appears to correspond rather well with the Stajkovic and Luthans (1998) discussion of two of the five basic human capabilities: (1) symbolizing, and (2) forethought, which are operating mechanisms for the bi-directional reciprocal influences discussed in SCT. These capabilities appear to match the processes that have occurred in the GDSS and project-planning meetings. The symbolizing construct suggests that humans have an extraordinary symbolizing capability that allows them to successfully react and then change and adapt to their respective environments. As they are used in this work, the output reports of the GDSS session and MS Project are powerful symbols, which can be processed and transform as immediate visual experiences into internal cognitive models that in turn serve as guides actions. Stajkovic and Luthans note that through symbolizing, people also ascribe meaning, form, and duration to their past experiences. Thus, rather than learning proper behavioral responses only by enacting behaviors (as reinforcement theory would suggest) and possibly suffering painful missteps, these project planning participants (faced with a difficult decisions) were able to "test possible solutions" symbolically first, and then eliminate or accept them as part of the plan on the basis of these thought processes. Bandura argues that the second operating mechanism, forethought, permits people not only to react immediately to their environments through a symbolic process, but also to self-regulate their future behaviors by forethought. Again, the members of the GDSS session appeared to be following this capability by planning their courses of action for the near future, anticipating the likely consequences of their future actions, and setting goals for themselves.

However, this initial work leaves many key questions about the uses of the tools and processes employed. Future research designs must develop a more complete understanding of the impact GDSS and the data migration tool and process capabilities. The objective of future research will be to obtain structured, reliable, and validated data on the outcomes of this overall process and to answer several key questions.

1. Can objective measures of the impact of the GDSS and data migration tool and process be shown to simultaneously improve project planning outcomes, collect more (and better) task data, and aid in participants understanding of what is required to complete complex projects when compared to traditional "ad hoc" planning methods?

2. At what level can the researcher obtain measurement data to assess the impact of the entire process and tools upon an organization? Should experiments and tests be made generating data at the individual and task level? Should surveys (or objective tests) be used to count planning data developed for each project, or should attempts be made to collect aggregate data to assess impact across an entire organization?

Secondly, it may be important to assess how processes may enable the application of the GDSS and the data migration tool to be extended to other organization problems such as expert or structured decision making and requirements collection efforts. In each instance, other "single user input process tools" may be effectively "loaded" with data originally collected and vetted in a GDSS environment or session.

Thirdly, it may be important to determine if a portion of the analysis should be focused on the identification of project managers or participants who can really be helped with this technology, as well as those who may not find it useful. Frayne and Laytham (1987) use social cognitive learning theory to explain why specialized techniques (training persons to come to work) may be effective for some students and not for others. It was noted that high outcome expectancies alone are not effective (in supporting coming to work behavior) if the employees judge themselves to be ineffective in overcoming their personal and social obstacles in coming to work. Therefore, it may be useful to concentrate on understanding how to structure project planning experiences that positively support project managers and project meeting participants' assessments of their self-efficacy at achieving the project and completing an effective plan that can be followed by an organization.

Results from a Second Case Study Combining the Process, Dedicated Custom System, and MS Project for a Real Organization [U.S. Coast Guard]

The second collaborative planning example describes the result of a similar session using a different tool constructed and specifically tailored to collect information during facilitated meetings and generate Microsoft project plans from the results. The developed and customized application differs from capturing project planning information using GroupSystems and then exporting the information to a flat file that can be imported into a Project Plan because it has fewer steps in the collection and migration process, and because it restricts user options in identifying or performing related tasks.

The new application was applied to develop a Coast Guard "umbrella" plan encompassing all STCW activities. The approach was focused solely on the project planning data and plan development issues. The tool used did not offer the features and functions available from a full functioning commercial facilitation tool (GroupSystems) and a fixed facility. The custom application tasks were sequenced and optimized for collaborative project planning. The tool's output is a generated a new Microsoft Project plan.

Collaborative planning capabilities of the application included planning and capturing WBS tasks, comments, and descriptive task attribute data. The new system is a Web enabled application, running on a wireless local area network that has significant contrasts with the 1999 client-server system. The Project plans are generated on the desktop of the client.

The system utilizes tabs to permit users to access data and functions. The planning agenda tab allows facilitators to develop detailed planning agendas for viewing by participants. The Documents tab allows documents to be uploaded for use during facilitated sessions. The voting tab allows for task voting by participants during facilitated meetings on selected task topics or issues. [Note: it was anticipated that the Documents and Voting functions would be used frequently, but this did not prove to be the case during the planning sessions.]

The process followed for the development of the plan was very similar to the previous process. Users viewed and added tasks and key task attribute data inputs as they became available/clear in the minds of the users. The overall objective of the planning team meeting was to develop a robust and comprehensive planning document which could be routed (as draft) throughout the involved units for further input, comments, and refinement. Preparation for the collaborative meeting included individual meetings between facilitators and program points of contact to identify attendees, develop background material, and set meeting schedules. Documents currently in development were pre-loaded into the Documents section of the application in preparation for the meeting. A final project management facilitation process plan was developed and provided to the sponsor for approval and comment.

The first morning of the meeting started with administrative details, statement by the sponsor, and restatement of the group charter. It was stressed that although implementation details may be important, the meeting goal was to develop a draft project plan including all tasks, assignments, and schedules. The next item on the agenda was a software demonstration and training session, which went quickly. After a short break, the final morning session was a discussion and comment period on STCW Implementation Outstanding Issues using the collaborative data collection tool.

The team met again in the afternoon, and started a collaborative task brainstorming session using the collaborative planning tool. Participants were able to enter proposed tasks in the project plan format. Over 100 proposed tasks were generated. After the tasks were collected, the day's last session consisted of participants electronically entering comments on the tasks.

For the second day, facilitators combined the results of the previous day's morning and afternoon sessions, and provided the data in a new session. The paradigm for the second day consisted of sessions where facilitators went through each task, with group discussion and viewing of comments. Tasks were reviewed to determine if there was group consensus on validity, and tasks were placed into appropriate folders of "like" tasks. Participants periodically entered new tasks into the system, as the collaborative analysis continued. By the end of the second day, all tasks had been reviewed, and the resultant 90 tasks were resorted into folders.

Following the second day's sessions, facilitators generated a Microsoft Project Plan containing all the input to date. This document was provided to participants on the third day. The session on the third data was spent reviewing the plan to ensure that tasks were properly worded, that the correct responsible office was listed, and whether the task "mandatory" designation was properly applied. The resultant draft plan was produced and delivered to the project owner so it could be routed for additional input and comment. Participant's comments were that they considered the result largely successful.

Deliverables from the first meeting included a draft MS Project Plan, a separate plan in Excel format for those without MS Project and Excel spreadsheet sorted by responsible office. A spreadsheet with comments by tasks was also provided.

It was anticipated the next series of meetings would discuss the collected input, temporal flow, prioritization and resources. In preparation for the second meeting, input on the draft plan was solicited, received and incorporated into the plan. The custom tool was then optimized for this session's goals, with the addition of fields for recording prioritization of tasks and resource sufficiency.

The first day of the second meeting was dedicated to reconciling new task and planning inputs received since the first meeting. This included comments on the draft plan and additional tasks. Once the new material was integrated, participants discussed collected input, temporal flow, prioritization and resources required by the plan. By the end of the second session, start and finish dates had been developed for each task, as well as scaled priority, and data indicating whether or not resources were sufficient to perform the task. As with the status issue, discussions were conducted, and consensus was reached on coding the tasks for resources.

Again, each task was discussed, and consensus was reached on the sufficiency of resources for the performance of each task. Entries were then made by facilitators for each task. The initial intent was to attempt to determine levels of effort to further refine additional resources required by hours or fulltime equivalents (FTE). However, it was very difficult to reach consensus on the resource issue, and it was decided that offices would develop resource estimates for each task between facilitated meetings. Prioritization was a simpler matter, and consensus was quickly reached on ranking each task from one to five, with one being the tasks with the highest priority.

Each task was discussed, and priorities were assigned by consensus, and entered by facilitators. Once status and prioritization were complete, the plan was reviewed a final time to ensure that tasks were complete and concise, and that full consensus was reached on status, resources and priority.
During the final facilitated session, session comments from previous meeting results were again integrated into the planning data. The attempt to quantify resource requirements between sessions proved to be only partially successful, with some offices responding strongly that the umbrella plan did not require that level of detail, and that resource estimates would be of poor quality in any case. Each task in the final plan

received a careful review to ensure correctness, and linkages between tasks were examined. Some linkages and precedence relationships were intuitively obvious, while others were less so.

Obviously, some tasks would be sequential and inextricably linked. It was then decided that detailed task descriptions would be developed and appended to each task in the notes section.

Following the final session, linkages were again reviewed and strengthened, task descriptions were developed and incorporated, and tasks and task attributes were reviewed and smoothed to balance the work loads.

In summary, the collaborative process and the dedicated system tool significantly aided the group in developing a complete and actionable implementation plan through a systematic process over the course of three multi-day meetings. The first meeting facilitated group formation and yielded a core of tasks for consideration. The second meeting furthered review of tasks, and consideration of temporal flow, status, priority and resources. The third meeting smoothed the results and allowed finalization of the plan. Time between meetings was spent preparing for future meetings and input and comment from offices involved. The result is a refined Microsoft Project Plan.

Research and Future Custom Development

Future tool development efforts include expanded interface improvements, interoperability with additional planning and collaborative applications, and interoperability with database applications and refinement of fields and inputs targeting specific domain where collaborative work may be necessary for success.

For example, a typical example of an alternative domain is a project task collection template for a disaster recovery - business resumption scenario, where either the custom developed application described in this paper or GroupSystems and a CPT tool could be combined to develop an Information Systems Disaster Recovery Plan. A GroupSystems session would be pre-loaded with a survey including all tenets of the typical disaster recovery plan. Meeting participants would provide organizational knowledge by selecting options and providing input relating to their specific organizational scenario. By using the pre-loaded survey template, participants and facilitators can rest assured that all typical aspects of disaster recovery will be covered. Participants have only to decide which of numerous options are applicable, and customize the plan to their company. The experienced facilitator can lead them through the process, helping the group derive advantages and disadvantages of various options, or indicating why special advantages or disadvantages don't apply in a specific task environment. Once participants have agreed on their work breakdown structure or task phases, the plan can be exported to MS Project and delivered to the customer. Additional value is added to the deliverable because due to the format, the customer can continually make additions and changes to their project plan.

Another new application, currently in testing, is optimized for requirements development and generation. Here, the emphasis is not on a project plan, but on collecting ideas and requirements in a manner typical of a Joint Application Development (JAD), Rapid Application Development (RAD) or general requirements collecting and development meeting. The application is designed to support these and other types of activities, both in information systems and other domains. Loosely based on those methodologies as well as requirements collection methodologies and documents such as IEEE 830, the application is designed to take users through requirements collection activities sequentially.

Designing a Template for Project Planning with PMBOK

The Project Management Institute (PMI®) is a nonprofit professional association dedicated to advancing state-of-the-art in Project Management. Founded in 1969, PMI has over 50,000 members. PMI develops Project Management standards, provides seminars, educational programs and professional certification. One of the functions of PMI's standards committee is to maintain the Project Management Body of Knowledge, "…an inclusive term that describes the sum of knowledge within the profession of project management." (PMBOK Guide, 3) PMBOK can be described as "…a structured identification of the concepts, skills, and techniques unique to the project management profession." (PMBOK Guide, Cover 3)

The committee also publishes A Guide to the Project Management Body of Knowledge (PMBOK Guide). The PMBOK Guide is a useful reference for development of any project:

> The primary purpose of this document is to identify and describe that subset of the PMBOK, which is generally accepted. Generally accepted means that the knowledge and practices described are applicable to most projects most of the time, and that there is widespread consensus about their value and usefulness. Generally accepted does not mean that the knowledge and practices are or should be applied uniformly on all projects; the project management team is always responsible for determining what is appropriate for any given project. (PMBOK Guide, 3)

The Project Management Knowledge Areas section of the PMBOK Guide describes accepted processes and elements to be reconciled in development of a successful project. Consequently, if more specific heuristic templates or similar previously completed project plans are not available, the PMBOK Guide could arguably be a good place to start.

In the PMBOK Guide, planning processes are broken down into process groups, and further into individual processes and steps. Rather than specific tasks, they are listed as standardized, general, processes:

> Within each process group, the individual processes are linked by their inputs and outputs. By focusing on these links, we can describe each process in terms of its:

- Inputs - documents or documentable items that will be acted upon.
- Tools and techniques - mechanisms applied to the inputs to create the outputs.
- Outputs - documents or documentable items that are a result of the process.

(PMBOK Guide, 29)

The Knowledge Areas contain processes common to most projects in most application areas. In the previous step, the areas were customized to include only those appropriate to the project at hand. Now, through a facilitated session, the entries for each Knowledge Area are modified into specific tasks to be completed during the project's implementation phase. For example, PMBOK lists Quality Assurance Tools and Techniques as:

> .1 Quality planning tools and techniques
> .2 Quality audits
>
> (PMBOC Guide, 88)

Again, one of the research goals is to integrate planning knowledge development and data acquisition techniques with structured planning processes. This would maximize conditions identified by efficacy theorists as those leading to successful cognition and task completion, regardless of task complexity and uncertainty. It is argued that plans will be significantly more likely to be used and projects completed if collaborative electronic meetings are combined with a will developed process optimized for knowledge collection, and the product presented in a widely recognized format (PMBOK attributes)

The strength in using a standardized and agreed task and project templates is that most, if not all, required actions are included. By adding and deleting items, the template may be customized to the appropriate business case. Since the areas listed in the PMBOK Guide are near exhaustive, the expectation is that few if any areas will miss being addressed. Once the template has been appropriately modified, the comments and remaining items are saved for easy reference during future sessions. Hard copies may be made for participants, and electronic versions are made available for participants and potential system users.

All of the process guidance and steps in the PMBOK template are changed to specific tasks. All tasks associated with successful project completion are listed. This may take several sessions.

As a result of following this process and using the tools, plan owners should be pleased, since a complete project plan can be developed in a short period of time. Participants in the sessions, since they would typically be tasked to implement the plan, should share a common vision and stakeholder ownership of the plan. Responsibilities and resources would be clearly defined and listed on the plan, fostering accurate accountability for task implementation. Through participation in the meetings and review of meeting reports, managerial visions and expectations are well defined and incorporated. Finally, each of the plan tasks can be completed independently, and managers or supervisors can constantly update the plan.

[Illustration 4 about here]

Conclusions

This paper has reported on a research project which has integrated full featured collaborative tools and developed custom collaborative tools. The different tools have each been combined with processes that enable task teams to collaboratively identify, define and agree on the tasks necessary to complete large, complex and dynamic projects. The work is contributing to the development of a better understanding of how group collaboration and teams can improve technologically oriented project task definition, project management, planning, and organization. In addition to the project plan developed in the case studies, there are many other scenarios that lend themselves to the demonstrated methodology, and application of the MS project planning capability. Some of the more promising scenarios include hardware/software deployment and system upgrade plans, IT and non-IT product deployment, product development planning, business process reengineering and office reorganization. Combining a concise and easily used follow-up mechanism with the capability of collaborative methodologies to collect knowledge may result in faster, easier and more useful knowledge acquisition. It was noted that the entire process appears to resemble the Stajkovic and Luthans (1998) description of the modeling behavior associated with SCT.

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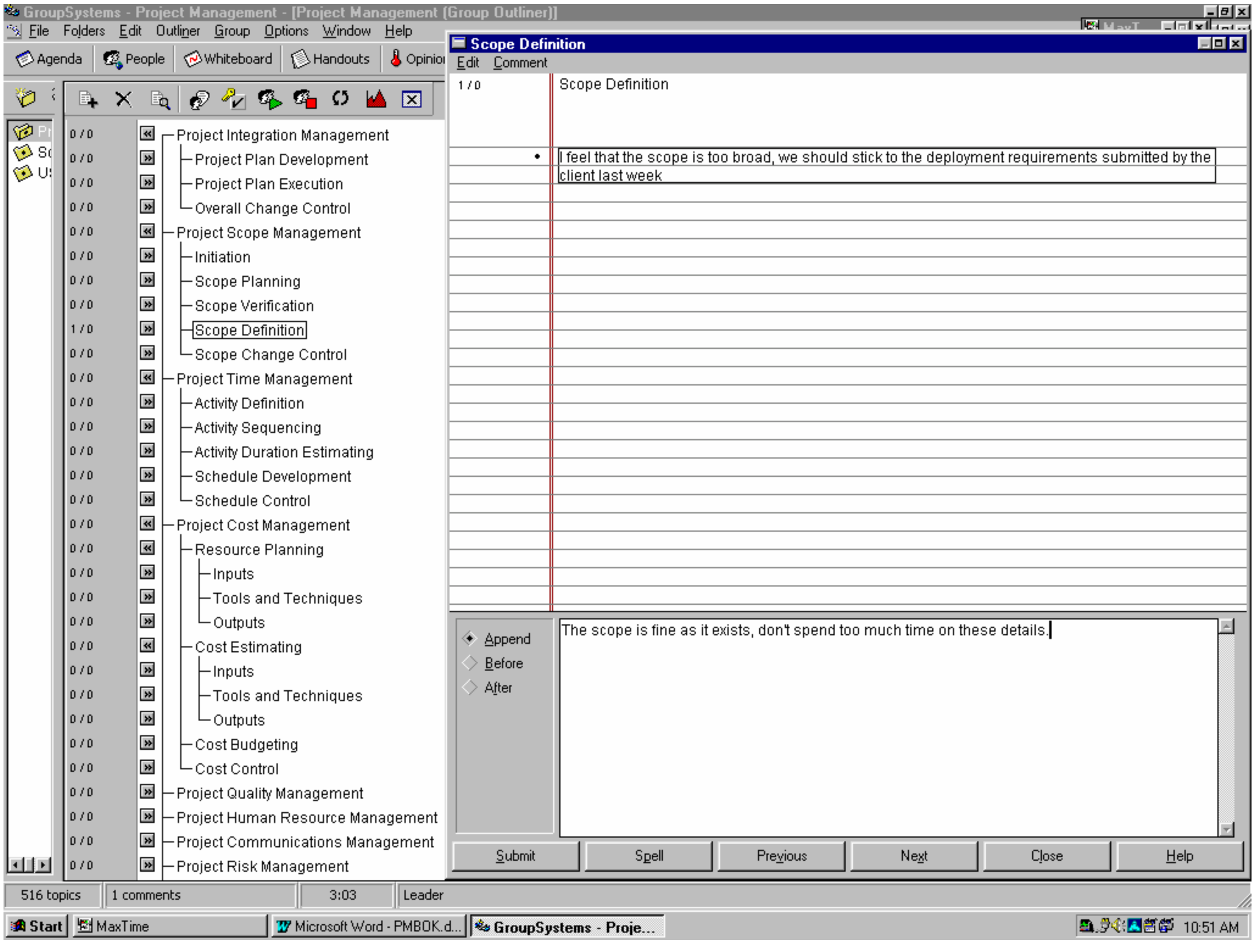
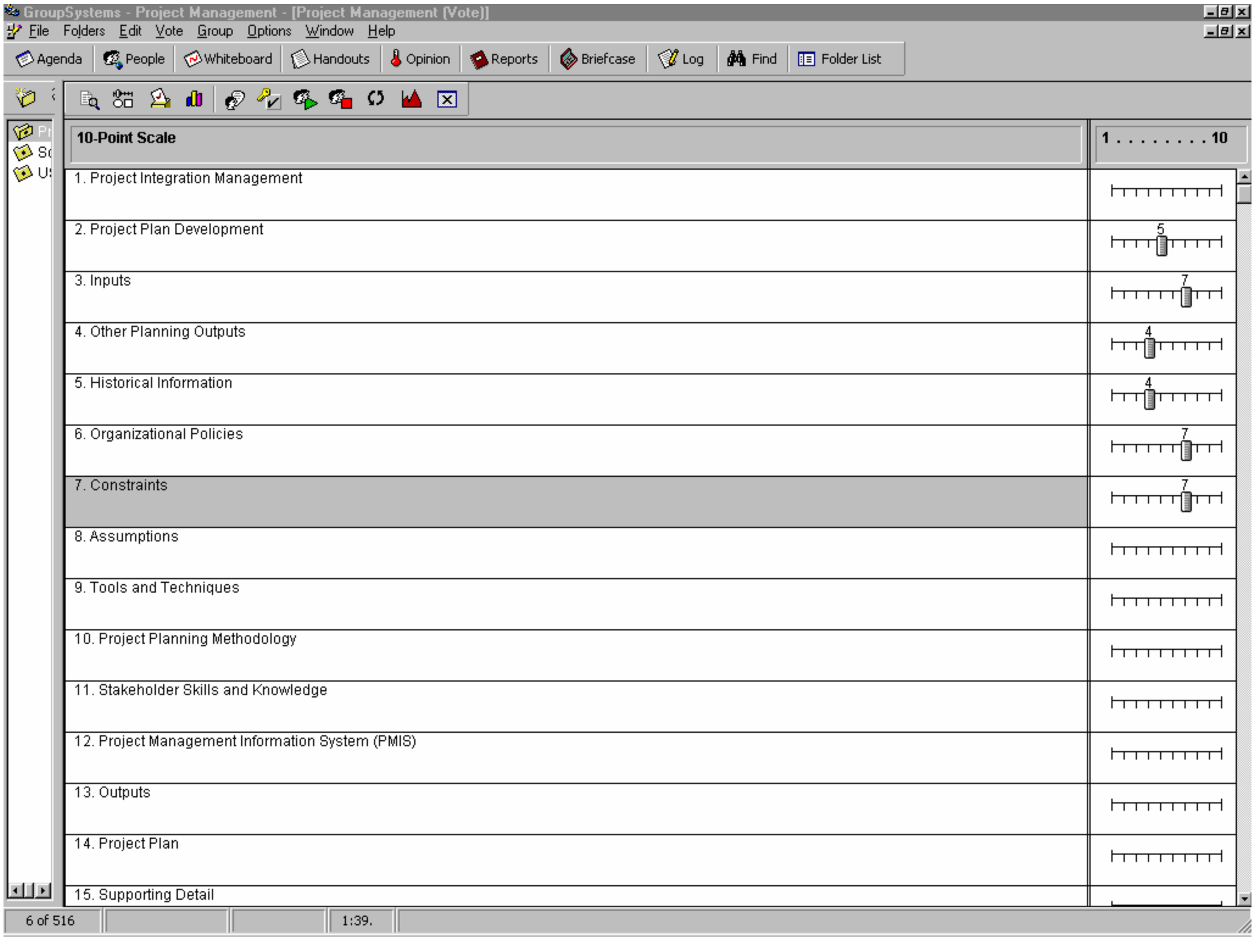
Illustrations



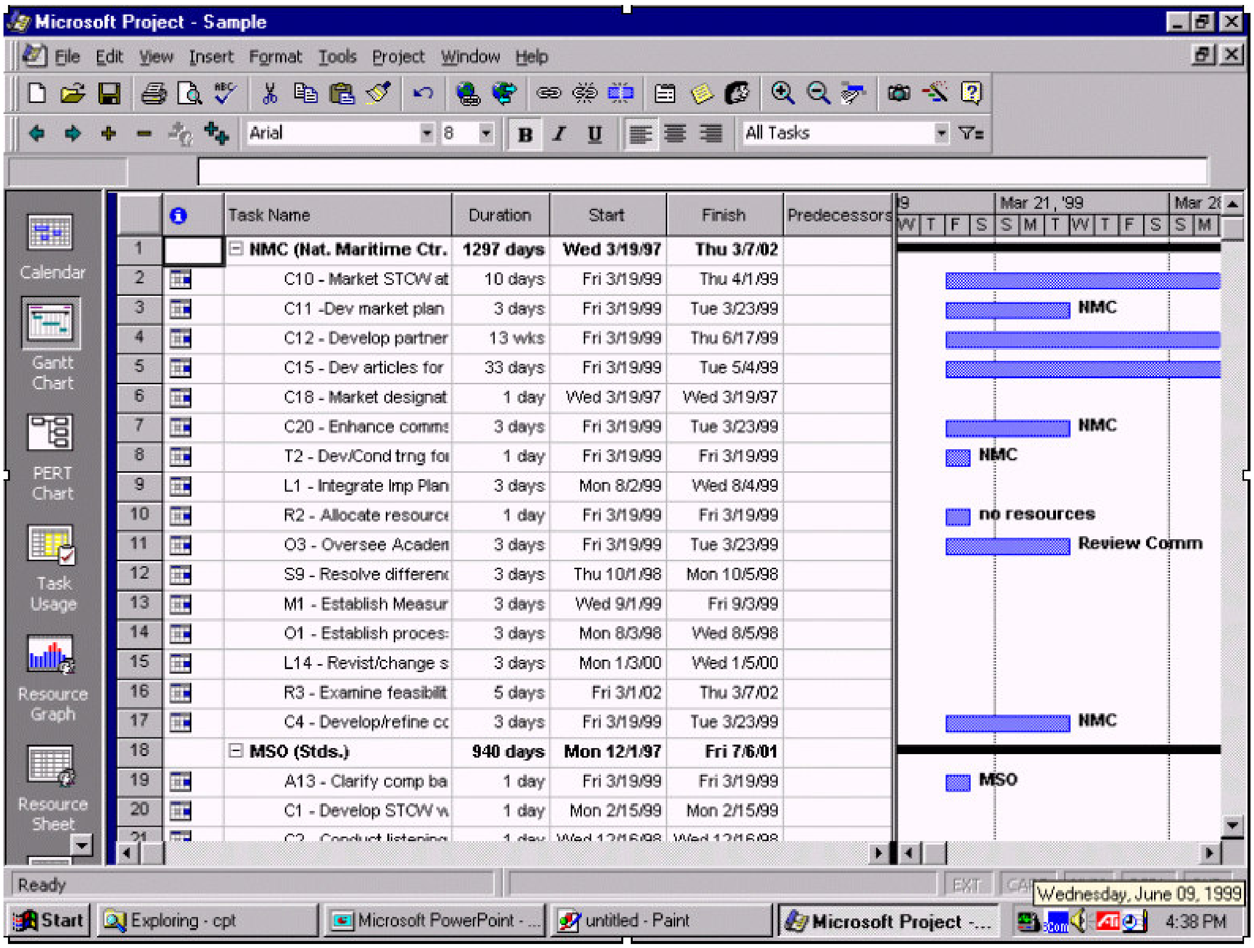
Comments entered on GroupSystems Outliner topics

[Illustration 1]



Example of voting on items to keep

[Illustration 2]



MS Project Plan generated by CPTeam using GroupSystems output.

[Illustration 3]

Participants following a successful planning session.

[Illustration 4]

Introducing the Principles and Practice of Collaboration Technology into a High Performing High School Environment

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Abstract

This paper presents the account of the introduction of GroupSystems collaboration software into one high performing high school, Thomas Jefferson High School for Science and Technology, in Alexandria, Virginia. Creating solutions, developing processes, airing ideas, and communicating in critical conversations are all key in educational environments as in business settings where collaboration technology is already thriving. School stakeholders want to make decisions faster as well as engage students in critical thinking skills. The authors worked with the high school faculty and administrators to introduce the concepts of collaborative technology with an eye to enhance their productivity. As the idea of implementing collaboration technology was introduced for the school, the authors identified the barriers to implementation and overcame each and every one. The successful adoption of collaborative technology culminated in the first demonstrations of electronic meetings for faculty and students at the end of the school year. The result was the TJHSST community experienced collaboration technology as an accelerator for more effective decision making and saw its use in group-related work projects.

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1. Introduction

Established in 1985, Thomas Jefferson High School for Science and Technology (TJHSST) is a Governor's School for Science and Technology in Northern Virginia, also supported by the Virginia Department of Education. TJHSST was created to improve education in science, mathematics, and technology and provides a specialized education for selected students in Fairfax County, Arlington, Fauquier, Loudoun, and Prince William counties as well as the cities of Fairfax and Falls Church. Local business leaders and Jefferson parents have formed the Jefferson Partnership Fund to help raise money to maintain and equip labs and classrooms in the school.

Carolyn Cukierman, a practicing facilitator in collaboration technology, became involved with the school when her son was accepted and enrolled in TJHSST in September 2003. Having worked in the District of Columbia Public Schools a decade before and having learned collaboration technology in that environment, Carolyn asked if the technology was available in TJHSST. Since collaboration technology was not available in the school, she began inquiring about and participating in activities to introduce the concepts into the school. To spark interest, she enlisted the aid of another practicing facilitator and colleague, JR Holt, to demonstrate collaboration technology rather than just to talk about it.

2. Getting Started

Carolyn first joined the Parents, Teachers, and Students Association (PTSA) Curriculum Advisory Committee (CAC) to present her idea that collaboration technology should be available at such a high performing school that strives to offer cutting edge opportunities in technology. At a CAC meeting in January 2004 with the Principal, Elizabeth Lodal, Carolyn heard about the accreditation process that TJHSST had recently undergone.

In the accreditation process for the Southern Association for Colleges and Schools (SACS), TJHSST had formulated its strategy for the years 2002-2007. The areas of focus for the action plan were intellectual risk taking, creative problem solving, use of time, and communication. Collaboration technology, Carolyn realized, would be able to enhance each of these areas of focus. So she introduced the concepts of collaboration technology as an area of interest in which TJHSST may benefit. The obvious connections between the concepts of collaboration technology and the focus of TJHSST were easily seen. Mrs. Lodal referred Carolyn to the Assistant Principal, Jim Kacur, who openly welcomed the idea. He advised Carolyn to work with Joan Ozdogan, the Executive Director of the TJ Partnership Fund to devise a plan.

3. Gathering Momentum

Every administrator who heard Carolyn talk about the benefits was eager to learn more. TJHSST is a school which centers its curriculum on science and technology, but encourages a well-rounded education. Collaboration technology provides a venue to support the school's goals. The TJHSST focus on developing leaders, using state of the art technologies, increasing risk taking, enhancing creativity in problem solving, improving communications, using time better, and developing critical thinking and decision analysis skills in students could be easily supported by collaboration technology.

Carolyn recommended that although many collaborative tools are available, a pilot project could be to introduce the GroupSystems software into the school. GroupSystems creates a dynamic that allows team members to come together and generate more ideas than ever before, evaluate their relative merits, make decisions and reach consensus in about half the time of a traditional meeting. GroupSystems software is the premier electronic meeting software which also provides a knowledge repository and is already proven in other schools, universities, and among teens.

In initial meetings with the TJ Partnership Fund Executive Director, the idea was to have the Partnership Fund act as a liaison between the TJHSST Administration, the Fairfax County Public Schools, and the software company, GroupSystems.com, to coordinate the effort to bring the software into the school. Carolyn and JR would, on a volunteer basis, become the trainers of those in the school interested in pursuing activities using the collaboration technology. Securing funds to purchase the software was an issue.

4. Developing ideas for usage

Ideas for using collaboration technology in TJHSST were at first listed in general categories as follows: consensus building, decision analysis, project management, brainstorming, action planning, college decision making, admissions process, and software acquisitions. Then in working with the Partnership Fund, a broader, more comprehensive view of how to interact with the school was developed.

Since no funds had been identified to purchase the software, ideas that could be mutually beneficial to the school and the software company were identified with an eye towards seeking a gift in kind from the software company. Ideas included leveraging the brainpower of the students by allowing them to test beta versions of the software and/or perhaps even writing some of the code, engaging students, parents, and school-wide activities in using collaboration software to develop plans, surveys, and decisions, and providing opportunities for demonstrations to community and other school members.

At the outset, all of these ideas were just generalized. To get students, faculty and administration to explore the use of the software, ideas for projects such as helping to run student government or club meetings, planning school special events, gathering feedback concerning the school from students, parents and visitors, and facilitating curriculum development and academic planning, were proposed. One of the goals was to get the software into the school and then conduct a session to get stakeholders' ideas of how to use it as well.

5. Working to get approval

Within TJHSST is a technology committee which must approve all new software. Carolyn and JR made a presentation along with a demonstration of the software to the committee. The Committee asked questions mostly about the impact to its network. All agreed that the most effective means to introduce the software into the school would be to use the workgroup edition of GroupSystems that operates on a local area network with a dedicated server so as not to interfere with any other software already running on the school's intranet. Approval was easily obtained from this group because of the separation of the software from other applications already installed.

The next hurdle was to gain approval from the Fairfax County Public Schools (FCPS). A scope definition had to be submitted along with a demonstration copy of the software for testing by FCPS information technology professionals. By the time all the required information was obtained and the application completed, the software was delivered to FCPS in February 2005 for its screening.

6. Obtaining the software

In September 2004, Carolyn had a chance to speak to Luis Solis, the CEO of GroupSystems.com, and asked him to consider gifting a copy of the GroupSystems.com software to Thomas Jefferson. Throughout the process of gaining approval from the school and the county, Carolyn kept Luis abreast of the developments. In March 2005, GroupSystems.com made an in-kind donation of a five year 10 user license for GroupSystems Workgroup Edition with maintenance to TJHSST. Fairfax County found no objections to the use of the GroupSystems software after its extensive review and testing, allowing Mrs. Lodal, the Principal, to approve its use in TJHSST. In the press release, she stated that "as a school recognized as a leader in the use of cutting edge technology, we are thankful to GroupSystems for providing this software for use in our school community. Thomas Jefferson's students learn through collaborative experiences that emphasize the development of interpersonal, leadership and communication skills. We look forward to using the software to foster creative problem solving and advance our commitment to developing, evaluating and sharing innovative ideas with the greater community."

The amount of time elapsed between January 2004 and May 2005 when the final approvals were all in place had sufficiently given all stakeholders appropriate review and understanding of what was being proposed. What had not occurred was the people who would be using the software had not either seen or understood how collaboration technology could help them.

7. Moving Forward

Carolyn quickly arranged a meeting in mid-May with Douglas Tyson, the Administrative Intern, who was assigned to manage the implementation of the collaboration technology. They met with Joan Ozdogan, TJ Partnership Fund, and Susan Beasley in the TJ Information Technology Department, who was in charge of installing the software.

The result of the May 17 startup meeting with included the following decisions:

1-GroupSystems clients will be loaded on the Wireless Lab laptops.

2-GroupSystems will be loaded onto a TJ server.

3-To check out the Wireless Lab, a technical person must assist to set it up.

4-Meetings using GroupSystems will require a technical person to set up the wireless lab; a LCD projector and screen (or blank wall); a meeting owner who has an issue to discuss, problem to resolve, or meeting to conduct; a Facilitator (objective person who has no investment in the outcome of the meeting); a Technographer (scribe) to operate GroupSystems; and Participants (10 is optimal, but 2-3 per laptop is manageable depending on the level of involvement).

5-To plan a meeting, a meeting owner must be identified who reserves the Wireless Lab and ensures the tech setup and teardown is arranged for the meeting. [Note: some training is required for the tech person.].

6-The best setup is a U-shape with four participants on each side and 2 at the back. The LCD projector is placed in the U. The Leader laptop is placed near the front of the room.

7-Noted issues are that no dedicated rooms are available, and rooms also must be booked. After hours usage must be secured by faculty or administrative staff, for example, for use with parents or community members.

Also, decided at the start-up meeting was the initial rollout of GroupSystems implementation. Three meetings were planned to occur before school was out in June: one planning and training meeting, one meeting of faculty only, and one meeting of students only gathering feedback about the student government elections, which were completed in May.

The schedule was laid out as follows. Friday, May 27, the loading of the software would be completed. Tuesday, May 31, would be the initial meeting and training of GroupSystems.

Carolyn created the following conceptual framework for the meetings.

7.1 Planning for Faculty Implementation Meetings

Meeting #1 Purpose: To introduce GroupSystems concepts of critical thinking and problem solving.

Objectives:

1-Train individuals to useGroupSystems.

2-Set a date for an Integrated Biology English Technology (IBET) faculty meeting.

3-Develop a plan for the IBET faculty meeting. Note: The 9th Grade Integrated Biology, English and Technology (IBET) Program is comprised of six teams of approximately seventy to eighty students each. Three teachers from each required subject (Biology, English 9 and Principles of Engineering and Technology) are teamed together with a counselor. As the school year progresses teachers become facilitators of learning as projects shift from teacher-directed to student-directed.

4-Brainstorm ideas for GroupSystems use in TJ for school year 2005-6.

Meeting #2 Purpose: To discuss IBET issues. Suggested date was June 15.

7.2 Planning for the Student Implementation Meeting

Meeting #3 Purpose: To gather feedback on the recently held Student Government Association (SGA) elections.

Objectives:

1-Train students to use GroupSystems.

2-Collect comments and opinions on SGA elections.

3-Gather lessons learned and possible improvements for SGA elections.

Suggested attendees were SGA officers. The meeting would be held during 8th period which is designated for student activities and activity-related coursework

8. Implementing the Collaboration Technology

Implementing technology at the end of a school year has its limitations. However, all the planners from the administration, the TJ Partnership Fund, the IT department, and the parents agreed that if implementation was not started until the fall, more time would have to pass before anyone had time to work with the new concepts. So the decision was made to hold whatever meetings were possible.

Pressure was added on the IT Department because the high usage of the Wireless Lab only allowed certain days when the software could be installed. Then when the time came to install it, the software was found to be irreparably damaged having gone through the school's inter-office mail system. Quickly requesting a new disk from GroupSystems.com, Carolyn was able to get the software to the IT Department so the installation was completed on time.

Naturally, with the end of the school year, schedules became compressed. The final decision was to hold only two meetings on June 15, one week before school ended. One meeting would be for faculty and interested administrators during their lunch hour. The second meeting on the same day would be during the 8th period as originally suggested.

The TJ Partnership Fund Executive Director sent out a memorandum to fourteen faculty and staff inviting them personally to the GroupSystems demonstration scheduled for June 15. In the memorandum, she said, "In bringing this (collaboration technology) online at TJ, Douglas (Tyson) and I have identified you as a high potential 'early adopter' of this amazing product…TJ parent, Carolyn Cukierman, a skilled GroupSystems practitioner, will lead this demonstration." Students from the SGA were contacted by their sponsor to attend the student session during the 8th period activity class.

8.1 Setting up the Room

The Wireless Lab had been positioned in the Old Admission Office, a good sized conference room with appropriate conference table and chairs. A screen was borrowed from the Library. Set up took about an hour. Logging into the TJ network required registered users. Only Carolyn, the facilitator, had no ability to log-in, but the IT professionals, the faculty, and the staff were all able to log-in. The machines were tested and then put to the side to charge before the meeting started.

The plan was to charge the wireless laptop computers during the break between the faculty session and the student session. Also, during the break between the faculty and student sessions, Mrs. Lodal, the Principal, was to get feedback since she was unable to attend the demonstration sessions.

8.2 Demonstrating to the Faculty

The meeting started at 11:45 a.m. and was only set for 45 minutes to fit with the lunch hour. Eight faculty members of the fourteen invited came to the demonstration. The purpose of the meeting had been adjusted as follows: to introduce Groupsystems concepts of critical thinking and problem solving. The agenda was set as follows:

1-Comments on an Introduction to Collaboration presentation using the Categorizer tool

2-Ideas for collaboration using the Categorizer tool

3-Prioritize recommendations using the Vote tool

4-Elaborate on ideas using the Topic Commenter tool

5-Feedback using the Topic Commenter tool

As Carolyn showed some slides about collaboration, the participants made their first comments using the Categorizer tool. Twenty-six comments were gathered. However, more time than allotted was required to instruct and to discuss their comments, many of which were about the mechanics of what they were experiencing.

The second agenda item on gathering ideas for implementing collaboration at TJ netted 23 comments. Carolyn led the discussion to pull out the best ideas into one category. The ideas this group favored were as follows:

1-warm up to a discussion for maybe 15 minutes

2-administrative and faculty meetings when given a comment session

3- gather student opinions on new policies

4- strategic planning sessions

5-in the classroom - teach - then typing - then teach

Time for the session was running out so the participants were asked to enter their comments on the Feedback agenda item using the Topic Commenter tool. In answer to “THIS SESSION WAS....”, the following comments were entered:

“Very interesting. The session was too short, but a good intro.”

“A good beginning - we should explore another working opportunity”

“A great opportunity to force us to think differently about how we interact with each other and how we approach problem solving”

“Very interesting - I can see many interesting applications for the classrooms”

“My concern is that we will require MORE training and this is another thing to plan for and figure out”

“Interesting and good to know about. I do feel we tried to do too much”

“Very informative and would need more explanation for all of its functions.”

In answer to the topic “I WISH WE COULD...”, the following comments were recorded:

“Really become a school that had technology more easily available for students. It is hard to find a free computer lab to do something like this.”

“Use this in faculty meetings but we do not have enough portable computers to get input from every member. I feel that not only faculty should be able to comment about the school but administrative staff would feel comfortable with the chance to make comments.”

“We could have another opportunity to pilot this technology.”

“Have a longer session in the fall. This is just too tough a time for us as teachers to become involved.”

“Business ideas can work in the classroom, but we all need to be careful when we introduce ideas. We are zapped at this time of year.”

“Biology IBET - try with Chris”

“On difficult concepts. Get input. Talk about and keep computers quiet. Get input. Continue.”

“Character education”

“TA - ethics, ready for business world”

“Education - get comments”

In answer to “MY FINAL COMMENT IS.....”, the following comments were entered:

“Pilot it with a specific group.”

“I agree with the next step with identifying a pilot opportunity.”

“This is great!”

8.3 Demonstrating to the Students

The meeting was scheduled to start at 3:00 p.m. and to last for 45 minutes to fit with 8th period schedule. The purpose of the meeting had been adjusted as follows: To gather feedback on recent SGA elections. The agenda was set as follows:

1-Comments on an Introduction to Collaboration presentation using the Categorizer tool

2-Comments on SGA elections using the Categorizer tool

3-Prioritize ideas to work on using the Vote tool

4-Elaborate on ideas using the Topic Commenter tool

5-Feedback using the Topic Commenter tool

At 3:00 p.m. no students had reported to the room. After staff was sent to locate some students to participate, the meeting began about 3:15 p.m. Of the nine students who volunteered to participate in the demonstration, three were seniors, four were juniors, and two were sophomores. Since not all of the 9 students who came to the demonstration were in SGA, a changed agenda focused on the parking policy was immediately instituted as follows:

1-Summer Plans using the Categorizer tool (to demonstrate how to use the software)

2-Parking Policy problems and solutions using the Categorizer tool

3-Prioritizing parking policy problems using the Vote tool

4-Feedback using the Topic Commenter tool

Using a noncontroversial topic asking students to write a one line description of their Summer Plans gave the students a quick introduction to the way the software works. Most students use computers proficiently so they understood the anonymous, parallel input immediately with this short exercise.

On the Parking Policy activity, two categories were created, Problems to Tackle and Solutions. Eleven problems were listed, and only six solutions were entered. To demonstrate the next logical step, the problems were converted into a Vote using Multiple Selection of three choices only.

Time ran out before the Feedback activity could be started. The students, however, noted that the software was easy to use and did produce good results even in such a short time.

9. Gathering Lessons Learned

Reviewing the two June 15 sessions with Mrs. Lodal, the Principal, Mr. Tyson, the newly appointed Assistant Principal responsible for technology, and

Ms. Ozdogan, the Executive Director of the TJ Partnership Fund, provided insight as to what did work and what could be improved. Understanding the workloads and attitudes of faculty, administrators, and students is key to implementing new technology successfully. Having a champion to support the implementation and to identify "early adopters" will also prove to be essential at Thomas Jefferson.

Technical Issues. Using the Wireless Lab proved to be not suited for the requirements of running electronic meetings. The batteries in the computers only lasted approximately two hours. To hold an all-day session would be impossible. Total dependency on technical assistance to move the Lab, set it up, and monitor its performance is not practical in the day-to-day operations of the school considering staff and student workloads.

Mrs. Lodal determined that a move to a computer lab where the software would be permanently installed would serve the school better. To train staff and students to use the software should prove to be easier without the burden of monitoring a wireless setup. The move is planned for implementation in the fall.

Meeting Conduct Issues. Establishing ground rules, even for short sessions, is essential to ensure no hurtful remarks are entered, that propriety is maintained, and that expectations are clear. All agendas will be coordinated through the Assistant Principal, Mr. Tyson, and the Executive Director of the TJ Partnership Fund, Ms. Ozdogan, to allow their perspective and guidance to be applied against all group work to be accomplished. Improving agendas will be a natural outcome, but also an integrated approach to electronic meetings in the school will emerge.

Guided pilots either using anonymous or non-anonymous input are essential. Carolyn and JR, as volunteers, will provide training and support with an eye to turning the operation of the collaboration technology over to either a lab director or a staff member or group within the school.

Finding champions and leaders among the staff, the faculty, and the students is a basic building block. Specific technology student groups and clubs, individual faculty members, and lab groups were cited as prone to openness for new technologies. They will be contacted for pilot opportunities.

10. Planning Next Steps

Many ideas were surfacing throughout the months the software was being evaluated. Some of them include the following:

A GroupSystems survey on the TJ website from students on the school-wide summer reading book .

Sessions to gather Lessons Learned from school-wide special events such as the All Night Graduation Party, the Sophomore Silent Auction, the SGA elections, and the 20th Anniversary of the school.

Incubation for ideas for the technology and science labs.

Faculty curriculum planning.

School-wide strategic planning.

Student activities such as Model United Nations and the Debate Team.

College planning.

Student issues such as chaperone policies, human relations, character education, and the parking policy.

Agreement was reached that in several areas of school life, one pilot with a champion would be identified to start in August 2005 before school opened. Pilots are planned as follows: in the classroom by one teacher from the June 15 demonstration who volunteered, in the community through the TJ Partnership Fund, in Student Services either on senior issues and/or IBET students' adjustment to TJ, by SGA on the parking policy by one student from the June 15 demonstration who volunteered to lead, and in Human Relations on the chaperone policy. Details are being worked as this paper was being written.

11. Concluding Thoughts

Thomas Jefferson High School is ready and willing to move forward on implementation of collaboration technology. Based on participation in short demonstrations, interested individuals agreed to work on test pilot projects. Perhaps one of the main reasons is that TJHSST and collaboration technology proponents share common goals: focus on developing leaders, use of state of the art technologies, increased risk taking, enhanced creativity in problem solving, improved communications, better use of time, and development of critical thinking and decision analysis skills in students.

School systems, however, are bureaucratic, and activities move slowly in a bureaucracy. Patience is required. Whoever wants to introduce collaboration technology must be dedicated and in the game for the long haul. Schools are closed systems where an outsider must find a champion who is powerful enough in that system to be able to help change occur. Resistance to change in a school is equal to other organizations, but some staff and faculty are more open to technological changes than others. Finding those more open to change is key to implementation.

Students are more ready to accept the technology in this school because it is a science and technology school. However, just because this school focuses on technology does not mean they know about all varieties of technology to include collaboration technology.

The authors who introduced collaboration technology into TJHSST are functioning as change agents for the school, but as external agents of change. The TJHSST community experienced collaboration technology as an accelerator for more effective decision making and saw its use in group-related work projects. However, careful nurturing of open-minded, curious volunteers will become the next challenge to insure collaboration technology gets firmly rooted into the decision making in the school.

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Tools for Managing an International Corporation

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Abstract

Collaboration technologies are proving crucially important for corporations to do business – especially as they, their supply networks, and their customer base become more global. Effective utilization, though, is still in its infancy. Most collaboration studies have examined the behavior of project teams spanning distance – the need for shared communication around a specific project is obviously high.

This study considers a high-level management group with high need for effective collaboration tools. The group was studied for the use of and reaction to various elements of synchronous collaboration technology over a two year period.

The conclusions are that managers are as dependent as operational or project teams on these technologies for communication, effective meetings, and decision-making. However, difference in status, power and control affect more clearly the degree of confidence, enthusiasm, and even co-operation that occurs.

1. Introduction

This study evaluates the use of synchronous collaboration tools by the executive management team of a NASDAQ 100 corporation over a two year period. Very few longitudinal studies exist for these technologies with such a user-group, not only because it is difficult to insert observers into strategic operational meetings, but also because differential capabilities are viewed as proprietary advantage not to be discussed.

Most field studies of collaboration tool usage have focused on project teams, for a variety of reasons. Projects are usually quite well defined and specified – comparative improvements are relatively measurable as a result. Project teams have had by far the highest adoption of these toolsets, so there has been good access to appropriate groups. Also, many project teams have become adept users of the current toolsets, so the studies have been able to evaluate the functionality rather than learning curve modes.

Collaboration tools, by comparison with most other computer-based tools [1], have two unique characteristics – a. they have importance and utilization for managers of companies, not just for their employees; and b. they are seldom used frequently enough that the user becomes familiar with the nuances and special modes of the tools – even more true for managers.

Most collaboration tools of value today require sizable learning curves, and few managers have taken the time to learn them well. Managers are frequently technology-averse, certainly by comparison with most employees.

This presentation describes the executive staff meetings for a two-year period at a NASDAQ 100 company. The company built technology that has played a key role in collaboration tools. The company's top management had significant need of these same technologies in order to get their mission accomplished. The top two tiers of management for this technology-proficient company were studied for their use of and reaction to various elements of collaboration technology during 1997 and 1998.

The company commissioned and installed specialized technologies during this time, including audio- and video-conferencing, shared whiteboards, file-sharing systems (NetMeeting and WebEx), and archival e-mail. The study evaluates the overall impact of the suite of tools rather than specifics of individual tool capability.

2. The Company

The company was a Computer Telephony pioneer in the late 1980's, managing to combine small, powerful PC technology with telephone switching technology in a very cost-effective, high-performance manner that allowed substantial reduction in cost for a medium-sized corporation's business switchboard. As this technology took hold, the company prospered, and it wasn't long before the virtues of additional functionality became apparent. "PC Fax" combined the functions of facsimile and the PC, "VOIP"[2] combined the functions of the telephone running over the Internet rather than the analog telephone backbone, and "Desktop Video Conferencing" merged voice and video on the PC for the individual user.

At the enterprise level, these technologies allowed the idea of a Customer Call Center to be installed and maintained quite cheaply. A host of business services – voice mail, call forwarding, call waiting, conference calling, and even Interactive Voice Recognition (IVR) – became practical, if indeed sometimes disruptive. Saving voicemails quickly consumed a datacenter's storage capacity, for example, so new policies – re length of time to store a message, and how many messages could be queued – were developed and invoked.

All of these nascent capabilities were being exhibited and even sold by a variety of start-up companies in the early 1990's, but each was a stand-alone application sold independently to a few early-stage users. The founders had hired an energetic, prescient, ebullient marketeer with a strong engineering background who pushed the company on two simultaneous fronts. Most visibly, he architected a series of key technology and product acquisitions to build a portfolio of techniques and product suites that would cover this "Unified Messaging" requirement.

The new CEO also stimulated a series of grand experiments within the company to use these new digital communication technologies as a key augmentation for his staff to manage the resultant decentralized corporation. His staff, while strong in entrepreneurial instinct, was relatively weak in interactive enterprise management skill. The findings have not been widely reported [3]; the composite learning offers some valuable lessons about collaboration.

Because the company built OEM cards rather than systems, they became a favorite vendor for many integrators to try new technologies. This in turn opened the possibility that the company itself might do some advance demonstrations, or internal usage modeling, for prototyping purposes. The new CEO was very enthusiastic about experimentation of this type – it is remarkable how many eventual "winners" were first put into trial usage at the company. The first outside installation of WebEx, for example, was done here, long before WebEx switched strategy to become a services provider rather than software purveyor. The answering service was the first installation of Nuance software for Interactive Voice Recognition. Later, prototypes of IBM's ViaVoice and Speechworks were also included [4].

The company bought a key PC Fax vendor and a leading DSP operating system provider. Digital Signal Processing units were the telecommunications microprocessor equivalent, and their subsidiary supplied the DSP operating system software for every third-party video-conferencing system, as well as the key OS for Soundblaster cards that turned PC's into multi-media entertainment units. These ancillary divisions thus brought specific knowledge from other systems integrators, especially those in the collaboration environment.

The company, having grown by acquisition was faced with twin problems of management somewhat unusual for its size. First, key managers and technologists were located where they had started their companies, not at the parent's headquarters. Relocating to a mid-Atlantic state from environs such as the Bay area, Boston, Santa Barbara, or Israel wasn't popular.

Secondly, the reason to buy the companies was to build an *integrated product*, not a series of stand-alone products. The key difficulty was that no one knew how to do that – whether it could even be done was debated at some length.

2.1. The Corporate Management

At headquarters, the operational leadership had been mostly homegrown. Over a two year period beginning in late 1995, The CEO upgraded his staff – e.g. a key legal expert from AT&T, a corporate IT director who had built Gateway's infrastructure, and key engineering executives from IBM. The leadership of the divisions, by and large, were seasoned veterans of larger corporations – HP, DEC, and Motorola. Thus, he built an extended staff well able to manage in complex organizations.

On the other hand, the engineering leadership, both at headquarters *and* in the divisions, had largely learned their skills in small start-up companies. With quite independent focus, they were nearly totally unaccustomed to interaction in order to build common value.

2.2. Management Ethos & Key Issues

The CEO hosted a four-day face-to-face meeting at the end of every quarter, which was a great mixer – a perfect place to connect a voice or e-mail colleague with a face and some collegiality. In addition to the quarterly meeting, he held a weekly Monday morning staff meeting for his entire extended staff. This routinely would be about nine people (plus recording secretary) in the Board Room, and another six or seven on the conference bridge. The meeting was obligatory, not optional, and a substitute was expected for all meetings if for some reason the department or division leader couldn't attend. Sensitive or confidential matters sometimes would excuse delegates, to be sure.

The topics were classical for the leadership of a company of this type – operational issues, such as shipments, change orders, quality problems, customer complaints, new acquisition targets, personnel matters, budget reviews, expense questioning, etc. Strategic topics were separate.

Engineering, by contrast, was managed at the divisional level, primarily by a set of peers, each of whom reported to their respective divisional manager rather than to a centralized R&D head.

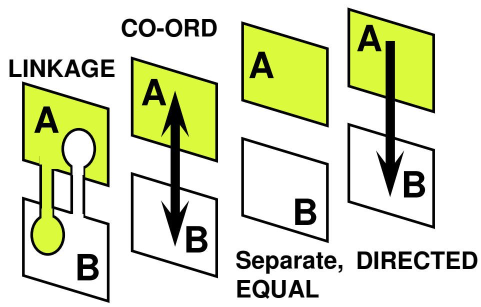

Fig. A – Issues of Lab Synchronization

Figure A depicts four possible relationships that two labs might have with each other. These are especially pertinent if one lab (*e.g.* Lab A) thinks that their purpose to to "direct" the other lab (*e.g.* Lab B), while the other lab thinks that the relationship is "separate and equal". Without a strong top management leadership to co-ordinate Labs A and B in this scenario, it is unlikely that a truly effective joint program or product strategy will be realized, no matter how effective the collaboration tools used.

Two years after the significant acquisitions, it was realized that essentially the "joint product strategy" for the corporation wasn't happening, and much more attention was paid to the nature of the organization and the quality of the communications that were happening at the top.

3. Questions that come into play for institutional communication

Several factors have significance for institutional communications in any company. First perhaps is the stature or prominence of the individual in the organization. It is much easier for the CEO than an entry-level worker to have communication access to all members. Someone with Toastmasters training can more easily walk to a podium without acute nervousness. Obviously, it is much easier to have access to people locally than in remote facilities. So the reality of rank, skill, and location are meaningful for what can be communicated, and indeed who is likely to, or able to, listen.

In addition, though, there is a rich interplay of context, where the personality and dynamics of the speaker(s) and the listener(s) affect the quality of the communication. This is quite apart from, though not independent of, the questions of skill and competence raised in the previous section. This has more to do with speaking and listening skills and desire, as well as the level and even the textual vs. graphical nature, of the material. This is also affected by the way the communication mechanisms are constructed.

3.1. Example of a staff meeting

Imagine a Monday morning staff meeting between the CEO, eight line managers, and five staff lieutenants. They all come in, sit down around a rectangular table, and begin the meeting. The CEO talks for a while about general interest topics, then in turn queries each manager for a status report of goals, activities, results, and issues in their respective area. The CEO's expectation is most likely that each manager will listen to the others' reports, note any points of intersection with his/her own department, and respond or carry away useful information to their respective group.

A staff meeting is a series of *1-to-some* discussions, *some* rather than *many* since it is not a company-wide meeting or a wide audience. Some very different kinds of communications are required in this meeting. There is a portion where the supervisor is talking to me *and* everyone else; there is the section where I am talking to the supervisor mostly, but the others are listening; and there may well be a section where we all have give-and-take to solve a problem or discuss an issue together. Depending on the supervisor's skills, the meeting can have a collegial tone or an interrogative tone, but that doesn't change the interaction dynamics. On the other hand, it may feel to managers that it is a series of quasi-public *one-on-one* meetings.

Note that all of the senses are involved in communications. Sights, sounds, touch, taste, smells, and the "sixth" sense or intuition, all play parts for different people on a nearly constant basis. From a business communications standpoint, we tend to think first about "data" such as numbers and figures, (*e.g.* shipments, scrap rates, profits), and conversations as the communication modes. A number of folk focus on "designs" – graphical or visual representations. But many folk "read" other signs as clearly, including who is paying attention in a meeting, who is dressed slovenly, who sits attentively and who is dispirited. Who can *vs.* who can't look you in the eye when you describe a problem to them. Figure B depicts the classical on-site staff meeting; note that anyone can choose eye-contact with anyone else.

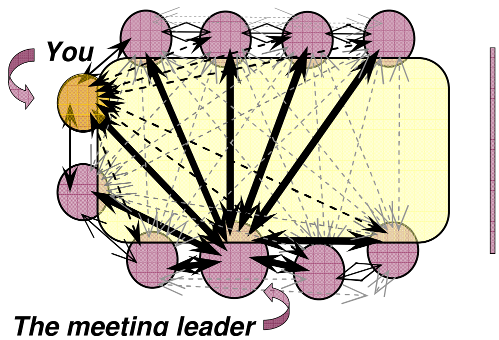

Figure B. Meeting eye-contact

3.2. Other sensory data

Much additional sensory data is able to be communicated in a meeting context, but it is difficult to represent data transmission that is visual, tactile, aromatic, or "felt". The degree to which these other forms of communication are effective seems to be much more variable, person-to-person, than studies show for aural or textual data in general. But we all know the feeling that *you had to be there* to experience it.

4. Communication across distance

Since the beginning of civilization, people have sought to amplify communications. Shouting allows being heard at a distance, smoke signals and semaphore flags can be seen further away than sound could carry. Runners carried word of the results of a battle (*e.g.* the 26+ mile marathon). The fast ponies of the Pony Express could carry mail across the continent in a few days, much faster than Clipper Ships around Cape Horn (which in turn were better than classic sailing vessels). Electronics, starting with the telegraph and the telephone, and then Marconi's miraculous "ship to shore" wireless which anticipated radio and television, decoupled communications from physical transportation. In the 20^{th} century, we have grown accustomed to communicating "at a distance" routinely, both by electronic means and with frequent travel for business or pleasure.

A current manifestation of this phenomenon is seen in the way companies grow. They are less often *grown from within*, and more frequently by M&A (merger and acquisition). An outgrowth of that is the decision often to manage the merged company with remote leadership joining the *home team* via remote electronic link weekly. So it became at this company. Let's rejoin our staff meeting, this time for a group with attendees from some off-site locations, to see how well it works (Fig. C).

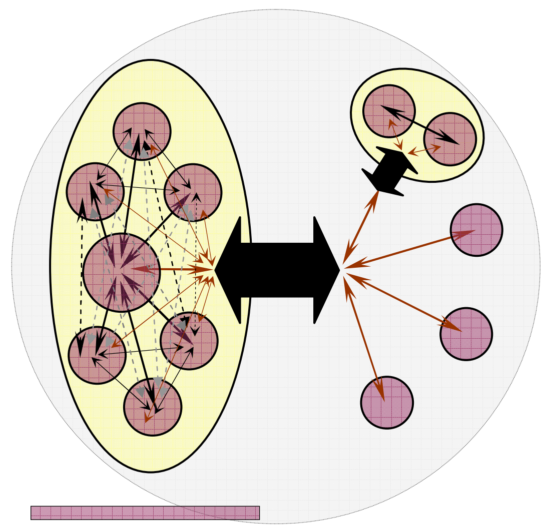

Fig C. Remote Meeting eye-contact

4.1 Meeting with remote participation

In the simplest case, there is a remote telephone connection from any one or several sites into the main meeting room. Using ordinary telephones at each end (the typical situation for 90%+ of American businesses, and 98%+ of European businesses), it is possible for attendees at a remote site to hear and speak in the meeting. Unfortunately, for multiple participants at the *main* meeting, and but one or two at each remote site, a couple of classic phenomena occur. First of all, the phones are usually half-duplex, which means that when one side is speaking, all of the classic "interrupt" signals (*e.g.* clearing your throat, waving a pencil, catching a gaze, or even shouting) fail to gain the floor if the speaker is long-winded, or uses only short pauses in a string of run-on sentences.

In a typical scenario, remote "participants" get quite frustrated for lack of ability to "jump in". When they finally do get the floor, they tend to talk longer and string several stored-up thoughts together. This in turn is *non-interruptible* from the main meeting floor, so a number of participants in the *real* meeting get frustrated, first for lack of ability to respond to the statements as they occur, and then for lack of ability to shut off a rambling talker, or worse, a talker who is revisiting topics that the rest of the audience consider complete.

Another typical situation is that the main meeting will have a succession of speakers, all of whom tend to look at and speak to each other, not to the telephone. In practice, usually the telephone handset is left stationary in the middle of the table (or worse, near the original speaker when the call was established) so that each new participant is heard at varying volume and distinction on the remote end. Any sidebar conversations that are as near to the phone as the extant speaker get inserted as noise – so, too, does a projector, a computer fan, or even a pencil scribbling on paper. And, worse, the remote participant can't even get the floor easily to say *"I cannot hear you, would you mind speaking up or moving the phone* [5]. It is truly maddening at both ends; tempers rise, communication ebbs.

The third classic situation concerns the slides being used for formal presentations. If they are sizable PowerPoint slidesets, they are too bulky to send efficiently by email, especially for the typical dial-up phone connection available to the traveling executive or the bandwidth-starved remote attendee in many countries of the world. And like as not, the file was being modified only minutes before the meeting began, so the rule of thumb that the slides should be sent and downloaded the night before goes for naught.

5. The Study

Over a two year period at the company, I tracked several variables to quantify these situations. Who attended the weekly staff meetings, via what mode? When they contributed to the dialogue, what was the communication category? How long did they talk, how long was the ensuing discussion, and what action resulted from the conversation?

Figure D shows the distribution of the 15 top managers who attended at HQ, remotely, or missed the meeting (delegates weren't included), Note that the HQ-based folk seldom attended remotely; remote folk infrequently came to HQ. It is worth noting that even though these meetings were obligatory, the remote attendees missed 28% of the meetings. Delegates took their places most of the time, but it is still suggestive that remote attendees missed the meetings more than twice as often as locals.

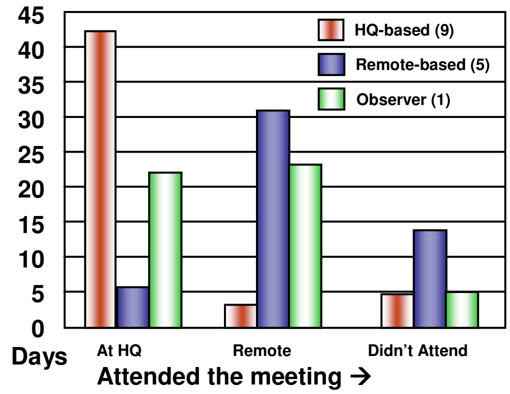

Figure D – Meeting Attendance 1997

A key question is who contributed within the meetings, as a function of attendance and site. Figure E illustrates the average number of formal presentations and comments from each member per staff meeting [6].

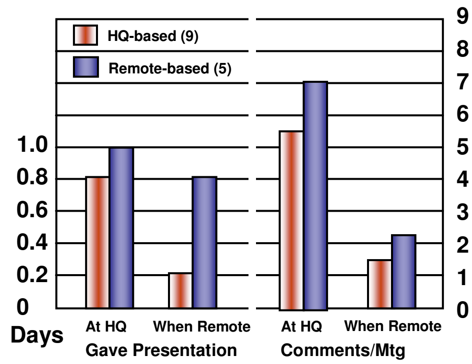

Figure E – Meeting Participation ('97)

There are two noteworthy elements contained in Figure E. The first is the fact that remote attendees are accustomed to giving a formal presentation at nearly every meeting, whether they attend remotely or have traveled to headquarters. On the other hand, when headquarters folk traveled remotely, they only presented formally about 20% of the time. Interviewed re this finding, almost all said "it's really hard to do an effective presentation on the phone". Yet they had never considered that 40% of the staff had to do that routinely.

Significant commentary by attendees is more suggestive. "On-site" commentary was high – about 5.5 inputs per meeting for locals; nearly 7 significant inputs per remote person when they were at headquarters. By contrast, each group, when remote, offered only about one-third as many comments. A key part of the study was the content of the commentary. Several categories were tracked – two *report* levels, four *response* levels, one *proposal* level, and *"other"*. The report levels were *status* and *tutorial*; the response levels were *question, clarification, affirmative support*, and *disagreement.*

Figure F shows a normalized number of formal presentations by category, by location and group, for the year. No funding proposals were ever broached from a remote site over the year. Note also that every remote participant took full advantage of trips to headquarters to present their proposals. Additionally, note that tutorials were taught at nearly a 300% higher rate by both headquarters folk and remote attendees when at headquarters than when folk were remote.

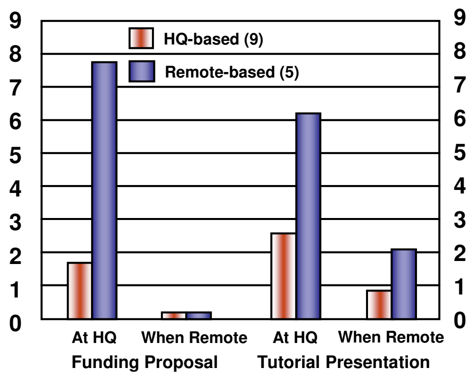

Figure F– Formal Presentations ('97)

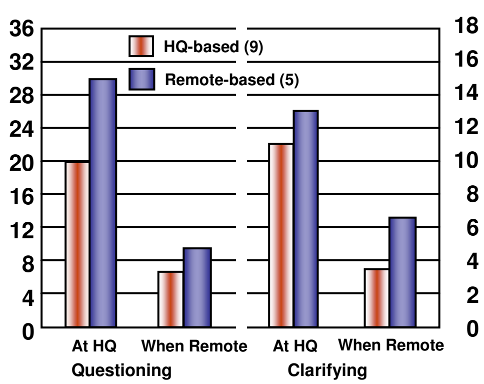

Figure G – Interactive Responses

Formal presentations are but one measure of the contribution individuals can make to a team. Often, the most meaningful interaction from meeting attendees is the insightful question or clarifying statement. Such insertions can occur during any presentation in the meeting. Naturally, they occur much more often per meeting per attendee than formal presentations. Figure G illustrates the relative rate of interactions per attendee. The comparative data of Figure G illustrates that remote participants question the presenter only at about one-third the rate that they do if they are present in the full face-to-face meeting. This is seen even more dramatically in Figure H, where the attendees have to *vote* on something.

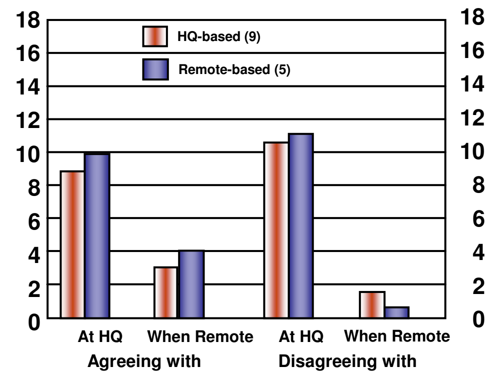

Figure H – Voting Patterns

Voting is the most declarative position that an attendee can take – either siding with the presenter, or dissenting. Many staff members are intimidated by this part of the meeting process, particularly when they cannot glean the sense of the crowd. Dissenting and agreeing is roughly evenly split when folk are all in one room. Involvement shrinks by more than 60% for agreement when meeting members are remote; disagreement is lower by a staggering 80-90%.

5.1. Inserting Collaboration Tools

One of the clear areas for research is to study how these factors can be mitigated, and remote participants can be truly empowered and *heard* in companies that increasingly have their key employees traveling or living remotely. In an age of "virtual companies", this seems like an imperative set of requirements for successful commerce. While we believe that toolsets can be constructed that will help greatly, we also believe that much opportunity exists for new understanding of management techniques.

5.1.1. Audio-conferencing

The most obvious requirement for a shared meeting is that remote attendees be able to hear the proceedings and be able to speak up at the right time with their inputs. This requires two components – an audio bridge, and conferencing telephones. A bridge can be leased from many services today. Most have security checking of various degrees, to ensure that only proper attendees can dial in – many have a variety of active, on-line audit capabilities for the host.

To overcome the issues of half-duplex phones (*c.f.* Sect. 4.1), a directional microphone deskset provides an incredible improvement for each end [7]. Multiple participants at each end can sit naturally quite a distance from the unit and be heard clearly and distinctly, with background noise muted, and with multiple additional features easily included (such as muting, and side conferencing). All discussion is full-duplex, so audio cues for interruption work very nicely.

5.1.2. Whiteboarding and data sharing for conferences is proving invaluable

The value of shared whiteboards and shared datasets, primarily for use in analytical discussions (engineering drawings, budget numbers, slide bullets for presentations, even animated PowerPoint slides with zooms, pans, inserts and music playing), has been well established. The PC user-world now has these capabilities much more widely available [8]. These powerful tools permit keeping an audience in multiple sites "looking" at the same slides in the same order, allowing virtually immediate access for all participants to "see" the overhead projections being shown in the *main* meeting room. This is a major step for shared meetings.

5.1.3. What about video conferencing?

Video Conferencing is perpetually "the next Killer Application". From the earliest Picturephone days in the sixties, to the struggling vendors of videoconferencing equipment today, there has been great enthusiasm and a belief that this technology holds enormous potential, but it somehow has always fallen short.

What are some of the issues that need solving for Video Conferencing to succeed? Intel's efforts with ProShare and TeamStation were spurred by the belief that the cost-per-seat had to be driven down drastically. For that goal, they succeeded admirably. But the basic desktop PC model suffered from off-axis camera placement, so you are guaranteed to look the other person squarely in the eyelid, never the eye. Seemingly minor, this directly confutes every cultural norm – *"look 'em in the eye"; "seeing is believing"; "don't shoot until you see the whites of . . . ".*

At least as big a problem, much more insurmountable for most users, is the bandwidth limitation – 384Kbits is required to have a large enough picture with enough frame-rate transmission for it to *feel* right. Fortunately, network connectivity advances are helping this.

A third flaw is that the tools assume that you can easily invoke the system; using the built-in phone directory, you can call any colleague with ease. In practice, this has the same issues that Bob Metcalfe noted years earlier for the Internet – the value grows as the square of the network members – so far the video-enabled membership is too small to have critical-mass value. Other issues – image and sound quality for multiple participants, complexity of equipment, hook-up of computer-support facilities, remote steering of cameras, and the ability of the speaker to watch the faces of his or her audience (esp. for multiple simultaneous sites) become daunting issues.

The list is unfortunately a fairly long one past these points. It includes lighting issues, people being self-conscious about their appearance on camera, extra cost of the higher-bandwidth channel, extra cost of a higher-quality picture monitor, extra difficulty of multiple simultaneous site participation, and so forth [9].

5.2. Upgrading Collaboration Tools

The CEO was enthusiastic to have the company use these new technologies to "span distance" and make a "virtual management team". The board room was outfitted with the latest technology – electronic whiteboards, multiple screens, a conference table with many network connections and plugs so that notebook PCs could be brought and used, and a set of multiple microphones connected to a directional conferencing telephone in the center.

Another four meeting rooms were outfitted similarly on the same floor. Some even had "surround walls" for sound. A mobile video-conferencing station was available as well, and several managers added desktop video-conferencing stations [10]. Remote sites weren't as elaborate, but they all had wideband network connectivity and with the WebEx server, all presentation files could be widely shared.

It is important to note that while this was a grand experiment, it wasn't described that way – it was rather viewed as "the way we do business here" because (a) ***we can*** {*i.e* these technologies are "ours", and we know them}, and (b) ***we must***, because even though we're a small company in many respects, we're multi-sited, multi-national and faced with the problem of having to do our job through *virtual teams* or else not at all [11].

5.3 Higher Participation Results

The comparisons between the participation rates of 1997 and 1998 are telling. Figure J shows the comparative attendance. There is only modest difference during the two years, except for the observer, who relocated to headquarters, and the absentee rate for remote attendees, which declined by a measurable (and valuable) 20%.

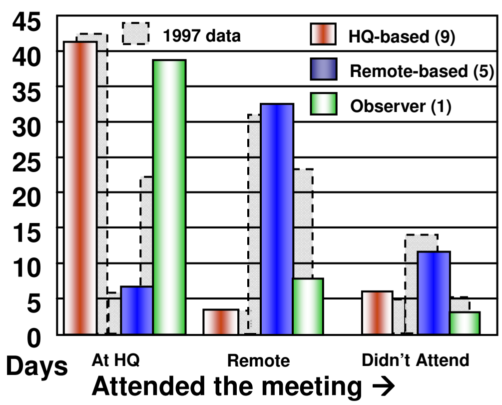

Figure J – Attendance Patterns

Figure K shows an exciting finding – remote attendee participation improved dramatically. HQ folk increased their willingness to give a formal presentation by 50% when traveling; all other formal presentation metrics did not change.

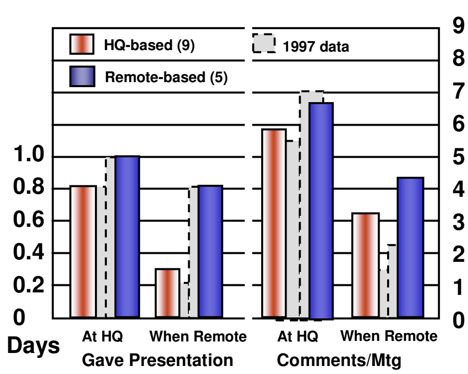

Figure K – Interaction Patterns

Comments, though, from remote attendees rose by more than 100%. When asked "what is different", most people attributed it first to the audio-bridge quality, and secondly, to the ability to follow the presentation due to the WebEx shared presentation slides.

The more interesting assessments, though, are contained in analysis of the comment categories. Figure L illustrates the improvement in level of questioning and in the number of clarification requests – what is especially gratifying is to note that the number of questions from folk at remote sites more than doubled, to a level nearly 75% of what the same people asked when at HQ.

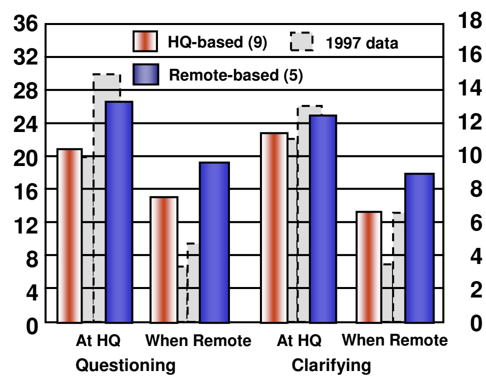

Figure L – Questioning Patterns

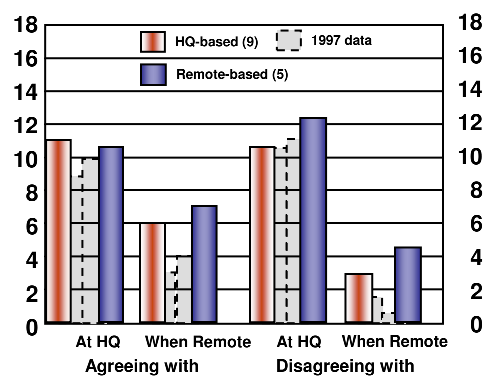

Figure M – Voting Patterns

Similarly (Fig. M), this increased engagement in the dialogue was also exhibited in the voting pattern. Voting is hard when self-confidence is low; thus, it is quite gratifying to see the much higher level of voting from remote site attendees.

All told, improvements with the new tools were dramatic for the remote participants, with little apparent impact on HQ interaction. Table 1 captures the essence of the percentage changes year to year, for overall comments as a function of location for the attendee.

Folk based in →		HQ	Remote
Meeting at HQ		+4%	-3%
Joining mtg Remotely		+108%	+91%
Ratio of remote to HQ Commentary	*1997*	27%	31%
	1998	54%	62%

Table 1 – Commentary Improvement

The commentary quality was even more significant, as shown in Table 2. Especially note the very dramatic increase in "no" votes by the "regular" remote attendees. The willingness of all participants to question more freely – up by nearly 2.5x overall – is perhaps the most solid metric of the value of the collaboration tool suite.

Percentage Change ('98/'97) for Folk based in →	HQ	Remote
Questioning speaker while remote	+130%	+148%
Asking for clarification while remote	+84%	+54%
Voting Affirmative while remote	+64%	+62%
Voting Negative while remote	+77%	+543%

Table 2 – Category Improvement for Remote Participants

6. Meetings and M^4

Considering the issues that surround a Monday morning staff meeting, we might summarize them as **M^4 = Meeting, Memory, Mobility, and eMotion.** Herein, we have only dealt with synchronous meeting tools and their impact on executive participation. The **Meeting** success itself is a function of many variables – preparation, agenda, content, data, presentation, meeting moderation and leadership – not to mention the degree to which attendees provide active debate, discussion, synergistic discovery, collaboration, and agreement. In this study, tools that enabled remote-site attendees to participate in regular meetings synchronously, primarily via better audio conferencing and shared presentations, altered participation rates heavily.

The study did not examine other elements of remote staff effectiveness directly. **Memory** of these staff meetings was provided primarily by notes that any individual took at the meeting. The CEO's secretary usually took cursory notes, and distributed them after the fact to attendees. These were seldom very complete, usually covering the leader's agenda and a few action items at best. If you missed the meeting, there was little help. If you were remote, and missed the meeting, it was even harder.

The **Mobility** factor in modern business, especially for managers who usually compose an executive committee, or remote-site leadership who would regularly be expected to attend a weekly meeting, is quite high. Some estimates are that only about 60% of the top twenty managers of numerous high-tech companies are able to attend as many as two-thirds of the regularly scheduled weekly meetings, unless drastic measures are taken (*e.g. NO ONE* travels on Monday morning, or at the least, must be at a remote-site with call-in capability).

Lastly, **eMotion** – in a business environment? The surprising answer is *yes*. Tone of voice, body language, eye contact and facial cues all are crucial factors during a presentation to *read* its acceptance, as earlier described. And this is true for even a hard-core analytical senior management team. It becomes more evident in training courses, in motivational leadership situations, in group participation meetings, and in collegial conversations.

7. Status and Next Steps

Beyond these results, the status of most meetings did not improve dramatically. These notes were taken from a meeting nine months after the study ended – in a key strategic meeting run by three HQ executives and two remote executives who had been in the two year group:

> Significantly, as I penned these lines for an InterNet II paper (9/10/99 1:08:02 PM), we are an hour and eight minutes into an annual Strategic Product Planning meeting, and a Senior remote manager blurted out *"could you guys call us back on the */:"&%* line, and I'LL set up the conference bridge. This is REALLY a SAD EXPERIENCE out here!"* This outburst followed at least five tries to configure the shared meeting for whiteboarding and audio conferencing across four sites. And an embarrassed reply by a senior VP – *"Sorry, I didn't think to prepare this for remote visibility."* If this were an isolated incident, or one that few other companies experienced, it would be one thing. But the lamentable fact is that this is routine rather than rare.

7.1. Still Missing from the Mix

While we have described some tools that helped greatly for the weekly staff meetings of a company, it is important to recognize that some things were NOT fixed at all. Bear in mind that the audio participant has no access to the *listener/watcher* or the *talker/watcher* modes earlier described, so *persuasive arguers* who rely on body language and facial expression to gauge their presentation, are still bereft of most of the cues on which they usually rely.

On the other hand, all of the attendees at the *real* meeting site have access to the cues, and they, much more quickly than a remote presenter, can sense when something has *gone south.* And it is like the kiss of death. No proposal can easily survive and re-emerge intact from an initial remote presentation *gone south.*

The net effect of this, for anyone who has experienced it more than once, is to ensure that you never get caught in this situation. Which of course robs the *joined meeting* of any real shared participation in true distributed decision-making. No one at a remote site would ever make a serious proposal without traveling to "headquarters" (HQ) to "make the case". Which inevitably builds a "hub and spoke" company, both for its organizational power structure and its communication system.

8. Conclusion

The study confirms the enormous value of two sets of tools – audio-conferencing with adequate conferencing telephone sound systems, and network-based file-sharing tools. It revealed enormous difference of involvement in various categories of interaction – voting and funding requests being the hardest for which to obtain participation. The tools helped re voting; they had almost no impact on funding proposals.

Video-conferencing tools, Shared Databases, and Electronic Whiteboards were not found to be of significant value for this group of executives, at least in their current form.

Executives need collaboration technologies as badly as many other target audiences – if they feel empowered by the tools, odds improve that they'll help support research and development of this still nascent field and discipline. It is certainly timely and appropriate that we attract such potential allies.

Endnotes:

[1] Software development, CAE, and Database tools; CRM, SCN, MRP applications, and Office Suites are all tools used daily in depth by their users. By contrast, collaboration tools are "background" infrastructure, used only periodically and occasionally for most users.

[2] VOIP = Voice Over Internet Protocol.

[3] It is difficult to study management teams at this level; permissions to even study the situations are hard to obtain due to the strategic nature of the meetings. If significant productivity gains are achieved, very often the company views them as proprietary knowledge.

[4] WebEx Corporation, www.webex.com; Nuance Corporation, www.nuance.com; Speechworks, now a wholly owned subsidiary of Scansoft Corporation, www.scansoft.com; IBM ViaVoice, http://www-306.ibm.com/software/voice/viavoice/ .

[5] The author has counted more than a dozen such requests per meeting in more than fifty corporate meetings in the past five years. So easily remedied, this is an astonishing timewaster / frustration producer.

[6] These were typically three-hour meetings, from 9am to 12 noon Eastern (U.S.) time. They included regular executive staff members from Europe, the Middle East, and Asia, all of whom accommodated the East Coast time week after week. No attempt was ever made at this company to rotate the time; many companies do try some sort of meeting time rotation.

[7] Polycom Corporation, www.polycom.com is one vendor of such sets. These sets are less than $500 per conference room, delivered next day from any of the large office supply chains. They are indispensable, even for the home, if used for remote conference attendance. For all of that, cursory surveys reveal that less than one out of two hundred home office workers in America have made this inexpensive investment a full decade after its major introduction.

[8] XeroxPARC pioneered numerous studies and experimental tools in this realm. NetMeeting (Microsoft Corp), and similar tools have more recently become indispensable for collaborative meetings.

[9] These are traditional drawbacks and shortcomings – they miss both the essence of the problem and deal only simplistically with the potential contribution.

[10]This unit was an Intel TeamStation, replicated at three off-site divisions. Individual stations – Intel ProShare – were placed in eight key management offices. None were being used six months later.

[11] Importantly, the studies being reported herein were not "known" to the participants. They were done "blind" by a participant/observer (me) in the regular meetings that I attended as part of my primary job. The company knew my title for the first year as a Division President, reporting to the CEO from 3000 miles away; the second year, my primary job was to align the strategies of the disparate divisional R&D programs into a cohesive whole. Only at the end of this period, when we hired a "central head of R&D", did my role as Research VP for communication morés get announced to the corporation.

An analysis of the role of the facilitator and alternative scenarios for collaboration support

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Abstract

There is increasing recognition of the importance of collaboration in today's global economy where individuals and organizations need to form alliances to optimize their potential to compete. Group working is on the increase both within organizations and across organizational boundaries. The goal of effective collaboration has been addressed by many researchers and in this paper we focus on one 'traditional' approach; that of employing a professional facilitator. We identify two key problems associated with this approach, first the lack of sufficient numbers of skilled facilitators worldwide and second the expense of bringing together people who are geographically dispersed into one meeting place. The paper provides a description of the role of facilitator and presents a classification of current literature on the subject. Three scenarios are presented, each of which offers solutions to the above problems. Scenario one is Collaboration Engineering which focuses on designing facilitation best-practices into packaged processes that practitioners can execute successfully for themselves without the ongoing intervention of a group process professional. Scenario two is distributed facilitation whose focus is on supporting the role while both the facilitator and the meeting participants are geographically dispersed. Finally, scenario three is the agent facilitator whereby the role is completely automated using an intelligent software agent. For each scenario we discuss what can be done by way of facilitation support and identify where difficulties arise. The overall analysis leads to the conclusion that there is a need for greater understanding of the social aspects of facilitation such that appropriate patterns can be developed and hence further support be provided.

1. Introduction

Collaboration is increasingly important in today's competitive environment as organizations need to be creative or innovative to manage competition [22]. However, group collaboration is difficult and groups have difficulty overcoming the challenges by themselves and often turn to a professional facilitator for help [28, 26]. Facilitated groups can now also make use of a variety of tools, technology and process support.

There are many developments in facilitation. In practice, facilitation may be viewed as an art that makes use of a wide variety of techniques, varying from complex decision making matrices to more creative techniques. Recent research, however, has tended to emphasize facilitation combined with computer supported meetings, and in particular, the use of Group Support Systems (GSS). GSS are electronic meeting systems in which a set of tools can be used to support the group in a range of collaborative, computer mediated activities. GSS can increase the effectiveness and efficiency of a collaboration process [11, 35], but it is difficult for groups to benefit from such systems without the guidance of a trained facilitator [26, 8].

Two problems have specifically challenged researchers in GSS and facilitation. The first is the limited adoption and diffusion of GSS compared to their potential added value, for which a potential solution is offered in the Collaboration Engineering approach. Second is the challenge of distributed collaboration and by extension the use of automated facilitation by agents. Such new approaches drastically change the task of a facilitator.

In this paper we will argue that the development of the role of the facilitator and the fulfilling of the range of tasks might offer some critical new challenges. This paper will therefore offer an overview of the role of the facilitator, and will explain how the tasks of the facilitator change in each of the scenarios of collaboration engineering, distributed facilitation and agent facilitation.

The remainder of this paper will describe the role of the facilitator. Section 2 also offers a seven layers model of the role of the facilitator and describes facilitation tasks within this. Section 3, 4 and 5 show the application of the model to each of the three scenarios. The paper concludes with a summary of what can be done and where there are difficulties for facilitation support.

2. The Role of the Facilitator

The term facilitator itself denotes a set of skills and behaviours that may be applied by a group-worker, teacher, manager or co-ordinator. The application of these skills may be different in the various contexts. Nevertheless, "facilitator" is a readily identifiable, common 'core' of skills and behaviours that may be used by any of the above.

Many authors have described the skills and behaviors required to best facilitate group work. Clawson and Bostrom [7] produced a list of sixteen dimensions of behaviors exhibited by facilitators during meetings. Dickson et al. [9] distinguished between task and social interaction interventions. Ackermann [1], however, classifies the functions and qualities according to the meeting stages: pre-, during and post-. Niederman et al. [25] describe a list of key characteristics of the facilitator as part of a larger study. Vreede et al. [34] produced six categories of the facilitation functions. Vreede et al. [33] produced twelve categories of facilitator activities, skills and qualities using participants' perspective. Hayne [12] categorized the activities of the facilitator into behaviors, interventions and roles. Finally, Schwarz [29] provides ground rules for effective groups to be followed by facilitators.

Hengst et al [13] combined several of these tasks [6, 28, 33] and categorized them in the following attention points: Atmosphere management, content focus, meeting procedures-execution, technology and ground rules. They then measured the demand rate of the different tasks in different settings.

Macaulay [18] presented the various aspects of the role of the facilitator using a seven layers model (see figure 1). The layers were developed through studying the facilitator in traditional face-to-face setting. The model uses the OSI seven layers model as a metaphor. The Open Systems Interconnection (OSI) model is a layered abstract description for communications and computer network protocol design[1] and is defined in ISO standard 7498-1. In the ISO seven layers model each layer represents a logical separation of concerns and the interface between each layer is well defined, thus allowing interoperability across various platforms offered by vendors. The seven layers are: 1: the physical layer; 2: data link layer; 3: network layer; 4: transport layer; 5: session layer; 6: presentation layer; 7: application layer. Typically lower levels are implemented in hardware and higher levels implemented in software.

The seven layers model of the role of the facilitator [18] describes seven areas of concern for a facilitator, described from a facilitator's point of view. Each layer represents a logical separation of concerns though the interface between each layer is as yet not well defined. The purpose of developing the model was to assist identification of the potential for computer support. The seven layers are 1: the environment layer; 2: technology layer; 3: the activity layer; 4: the method layer; 5: the personal layer; 6: the social layer; 7: the political layer. Typically the lower layers lend themselves to implementation in software/hardware while the higher layers (5, 6, 7) are typically 'implemented' by humans.

The challenge for collaboration engineers is to raise the level of computer support from the lower layers to the higher layers. Figure 1 presents indicative contents of each layer from the facilitator's point of view.

[1] ISO standard 7498-1:1994 (http://standards.iso.org/ittf/PubliclyAvailableStandards/s020269_ISO_IEC_7498-1_1994(E).zip)

1.Environment	Create an environment that is conducive to learning Oversee meeting logistics Ensure appropriate physical environment
2.Technology	Select appropriate technology and control its use
3.Activities	Take control of the agenda Control each activity within the method (e.g. brainstorming) Take control of recording outcomes Make summaries at appropriate points
4.Method	Be an expert in the application of the method (e.g Requirements Analysis method) Adapt method according to the success criteria of the team
5. Personal	Be aware of your own feelings Be able to 'think on your feet' Be aware of your own behaviour and credibility Be aware of conversations and social norms Be able to call upon a range of techniques to help deal with difficult situations Be aware of your own appearance and body language
6. Social	Deal with cultural differences Identify individual differences Build the team spirit Establish a model of behaviour Deal with socio-emotional problems Encourage creativity Be sensitive to verbal and not verbal cues Identify human communication problems and intervene appropriately
7. Political	Be sensitive to organizational differences Deal with internal power struggles Empower the group Identify hidden agendas Be clear about the objectives of the sponsor Help project sponsor identify stakeholders

Figure 1. Seven Layers Model for the Role of the Facilitator in Face-to-Face meetings [18]

Table A.1 presents an analysis of the literature on facilitation against the seven layers model.

Due to the complex nature of facilitation tasks, they will remain difficult to classify. Atmosphere and ground-rules focus on relations and conflict and will contain similar tasks as personal, social, political. Procedure execution will contain tasks that can also be classified under activities and methods. We are then left with one distinct aspect; content focus. The tasks in this category are [13]:

- Promotes ownership and encourages group responsibility
- Presents information to group
- Tests agreements among participants

There are discussions among facilitators and facilitation researchers about the effect of content presentation on the objectiveness and impartialness of the facilitator. As we are aware of this problem, the purpose of our model is to give an overview of tasks. Since content focused tasks are indeed not of a procedural nature but focused on the content, we will use the layer model of Macaulay, together with a content layer as displayed in fig. 2.

Environment
Technology
Activities
Method
Content
Personal
Social
Political

Figure 2. Seven (+1) Layers Model for the Role of the Facilitator

Applying this layered model and the task categorization in each the task of a facilitator can be summarized as displayed in table 1:

Layers model	face to face GSS supported facilitation tasks
environment	Planning, preparing and handling logistics
technology	Selecting, preparing and operating appropriate technology
Activities	Selecting, preparing and instructing appropriate group activities
methods	Selecting, preparing and following appropriate methods

content	Present, integrate and summarize information
personal	Preparing the facilitation role and being self-aware
social	Getting to know the group or as much info about them as possible and dealing with group dynamics and conflict
political	Understanding different stakes and perspectives and dealing with politics

Table 1: Application of the Seven (+1) Layers Model to the traditional task of the Facilitator.

3. Application of the model to Collaboration Engineering (Scenario one)

Collaboration Engineering is an approach to the design and deployment of collaboration processes such that they can be executed by practitioners in the organization and hence reduce the need for professional facilitators [4, 31]. Professional facilitation can be difficult to sustain in organizations [24, 2], in contrast, for recurring facilitation tasks, investment in training practitioners is more easily sustained and thus might lead to more widespread use of collaboration support. To replace the facilitator with a practitioner, Collaboration Engineering introduces a second role; the collaboration engineer. The collaboration engineer is an expert facilitator who takes over the preparation task of the facilitator. A collaboration engineer designs a collaboration process that is predictable, reusable and can be transferred to practitioners in the organization. Removing the complex design task and arming a practitioner with a high-quality predictable collaboration process design will compensate for lack of experience as a facilitator.

In Collaboration Engineering the task of the facilitator is split up in a design tasks and an execution task Table 2 explains these tasks with our layers model.

Layers model	Collaboration engineer	Practitioner
environ ment	Set environmental requirements	Planning, preparing and handling logistics
technolo gy	Selecting and preparing Appropriate technology	Operating and preparing technology
activities	Selecting, preparing and scripting appropriate group activities	Executing script
methods	Select, prepare and transfer appropriate methods	Executing script
content	Indicate where content information should be inserted	Present, integrate and summarize information
personal	Train practitioner	Preparing the facilitation role and being self-conscious
social	Create participant and organization profile and make design fit	dealing with group dynamics and conflict
political	Understanding different stakes accommodate where possible	dealing with politics

Table 2: Application of the Seven (+1) Layers Model to Collaboration Engineering.

When we compare these tasks we can identify a number of challenges.

Environment
While the collaboration engineer sets requirements for the environment, the required resources (time, room, materials, etc.) might not always be available, in such case the practitioner has to improvise

Technology, Activities and Methods
When technology, activities or methods to not work as planned, the practitioner does not have the skills to flexibly adapt the design to the situation. The better the script, the less this problem occurs. CE offers Collaboration engineers thinkLets. ThinkLets are facilitation building blocks that contain a script with instructions to operate the tool and to guide the group. ThinkLets are predictable, reusable and transferable. Using thinkLets, will therefore increase the success of this approach [4, 32].

Content
Practitioners should be content experts so this task should not offer challenges.

Personal
Practitioners have no facilitation experience, and therefore their self efficacy is likely to be lower.

Social and Political
Practitioners will have very limited experience with social and political group dynamics. Although prior analysis of politics and the social context can be useful, stakes and culture are can be difficult to accommodate, and different perspectives can have different conflicting requirements.

It will be very hard for practitioners to deal with such issues, and training and stakeholder accommodation will only help in a limited extend.

4. Application of the model to Distributed Facilitation (Scenario two)

In a distributed setting the facilitator role is not split-up, but all communication has to go through audio channels, possibly accompanied by video. However, video quality, the two dimensional depiction and the focus of the camera make it difficult to interpret body language, emotions and feelings. In this situation, part needs to be compensated by additional technology features, part should be done by the participants themselves and part by additional behavioral rules and procedures, enhanced by technology.

Distributed facilitation occurs during geographically or temporally dispersed meetings. This mode of facilitation lacks many of the features of a face-to-face meeting [21] and suffers from the lack of non verbal cues. McQuaid et al. [21] suggest a separate channel for each of the process and content of the meeting and propose, for example, that a persistent visualization of an asynchronous meeting summary is necessary to keep track of members' activities. Also, they suggested a virtual reality toolset which gives a representation and a feeling of the face-to-face meeting.

Mittleman et al. [23] suggest the use of a group dictionary that maintains the terminology that reflects the concepts shared by the group. The facilitator helps the group agree on the terms as a difference in meaning attributed to terms used can hinder the group in reaching decisions. Mittleman et al. [23] further suggest that a persistent group dictionary, which incorporates terms previously agreed, would increase the speed of decision making.

Hayne [12], in a study on both face-to-face and distributed meetings, argues that ICT support for the facilitation functions should be determined by meeting activities requiring high control from the facilitator. For example, the facilitator is required to record information about all activities during a meeting. Possible support for this would be automation of the recording by transcripts, snapshots or summaries.

When we apply the seven layers model to distributed facilitation tasks we can identify a number of challenges.

Environment and Technology
The environment and technology is distributed, therefore the facilitator can only manage part of it. Participants or local assistants will have to manage the environment at location. If the main communication technology is not working, or participants do not operate it correctly, separate communication channels such as phone or mail should be used to solve the matter. Once the main communication channel is working, instructions can be offered. The technology itself can contain trouble-shoots, manuals or help-files to support the participants when the facilitator is not available.

Activities, Methods and Content
Instructions for the activities, methods and content can be done trough the distributed communication channel. For "hard" data such as brainstorming, categorizing, and voting, this should not be difficult. However, in activities where soft group data such as consensus, commitment, trust, or agreement are required, it becomes more difficult. The limited communication channel removes part of the feedback that the facilitator uses to guide the group, such as body language and voice tone.

Personal
Interventions related to the personal layers also become difficult the facilitator's ability to present himself and to get feedback on his performance are limited as they exist mostly of body language.

Social and Political
The social and political interventions also suffer from the lack of "soft" communication. However, this can also be an advantage. As the limitation forces the participants to make soft feedback, hard feedback, this increases the anonymity of the discussion and can make it more rational [3, 26]. A last challenge in political issues can be that participants can by-pass the facilitator and the group by using private channels to discuss matters with other stakeholders.

Table 3 further highlights the difficulties of distributed facilitation for each layers of our model.

5. Application of the model to agent facilitation (Scenario three)

The goal of agent facilitation is to totally automate the role. A number of researchers have attempted to apply agent technology to the role and some of these are described below.

Some aspects of facilitation are difficult to automate, for example, facilitators are aware that many aspects of meetings are 'political' with participants bringing hidden agendas into the meeting [36]. McQuaid et al. [21]

highlighted the importance of pre-meeting preparation in order to prepare members for the meeting and suggested best practice guidance. Possible pre-meeting technology support could include tools to support agreement on the meeting goals and agenda, agreement on a dictionary of terms and automated processes for identifying membership and gaining commitment.

At the next level of support comes the automation of routine, predictable and context-free facilitation tasks. This alternative mostly draws upon work in intelligent agents. Jahng and Zahedi [16] provide an example of such alternative when they propose a model for implementing an intelligent agent facilitator. They classify the facilitation functions into four classes: technology support, information management, process management and group management. The first two represent possible automation and the latter two identify the role of the human facilitator.

Macaulay et al. [20] and O'Hare et al. [27] have also looked to intelligent agents to provide partial support for problem identification and diagnosis. Patterns of problems were identified based on Westley and Walters [36] Generic Problem Syndromes. The syndromes were in essence patterns of behaviors in meetings for example, the 'feuding factions' syndrome, the 'sleeping meeting' syndrome or the 'multi-headed beast' syndrome. O'Hare et al. [27] implemented an agent that monitors for cues from the group conversation. The agent aids the facilitator by notifying of possible occurrence of a problem syndrome.

Chen et al. [5] and Houston and Walsh [15] use intelligent agents and AI tools, respectively, to help the facilitator analyze and classify comments from a brainstorming session. For example, participants in a brainstorming session of an e-meeting use intelligent agents, which utilize techniques for natural-language parsing, to aid the facilitator in identifying initial categories of their comments. The facilitator then refines these categories manually.

Zhao et al. [37] propose a system based on intelligent agents and workflow management. The intelligent agents embody several facilitation functions and skills by utilizing a multitude of techniques. For example, intelligent agents may reveal any difficulties facing the group member by monitoring and analyzing their input rate. The sequence of activities is controlled by a workflow management system.

Our focus is on the agent taking over the role of the facilitator and table 3 below shows where the difficulties arise.

6. Summary

For each of the layers the facilitator requires feedback from the group process and needs to interpret this, to adjust his interventions. In the personal, social and political layers this is extra difficult since the feedback in these situations is often partial or not explicit. Each of the different facilitation scenarios impairs the feedback mechanism. The practitioner is unable to interpret and react on the cues, the distributed facilitator gets and gives incomplete cues and agents cannot interpret the (incomplete) cues as well as human facilitators. Therefore we need to discover patterns in the cues that can be recognized from incomplete cues, by agents, practitioners and distributed facilitators, and for which possible response interventions are identified.

In this paper we have reviewed a range of descriptions of the role of the facilitator and classified these against the seven layers model. We considered three scenarios for collaboration support the first and most extensive was that of Collaboration Engineering. The second of that distributed facilitation clearly requires further understanding at the personal, social and political levels. The third scenario of agent facilitation is least well developed and is clearly a subject for future research.

Layers model	face to face facilitation	face to face preparation	Scenario 1: practitioner	Scenario 2: distributed facilitation	Scenario 3: agent facilitator
environment	Handling logistics	Planning logistics	Can be done by practitioner	Should be done by practitioner	Should be done by practitioner
technology	Operating technology	Selecting and preparing appropriate technology	Can be done by practitioner	Operated on distance	Automatic instructions?
activities	Instructing group activities	Selecting and preparing activities	Can be done by practitioner with use of CE design	Instruction through technology or separate communication channel	Automatic instructions?
methods	Follow selected methods	Selecting and preparing appropriate methods	Can be done by practitioner with use of CE design	Instruction through technology or separate communication channel	Automatic instructions?
Personal	Being self-conscious	Preparing facilitation role	Difficult for practitioner because lack of experience	Difficult because communication channel is limited	Is removed
Social	Dealing with group dynamics and conflict	Getting to know the group or as much info about them as possible	Difficult for practitioner because lack of experience	Difficult because important feedback mechanisms are removed such as body language and tone	Automatic adaptation through signals in text?
Political	Dealing with politics	Understanding different stakes and perspectives	Difficult for practitioner because lack of experience but can be avoided in good CE design	Difficult because important feedback mechanisms are removed and because other communication channels can be used to bypass facilitator	Automatic adaptation through signals in text?

Table 3 What can be done and where there are difficulties for facilitation support in each of the three scenarios.

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Appendix A. Tables

Table A.1. Relation of the seven layers to the role of the facilitator described in the literature

Author	Facilitator Functions, Qualities and Skills	Political	Social	Personal	Method	Activity	Technology	Environment
Clawson and Bostrom [7]	Plans and designs the meeting					•		•
	Listens to, clarifies and integrates information					•		
	Demonstrates flexibility			•				
	Keeps group outcome focused	•						
	Creates and reinforces an open, positive and participative environment		•					
	Selects and prepares appropriate technology						•	
	Directs and manages the meeting	•	•	•	•	•	•	•
	Develops and asks the right questions		•	•				
	Promotes ownership and encourages group responsibility	•	•					
	Actively builds rapport and relationships		•					
	Demonstrates self-awareness and self-expression			•				
	Manages conflict and negative emotions constructively	•	•					
	Encourages/supports multiple perspectives	•						
	Understands technology and its capabilities						•	
	Creates comfort with and promotes understanding of the technology and technology outputs						•	
	Presents information to the group					•	•	•
Dickson et al. [9]	**Task interventions**							
	Structure group activities				•			
	Guides the agenda					•		
	Clarifies and rephrases issues			•				
	Keeps discussions on topic					•		
	Reformulates questions or problems			•				
	Summarizes					•		
	Test agreements among participants	•						
	Identifies decisions					•		
	Interactional interventions							
	Equalizes participation of participants		•					
	Identifies communication problems		•					
	Solicits feedback			•				
	Manages conflict	•	•					
	Provides and aids the group's emotional climate		•					
Ackermann [1]	**Pre-workshop stage**							
	Providing the client with some control over the meeting	•						
	Giving advice to the client concerning the potential dangers of participative methods				•			
	Providing information on the benefits gained from participative methods				•			
	Ensuring that a match is made between the problem			•	•			

	task and the facilitator's skills							
	Understanding more about the organization	•						
	Paying attention to group membership	•	•					
	Discussing the location of the workshop/meeting							•
	Workshop stage							
	Providing an explanation of the process				•			
	Providing a clear set of objectives and corresponding agenda					•		
	Creating and displaying an overview of the issue/problem					•		
	Managing the group's direction and progress					•		
	Ensuring that participants perceive themselves to be equal for the event		•					
	Enabling participants to contribute freely		•					
	Enabling the group to concentrate on the task being addressed		•			•		
	Asking difficult or sometimes obvious questions			•				
	Exhibiting energy and enthusiasm			•				
	Making regular reviews of the material					•		
	Providing the client with some form of control	•						
	Putting aside time to review the outcomes					•		
	Reexamining agreed actions	•						
	Considering the actions in light of the responsibilities	•						
	Post-workshop stage							
	Keeping the energy and enthusiasm alive		•			•		
	Stressing to the client the importance of implementing outcomes					•		
	Agreeing on 'quick' wins					•		
	Promulgating actions achieved					•		
	Managing the process of review and control					•		
Niederman et al. [25]	Good communication skills			•				
	Flexibility			•				
	Understanding the group and its objectives	•						
	Ego-less facilitation			•				
	Task focus					•		
	Leadership			•				
Vreede et al. [34]	**Atmosphere management**							
	Creates and reinforces an open, positive and participative environment		•					
	Actively builds rapport and relationship		•					
	Encourages/supports multiple perspectives	•						
	Manages conflict and negative emotions constructively	•	•					
	Meeting procedures – design							
	Plans and designs the meeting					•		
	Develops and asks the right questions		•	•				
	Content focus							
	Promotes ownership and encourages group responsibility	•	•					
	Presents information to group					•	•	•
	Tests agreements among participants	•						
	Meeting procedures – execution							
	Keeps group outcome focused	•						

	Directs and manages the meeting	•	•	•	•	•	•	•
	Technology							
	Selects and prepares appropriate technology						•	
	Understands technology and its capabilities						•	
	Creates comfort with and promotes understanding of the technology and technology outputs						•	
	Personality							
	Demonstrates self-awareness and self-expression			•				
	Demonstrates flexibility			•				
Vreede et al. [33]	**Workshop design**							
	Preparation of scrip				•	•		
	Choosing/preparing meeting accommodation							•
	Required knowledge							
	Technical/GSS knowledge						•	
	Content knowledge	•						
	Knowledge of group processes/group dynamics		•					
	Setting the stage							
	Introduction/explanation of meeting process & rules		•		•			
	Introduction/explanation of GSS technology						•	
	Introduction/explanation of meeting topic					•		
	Being available							
	Being available/approachable		•					
	Human qualities and attributes							
	Self projection			•				
	Social skills			•				
	Being sensitive/building rapport							
	Building rapport with problem owner	•						
	Being sensitive to the group		•					
	Intermediate results/group output presentation							
	Explaining/resuming/interpreting group output and giving feedback					•		
	Directing meeting process and group towards output/results							
	Motivating/stimulating group (meeting process)		•					
	Giving free reign/tightening the reign (meeting process)	•				•		
	Brining the group to results/effectiveness (group)	•				•		
	Leading the group and its discussion in general (group)		•			•		
	Guarding							
	Guarding the discussion focus	•	•					
	Time management (balancing time and results)					•		
	Script evaluation/modification and redesigning process							
	Structuring discussions					•		
	Process adaptivity				•	•		
	Being sensitive to results							
	Being sensitive to the meeting content/topic	•	•					
	Respecting the group results		•					
	After-care					•		
Schwarz [29]	Test assumptions	•	•					
	Share all relevant information					•		
	Use specific examples and agree on what important words mean	•	•					
	Explain your reasoning and intent	•						
	Focus on interests, not position		•					

	Combine advocacy with inquiring	•		•				
	Jointly design next steps and ways to test disagreements	•				•		
	Discuss undiscussable issues	•	•					
	Use a decision-making rule that generates the level of commitment needed				•			
Hayne [12]	**Behaviors**							
	Recognizing stages of group process				•			
	Providing motivation		•					
	Establishing a model of behavior		•					
	Managing group creativity, anxiety, and conflict	•	•					
	Maintaining awareness of own feelings as an indicator			•				
	Demonstrating flexibility			•				
	Interventions							
	Planning the meeting					•		
	Observing communication patterns		•					
	Determining levels of consensus	•						
	Creating situations conductive to learning		•					
	Synthesizing information and building cognitive maps					•		
	Recognizing implicit vs. explicit decisions	•		•				
	Detecting variance from structures			•				
	Confronting group regarding its process				•			
	Providing structure to focus group limits and boundaries				•			
	Intervening when appropriate at level of group instead of individual		•					
	Providing closure			•				
	Roles							
	Ensuring members identify and maintain a discussion focus and a procedure for that focus				•			
	Ensuring everyone has an opportunity to contribute to the discussion and decisions regarding focus, procedures and decision issues	•	•					
	Understanding group values and providing new values in process		•					
	Sensitivity to time management			•				

Virtual Working Elements Model

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ABSTRACT

Virtual teams comprise an important structural component of many organizations and are particularly important in globally dispersed, cross-functional, and cross cultural enterprises. This study explores the possibility of creating a Model of Virtual Working Elements, which helps people involved in virtual teams or organizations to understand and keep track of elements which effects their daily work. The model also helps researchers on their selection process of virtual teams for case study to assess not only theoretical but also practical facts. The model was created based on a case study on virtual teams. As an appropriate approach, a multi-case research was chosen to enable capturing the best overall picture of virtual team's elements. The data were collected from over 50 virtual teams, in different industries, in Finland. One of the selected virtual teams was chosen to be studied in detail and to be compared with rest of the virtual teams as reference. The model provides an in-depth and yet a simplified structure for major elements affecting virtual work environment.

1. INTRODUCTION

Due to the globalization of markets and the growing need to react to the increased speed, a growing number of organizations have been established or modified in last decade. Among the most commonly used terms found for these developing organization forms is virtual organization. The emergence of such organization forms presents a challenge to information system research.

A broad methodological gamut and a deep understanding of the work context in a concrete organization is required to work on dynamic and diverse virtual organization, which is concerned with the design, introduction, and use of groupware systems. These aspects appear in classical organizations, but are even more important in virtual organizations which are less rigidly structured and much more flexible than classical organizations.

The current research work aims to; 1) find the most important elements of virtual teams/organizations, 2) analyze the purpose, goals, preconditions, and 3) critical factors of virtual team/organizations in their internal processes and dynamics, 4) to compare the findings with international experiences and publication on the topic and 5) finally provide a model for better understanding and managing virtual teams and organizations. The model may help to improve the performance of the virtual teams and create common understanding of the virtual team through the organization. Meanwhile searching for virtual working elements, I have eye on the method we use and also try to generate some recommendation for future case study research in this field.

2. BACKGROUND

2.1 Team working

The power of teams is not a new concept. In the 1960s quality circles in Japan were self-directed study groups at the workshop level. Workers trained themselves in the concepts and techniques of quality control collectively studying the subject and collaborating to solve problems and generate ideas. These collaborations created explosive growth in both quality and productivity. The movement towards more enriching work of the 1960s and 1970s which highlighted methods like autonomous work groups was never really implemented. By the mid 1980s, a new wave of employee relations emerged based upon the empowerment and involvement of employees in the workplace. Employee involvement embraces a wide range of programs, some of which are connected with employee's control over redesigned work. (Campbell & Mavin). During 1990s, self-managing or empowered work teams were defined as "groups of interdependent individuals that can self-regulate their behavior on relatively whole tasks" (Cohen & Ledford, 1994).

The introduction of self managing work teams to the work environment resulted in record productivity gains. Mid-1990s, exporting the team concept to their foreign affiliates in other continents started (Kirkman et al. 2001). Virtual teaming increased exponentially as result of 2001–2002 recession and the events of September 11, 2001. By 2003 over 100 million people worldwide were working outside traditional offices from home online or from another location. This number is expected to grow to 162m by 2006 (Singh 2003). Now, due to communication technology improvements and continued globalization, virtual teams have been increasing rapidly worldwide.

2.2 Virtual teams

A virtual or distributed team can be defined as a temporary, culturally diverse, geographically dispersed, electronically communicating work group (Kristof et al. 1995). Virtual teams are "groups of geographically and/or organizationally dispersed coworkers that are assembled using a combination of telecommunications and information technologies to accomplish an organizational task" which may be temporary and thus adaptive to organizational and environmental changes (Townsend et al. 1998).

Virtual teams are using different electronically communicating technologies which include, a virtual workplace that provides a record of the process of the group, different forms of interaction such as email, telephone and televideo, and shared information storage, access and retrieval (Romano et al. 1998). As a result, such systems facilitate the access, creation, processing, storage, retrieval, distribution, and analysis of information across positional, physical and temporal boundaries (Davenport & Prusak 1998, Lipnack & Stamps 1997, Mankin et al. 1996, Warkentin et al. 1997).

Electronically communicating or storing technologies foster information sharing, and also help virtual teams create a shared social reality that transcends the initial differences and obstacles team face (Boland et al. 1995, Gabarro 1990, Krauss & Fussell 1990, Weick & Meader 1994). A shared social reality is often defined as the set of norms, behaviors, and understandings the team members have about the task, work, contexts, jargon, and assumptions necessary for effective and successful collaboration (Krauss & Fussell 1990). However, complete reliance on electronically communicating technologies for information-sharing has its own set of problems, such as loss of project momentum (Kraut et al. 1990), unevenly distributed information, private communication that leaves other participants uninformed or mistaken in their assumptions, a tendency to fail to communicate information about context (Cramton 1997), insufficient richness to convey context and socio-emotional issues (Kydd & Ferry 1991; Rice 1992); and information sharing that makes decision processes too explicit, accountable, and capable of being monitored by others (Bowers 1995).

2.3 Cross-cultural communication

The global nature of virtual teams merits a discussion of possible cross-cultural differences in communication behaviors. Individuals from different cultures vary in terms of their communication and group behaviors including the motivation to seek and disclose individual related information and in the need to engage in self-categorization (Gudykunst 1997). Individuals from individualistic cultures might be more prone to trust others than individuals from collectivist cultures in computer-mediated communication environments. People with high confidence and good knowledge of other cultures tend to be more prepared to explore cultural topics and challenges.

Cross-cultural communication has impact of level of trust in virtual teams. In the beginning of any virtual work, communication behaviors such as social communication and communication conveying enthusiasm and also member actions, such as coping with technical and task uncertainty or individual initiative, helps to facilitate trust. Communication behaviors, such as predictable communication and substantive and timely response have positive effect on the trust during and or in late stages of the trust. Leadership and having mechanisms for action or reaction to crisis are part of member action in virtual team, which facilitates trust during or later stage of the virtual work. (Jarvenpaa & Leidner, 1998)

2.4 Virtual organization

Changes in organizational structure and advances in informational technology define the environment in which the virtual team operates. Virtual organization constitutes a number of different geographic locations within the organization, which adapts to the telecommunication and informational technologies that link, its members and also adapts to a changing variety of assignments and tasks during the life of any particular team. Virtual organization can also be described as a form of cooperation of legally independent companies or people contributing their core competencies to a vertical or horizontal integration and appearing as one organization to the customer. Information and communication systems are base of virtual organizations and the fact that hierarchies in virtual organizations are flat and central control functions should not be established. Virtual organizations have the potential to significantly decrease the amount of travel required and can at the same time increase the productive capacity of individual members. Virtual organization members may be asked to participate in a higher number of separate team situations than was practical in traditional teamwork. Thus, each employee's physical location is no longer a barrier to effective team structure.

Work setting affects the way people communicate, so virtual organization members should learn new ways to express themselves and to understand others in an environment with a diminished sense of presence. Team members in virtual organization require superior team participation skills, quick assimilation into the team, and become proficient in a variety of computer-based technologies. In a virtual organization, employees are expected to be able to repeatedly change membership without losing productivity. Such skill requires basic teamwork training and development. Virtual organization is a multicultural environment. It is expected that member of virtual organization know how each of their respective cultures may differ, and how they can overcome these differences and use them to the team's advantage.

Leaders of virtual teams in organizations play key role in productivity and success of teams. Leaders may have two roles, which represents two entirely different perspectives. In traditional leadership, the leadership role emphasizes the leader as the boss. In the case of empowering leadership, a leader is more often in the background, ensuring the work team has all the necessary preconditions to do the good job. The empowering leader has come more into focus in recent organizational setting, especially when teamwork is emphasized. His/her role is divided into functions such as; support of personnel, administrative tasks, taking part in the work process, and strategic planning.

Virtual organizations should invest in their virtual teams to keep the teams productive. For creating virtual teams, the organization must define the team's function and role, develop the technical systems to support the teams, and assemble individual teams with potential team members. A high degree of informational integration requires greater use of collaborative software applications. Managerial direction and control play an important role; managers will need to clearly establish expectations about the virtual team's performance and criteria for assessing the team's success. In virtual organization, it is crucial to define the team's organizational role and function. The pattern of these teams will be highly dynamic and dependent on current tasks and planning requirements. The potential team members must be trained and attuned to the virtual team environment for developing teams and team members.

2.5 Challenges for virtual teams and organizations

Virtual teams face many challenges. As members of virtual teams come from different locations within and outside an organization, they often become involved in more different and varied team situations. This leads to multiple, perhaps competing alliances and demands. As result virtual team members must manage multiple sets of expertise, need to overcome crucial knowledge, require significant coordination, may have difficulty in engaging in spontaneous informal communication, and have to adjust to the loss of some missing social mechanisms such as non-verbal cues and lack of trust (Bowers 1995; Finholt et al. 1990; Fish et al. 1993; Grudin 1994; Hibbard 1997; Järvenpää and Ives 1994; Järvenpää & Leidner 1998; Kraut & Streeter 1995; Mohrman et al. 1995; Purser et al. 1992; Townsend et al. 1998).

Trust is the greatest challenge in creating successful virtual teams and organizations. Trust can be built virtually and does not require face-to-face interaction. The key issue is to understand the need for trust in facilitating virtual communication and also different ways to acquire trust in virtual teams. Trust can be build based on three level, 1) Experience, either based on assumptions of other members past experiences or shared experiences between the members, which are based on social dialog, 2) Role, either establishing structures such as role assignment, re-porting mechanisms…, or discussions of who will do what, when and with whom, mastering both problem solving and conflict resolution process, 3) Action and commitment.

Group-process gains are more difficult to obtain in virtual teams but working virtually can reduce team process losses associated with personality conflicts, power, politics, and cliques commonly experienced in face-to-face teams. Isolation and detachment is one of the big challenges for virtual teams, specially sites which are far from the main site. Some level of social interaction with supervisors and coworkers is essential in almost all jobs. Without such interaction, workers feel isolated and out of the loop.

There are also some challenges and obstacles for virtual organization. One of the greatest challenges in the introduction of virtual teams is to create a common understanding for team members of challenges a virtual team faces and elements which effect virtual working environment. This is done normally by some intensive courses in topic of virtual team. But such courses have short term effect, as team leaders and members do not follow the learning in day to day business. Successful incorporation of valuable, techno phobic personnel with good interpersonal skills into the virtual team environment may help virtual teams to have better performance. But this may not be possible as leaders may have to select the team members among available resources in the organization.

As main communication in virtual teams is done through technological tools, organizations must establish a clear policy regarding communications privacy, and must then strictly adhere to that policy. Virtual team members usually have multiple tasks, one important supervisory role will be to ensure that virtual team members have enough private time to complete their individual assignments and prepare for their team participation. Management must carefully design an implementation program that highlights the contribution that virtual teams will make and ties these contributions to important organizational values. Assessment and recognition are important during and at the end of any projects. Using target setting and evaluation forms provide an excellent approach for measuring virtual team effectiveness.

2.6 Research framework

It can be concluded from above litreture review that a growing number of virtual organizations have been established which presents a challenge to information system research. There is precisely the research condition for a model to bring a deep understanding of the work context and dynamic in a concrete organization. It can also be concluded that phenomena related to global virtual teams have been studied sufficiently to provide solide foundation. Therefore a case research study conducted to collect findings to build a model for elements which effect virtual teams or organizations.

The study was designed to capture major information through running a set of questionnaires, and then initial analyses were conducted within the results. I incorporated into the result of the questionnaires, my personal experience over last five years leading and working in virtual teams and organizations. The model is targeted to help to improve the performance of the virtual teams and create common understanding of the virtual team through the organization.

3. RESEARCH METHODOLOGY

As an appropriate research approach, a multi-case research was chosen to capture the best overall picture of virtual team's elements. The case study and comparison between different cases allows the investigation to retain the holistic and meaningful characteristics of complex real life events (Yin 1989). The research data was gathered through obtaining responses from the questionnaire which was sent to several virtual team members in different companies.

The data was collected from over 50 virtual teams, in different industries, in Finland. The minimal condition for selection was that the members or subsets of the groups worked in a dispersed manner, located in different places, and communicated mainly via information and communication technology. All the work groups consisted of experts conducting non-routine tasks.

One of the selected virtual team "N" was chosen to be studied in detail and the gathered data be compared with rest of the companies "O" pooled as reference. The case group was selected in collaboration with the contact person of the company and with the agreement of the group leader. Knowing the team and its characteristics was essential for analyzing the data which are going to be obtained during the study. A set of questionnaire was sent to the virtual team N before end of year 2003 to be able to compare the results with other virtual teams, O. The other virtual teams were selected from financing, marketing, management and R&D sectors. The questionnaire was carried out by researchers from Helsinki University of Technology, TAI Research Center, in Nov. 2003. The author used secondry data to write this article.

The virtual team N was based at a global IT company working on a global research and development project. The project started at the beginning of 2002, and was planned to continue till the end of 2004. The inter-organizational project team involved eight engineers from four different sites in three countries, Japan, Finland and USA. The leader had compiled the project members during the first six months of project. Their participation was solicited because of their highly specialized areas from different disciplines of expertise, which would not normally have been available in only one site. The virtual team N consisted of eight members. Three of the group members were located in Tokyo, and three others in Dallas. One group member worked with the project leader in the Helsinki office.

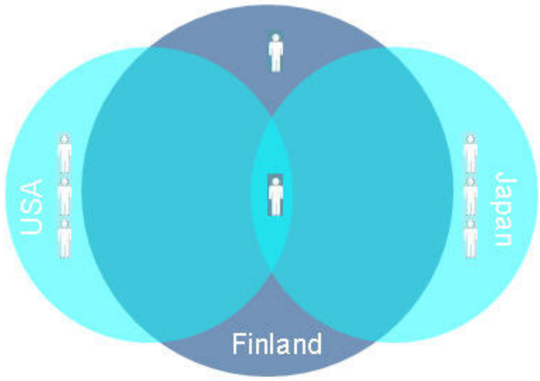

Figure 1: Globally IT based, R&D virtual team "N"

The virtual team N was a mix of five different cultural backgrounds. Three of the group members were Japanese, two were Chinese, and one was from each nationality of American, Iranian and Finnish. Both of the Chinese employees, working in US site, are women, and the other group members are men. General characteristic of the selected teams are shown in Table 1. Most of the group members have a long career in the industry. Only one Japanese employee is a young novice growing by the guidance of his colleagues.

Most of the group members had never worked together previously, so they had no common understanding or shared knowledge about relevant work processes, organizational norms, or even technical language which they have to use specifically working in such virtual team. All members were involved & responsible for one or many tasks. As result the team members were allowed to spend only a part of their total work time on this virtual team, project, and the rest in other projects or their sites activities.

The leader coordinated meetings, resources and also guided the technology development. The group members had different responsibility areas. There was no kick-off meeting to start the project. People had joined the team during the history of the project. After one and half years, the first team building session was organized. That was the first time when all the team members could gather together and meet each other. The effort was to hold the meeting in an informal setting and have several social activities to break the boundaries of formal work and help the team members to open up and talk freely. The purpose of this meeting was to get to know each other better personally and to strengthen the team spirit. The second team building was organized a year after the first one.

The team was not provided with any new or special communicating tools. The commonly used tools were: email, Inter- and Intranet, Web-based conferencing (NetMeeting), videoconferencing, and documentation by using Microsoft Office© package. There were also possibilities for using other tools such as Lotus Notes but it was not used. The group member's tasks were interdependent, but they found it hard to collaborate due to the time zone differences. Japan and USA sites had no overlapping working time and they rarely communicated directly with each other.

The project leader acted as a central source of communication and information flow. The development trend was to allocate the communication more to the site managers to relieve the project leader's communication load. General characteristic of the team N is listed below in comparison to average of other virtual teams, O. The virtual team N, in the global electronic company, was selected based on their extensive use of dispersed work groups. Our prior work with other virtual organizations suggests that the selected cases were representative samples of typical dispersed workgroups.

Team Characteristics	Team "N"	Other teams "O"
Mean age	38	42
Women	25%	26%
Average number of work locations in team tasks	1.4	3.3
Team tenure mean (months)	16	11
Company tenure mean (years)	6	12
Travel days on average per year	8	21
Size of team	8	10

Table1 : General characteristic of the selected teams

4. DATA COLLECTION

The questionnaire was designed based on literature study and includes topics highlighted in different articles and books which have influence on virtual team performance. With this survey, researchers aim at gathering information on some basic issues regarding virtual teams. The questionnaire was divided into four categories: I) Elements of virtual work, II) Communication tool & usefulness, III) Collaboration tools & usefulness, IV) Effects of virtual work. A list of the topics is shown in Table 2.

– Goals & their attainment – Trust (different type of trust) – We-spirit – Fairness – Location – Mobility – Time zone – Electronic communication	– Diversity – Stress & well-being – Job demand – Temporaries – Communication (Frequency, Usefulness in teams*s work performance, Usefulness in getting to know each other)	– Collaboration (Frequency, Usefulness) – Work related information – Effects of virtuality – Personal information – Performance & effectiveness – Leadership

Table 2: Selected topics in the questionnaire based on literature study

Table 3 presents some of the statements which were used in the questionnaire based on the above topics. It was mentioned to the virtual the team members that by answering the questionnaire, they contribute to the research and development in project N which is important for contribution to the research and to the development endeavours in the companies.

Goal clarity: "My present goals in my team are completely clear to me"
Role clarity: "My responsibilities are clear to me"
Effort: "I try very hard to do my work in this team"
Interestedness: "I would describe my work as very interesting in this team"
Sense of competence: "I am satisfied with my performance in this team"
Trust: "Overall, the members of my team are very trustworthy"
We-spirit: "When I talk about this team, I usually say "we" rather than "they""
Leadership quality: "I am satisfied with the overall quality of the leadership in this team"
Fairness: "In our team everyone is treated with respect"
Job complexity: "My work in this team requires complex decisions"
Information load: "There is always more information available to utilize in this team than I can absorb"
Team satisfaction: "Generally speaking, I am very satisfied with this job in my team"
Stress: "Working in this team causes me a lot of stress"
Performance: "Our team achieves better results than required"

Table 3: List of some of the statements used in the questionnaire based on selected topics from literature study

All respondents were assured that their answers are confidential and the information will be used only for research purposes and no information revealing their identities will be published in any report or article. For each of the statements and questions in the questionnaire, team members answered by choosing the option that best corresponds to their opinion or by filling the inquired information in the box. All the eight team members, eight, responded the questionnaire. Each questionnaire approximately took 40 minutes to answer. Each team members answered the questionnaire in their local sites around the world.

5. RESULTS

The result of the questionnaire on elements of the virtual work was shown in Figure 2. Even though there are some difference between team N and mean of rest of the virtual teams, O, but no specific conclusion can be made due to; 1) culture of a team and organization have big influence on the issues such as team satisfaction and performance of the team, 2) leadership style and personality of the manager of the virtual team plays an important role in the issues such as fairness, trust, and we-spirit, 3) virtual teams are different based on their natures of the work, e.g. working in area of R&D, finance or marketing and 4) the difference can also be based on the period which a virtual team exists and works, e.g. in short term projects, 2-3 months, or in long term projects for many years. The above mentioned issues affect selected elements in the questionnaire. As result, it does not seem correct to compare different virtual teams with each other when their culture, leadership and nature of their work are different.

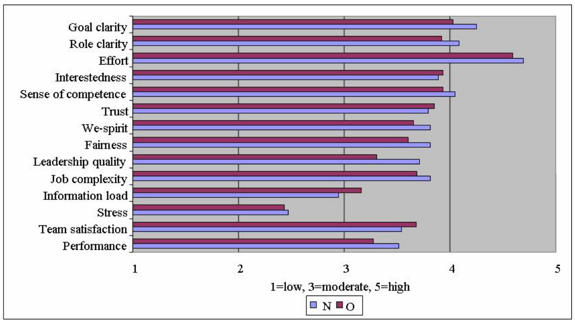

Figure 2: Result of the questionnaire on the elements of virtual teams

Figure 3, shows the result of the questionnaire on communication tool & usefulness. Based on many references, information technology tools are the skeleton of the virtual teams and their success. It is not all about communication tools; it is also about communication rules. Communication rules in the organization and the virtual team create a structural discipline on how to use different communication tools. As result, comparison of the different teams just based on communication tools may not bring good insights on how the tools are used and how to improve communication in virtual team.

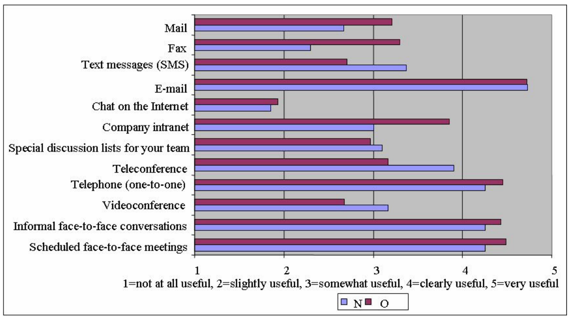

Figure 3: Result of the questionnaire on communication tool & usefulness in work

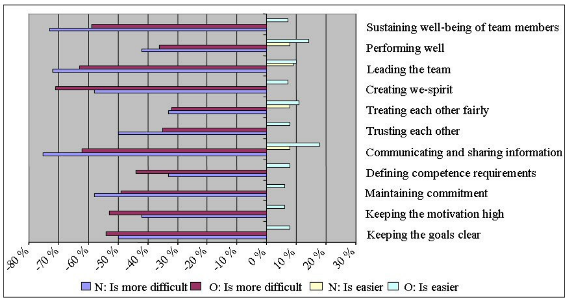

Figure 5: Result of the questionnaire on effects of virtual work, % of frequencies; compared to collocated work.

The same argument can be applied to the result of collaboration tools and usefulness which is shown in the Figure 4. Based on the observation it is concluded that collaboration tools and their usefulness not only depend on the collaboration tools and rules but also depend on the type and size of the team and culture of organization and virtual teams. As the culture of the selected virtual teams and their organization are different, no direct conclusion can be made and the differences may not result on major conclusion affecting the teams.

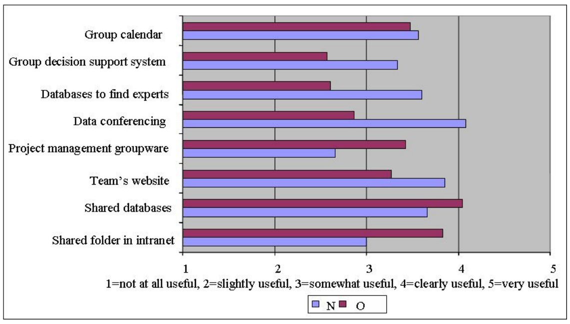

Figure 4: Result of the questionnaire on collaboration tools & usefulness

Result of the questionnaire on effects of virtual work, % of frequencies; compared to collocated-work is shown in Figure 5. Challenges of virtual team in comparison with face to face teams are already known. Comparison of such data between different teams can not lead us to any specific conclusion as there are many issues effecting the virtual work such as, nature of the teams and organizations or leadership.

6. DISCUSSION

The result of the questionnaire on elements of the virtual work highlighted that communication in any means requires clear rule and tools. Such common understanding of communication platform brings clarity of goals and roles which helps to build a common trust in virtual working environment. Communication rules and understanding of how and when to use the tools and for what purpose, brings the team members to a fair position in relation to each other which results in an increase fairness and create We-spirit. As result of a correct communication process, team can manage their job complexity better, which helps the team to reduce the stress level in the team.

Culture of the team and organization has big influence on the selected topics in the questionnaire on the elements of virtual teams. Cultural issue has impact on team performance, trust and stress levels in the virtual teams. Culture of each team depends of culture of organization, individuals and leadership style. If there is big difference in culture of teams, under research study, no direct conclusion can be made and the differences may not result on major conclusion affecting the team's performances.

Leadership style and personality of the manager of a virtual team plays an important role in the issues such as fairness, trust, we-spirit and so on. The leader's role in virtual team is fundamentally different than a traditional role of a leader. In traditional role of a leadership, the role emphasizes the leader as the boss, the distance to employees is marked, and the leader takes the responsibility for the group's action and gives it support in their work; however the leader is also the decision maker. In empowering leadership, the leader is more often in the background, ensuring the work team has all the necessary preconditions to do a good job. The empowering leader supports and encourages each individual where s/he has her/his learning potential at the moment. One of the biggest challenges in virtual team and organization is that the leaders still trying to apply traditional rules to lead the organization, especially in masculine cultures.

The empowering leadership seems to be the only successful way of managing virtual organizations. The empowering leaders have come more into focus in recent organizational setting, especially when teamwork is emphasized. This type of leadership has increased the possibilities for enacting leadership in new ways, incorporating IT as a management tool. Since the leaders physical presence is not always required in the empowering leadership, the practice can, and often is, more advantageous to execute using IT technology. Virtual team's leaders can also act as gatekeeper or interface, controlling the information transfer in the teams and use this as a tool of management. This might be the case for short term virtual team projects but in long term, leader should act to help the virtual team to function as a team, build trust and, encourage and empower information transfer between team members.

Virtual teams are different based on their natures of the work. Virtual teams in R&D have different needs and function differently in comparison to virtual teams in financing or marketing. The difference can also be based on the period which a virtual team exists and functions. Many issues such as trust may have very limited effect on a short term virtual teams in the case that in long term virtual teams, trust plays an important role. Size of a team is also a key factor in the nature of the virtual team. Smaller virtual teams may handle the problems and challenges differently in comparison to bigger teams. As mentioned above, nature of work, type, size and length of the projects makes virtual teams different from each other. Running questionnaires among random virtual teams with different nature may not help to draw any practical conclusion to improve any team's performances. For drawing successful conclusion one needs to be more careful to select virtual teams which have closer nature of the work.

The result of the questionnaire on communication tool & usefulness shows that information technology tools are keys for virtual teams and their success. But as mentioned before, communication is not only about tools but also is about rules. Most of the organizations make the communication tools available with basic communication rules. But it is the responsibility of the leader for each virtual team or even team members to create detail communication rules based on each team's need for success. As result, comparison of the different teams with different communication rules and tools may not bring good insights on how to improve communication in virtual team. The key challenge here is to find the key elements of virtual team which has effect on the performance of a team and/or issues such as trust, fairness, we-spirit, team satisfaction and so on. The same argument can be applied to the result of collaboration tools and usefulness. Result of the questionnaire on effects of virtual work, gives some insight about challenges of virtual teams in comparison with face to face teams. Many issues impact such challenges such as nature and culture of the teams and organizations or leadership style.

7. CONCLUSION

Based on the result of the study and also practical experience on leading virtual teams for last few years, it is concluded that, there are four major elements which characterize a virtual team and each of the major elements can have two dimensions which help to describe the elements in more detail. The four major elements and their dimensions are:

1) Communication:
   a. Tools: Virtual teams are using different electronically communicating technologies, tools, which facilitate different process on information, across organizational boundaries.
   b. Rules: Electronically communicating or storing technologies foster information sharing, and also help virtual teams to create a shared social reality. Such shared social reality, rules, should be defined as the set of norms, behaviors, and understandings the team members have about the task, work, and contexts for effective and successful collaboration.

2) Culture:
   a. Individual and Team: The global nature of virtual teams merits a discussion of possible cross-cultural differences. Individuals from different cultures vary in terms of their communication, group behaviors, values and traditions. Team's culture is created by combination of cultural background of individuals, leadership style of virtual team leader and organizational culture.
   b. Organization: Organizational culture is the personality of the organization, comprised of the assumptions, values, norms and tangible signs of organization members and their behaviors. Organizational culture can be looked at as a system having inputs, feedback from, e.g., society, professions,

laws, stories, heroes, values on competition or service, etc. and outputs or effects of our culture, e.g., organizational behaviors, technologies, strategies, image, products, services, appearance, etc.

3) Leadership:
   a. Traditional: The leadership role emphasizes the leader as the boss. The boss makes the final decision and puts him/herself in the center of decision making and also information transfer. Everything should be checked with him/her before any actions or decisions are made. Such leadership style and personality of the manager plays an important role in the issues such as fairness, trust, we-spirit and so on.
   b. Empowering: The leader is more often in the background, ensuring the work team has all the necessary preconditions to do the good job. Major roles of empowering leaders are coaching, taking care of dynamic of team, strategic planning and so on. The empowering leadership is the only successful way of managing virtual organizations.

4) Nature of work
   a. Type of Project: Type of project creates certain characteristics for work routines and environment, e.g. virtual teams in R&D have different needs and function differently in comparison to virtual teams in financing or marketing.
   b. Period and Size: Issues such as trust plays an important role in long term virtual teams in the case that it has very limited effect on a short term virtual teams. Problems and challenges in virtual teams increase when size of team increases.

The following model, shown in Figure 6, illustrates how four major elements are connected to the minor elements in each category, and how these four major and eight minor elements effecting environment of a virtual team on issues such as trust, stress, we-spirit , fairness, we-spirit, performance job complexity, team satisfaction, clarity and so on. As result, the study provided a model for better understanding and managing virtual teams and organizations. The model provides an in-depth and yet a simplified structure for major elements affecting virtual work environment. Through the case study, findings were challenged with international experiences and publication on the topic. The model may help to improve the performance of the virtual teams and create common understanding of the virtual team through the organization.

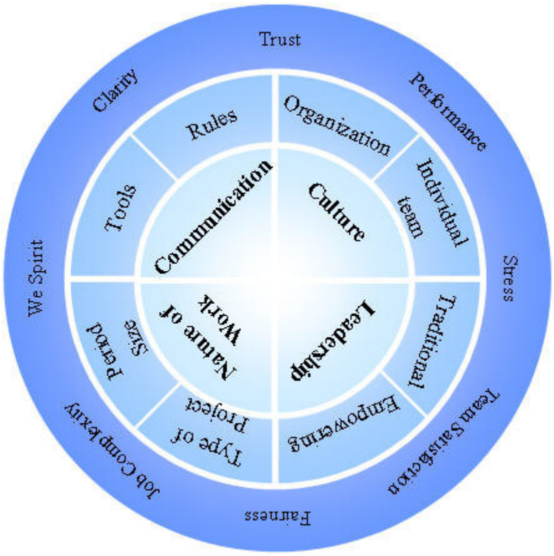

Figure 6: Model for elements effecting virtual teams or organizations

Following of the elements which is highlighted in the model help people involved in virtual teams or organizations to understand and keep track of elements which effect their daily work. Most of the virtual team members and leaders are not necessarily trained to work effectively in virtual teams or organizations. Their learning, basically, comes from their experience or some intensive courses. The most important role of a virtual team, team member, leader and even organization is to know characteristics of these four major and eight minor elements and make sure of a common understanding on these issues and their effect on the day to day work of virtual team.

As conclusion, it is also noted that in many articles, questionnaires and above mentioned measurements are used to compare different virtual teams. There are three main problems with use of such a set of questionnaires to compare different virtual teams; 1) the result depends a lot on the questions and definitions understand by individual, this might cause problem in multicultural virtual teams, 2) the nature and culture of the teams and organizations plays important role, such as communication rules, and finally, 3) most of the virtual teams, generally, scoring almost the same in this measurements, so no clear result can be obtained. For comparison of two or more virtual teams, it is better to select teams which have more similar characteristics of the four elements. This helps to apply lessons learned from one team to another or compare the result of different teams with each other to have a more practical conclusion.

This multi-case study has number of limitations and opportunities for future research, as with all case studies. The ability to make generalized conclusions is sternly limited in case study. Still, the fact that one case was scrutinized and the data was compared with mean value of more than fifty other virtual teams may reduce the risk of misinterpreting of a single case study. The practical experience and lesson learned from many years leading virtual team played an important role on building the conclusions. Construct validity of the study is limited because of usage of mean value of the results of questionnaire on fifty or more virtual teams as a source of evidence. Thus, in addition, the lessons from practical experiences are used to create the model. This way, the reliability and validity of the findings were supported and the model was generalized. In the future, it would be valuable to exercise the model, over some virtual teams to verify applicability and validity of it.

8. ACKNOWLEDGEMENT

The author gratefully acknowledges support of Niina Kokko from Helsinki University of Technology to help gather the data from questionnaire, Mahsa Asil for her contribution on gathering background information and Viswam Puligandla for his remarks to improve the article.

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A Gaming Laboratory to Study Distributed Collaboration Processes

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Abstract

Current events present many examples of situations where a fast and coordinated response is required from many and diverse organizations and stakeholders. Technology-mediated communication and collaboration may be the only option for getting things done in situations like these. There is a real need for research on the kinds of environments and processes that best support fast response on urgent tasks for virtual teams. The paper presents the development and initial test of a gaming laboratory to study such processes. The laboratory is adaptable to different kinds of situations. We discuss the design principles and implementation of the laboratory environment, along with lessons learned from the first experiences with it.

1. Introduction

Virtual collaboration is fundamentally different from collaboration in traditional co-located teams. Differences may be exacerbated in urgent or crisis situations where a rapid response is required. Such situations have been regrettably common in current events, and the interest in collaborative technologies and processes for these situations has grown.

The focus on collaboration processes is especially important, given the evidence of its essential nature from studies of both traditional and computer-mediated groups, e.g., [1], [2], [3], [5]. Indeed, the new field of Collaboration Engineering has emerged to focus on the development of sustainable and repeatable processes [7]. But much of the development of these processes has been in face-to-face environments, and their transfer to virtual teams – especially in situations requiring rapid response – remains a challenge.

Our response to this challenge was to create a laboratory and "gaming environment" for the design and evaluation of new Collaboration Engineering techniques and methods. This paper reports on the development and initial test of this laboratory.

2. Overview of the laboratory

We created an environment to study the design of virtual collaboration processes. Our goal was to create an environment that was realistic yet sufficiently controlled to allow for studying virtual team processes in depth. In addition, we were interested in situations that are more complex in nature than the typical studies presented in the literature. Most of the reported studies on collaboration tasks focus on divergence, i.e. brainstorming, tasks [4]. We wanted to be able to investigate other tasks, e.g. convergence or organization tasks, or combinations of tasks as well. The design of the environment took into account the following issues:

1. How should the task be developed?
2. What technology should be used?
3. What process objects should be provided and how should they be presented to the participants?
4. What process support needs to be provided to participants during execution of the task?
5. How should the gaming process be designed in terms of messages and scripts, from the perspective of participants as well as experimenters?
6. What data collection instruments need to be implemented?

The environment took the shape of a virtual laboratory that could host simulation games of varying degrees of complexity. The following sections address how the design addressed each of the questions above.

3. Detailed design of the laboratory

3.1. Task

We developed several guiding principles for the development of the task. First, the task should have a high level of realism, with a high degree of possibility of occurrence in real life. Second, the task must trigger the need for collaboration among members. We considered these two characteristics as essential, baseline needs. Third, the task should be able to be accomplished using commercially available software. Given that our goal was to get up to speed quickly, without having to engage in developing our own tools, this principle was essential.

Two other task design principles related to the specific phenomena that we planned to study in the first implementation of the laboratory – urgency and leadership. Thus, participants should perceive a sense of urgency when completing the task and the task should be amenable to the testing of different leadership styles or structures. Finally, given that we expected participants to come from classes related to Information Systems subjects, the task should have a high degree of relevancy to systems development.

The task we developed for the first study was a disaster relief situation based on Santanen [6]. Participants were asked to define the key requirements for a web-based crisis management system. The requirements had to be stated clearly enough so that system developers would have enough information to develop prototypes. Each team of participants consisted of five people, four of whom played a role that represented a different stakeholder involved in disaster relief while the fifth was an information systems developer.

3.2. Technology

Several candidate technologies were examined, including Blackboard, BSCW (Basic Support for Cooperative Work), Groove, GroupSystems, and Intranets.com. We evaluated each candidate on the extent to which the application demonstrated that it could:

1. Implement all patterns of collaboration (diverge, clarify, reduce, organize, evaluate, and build consensus [8]);
2. Provide easy access for all participants;
3. Be easy to use;
4. Be relatively low cost, or free; and
5. Provide a valuable experience for the student subjects, e.g., in terms of them being able to include their experience with the technology on their vita.

Table 1 shows our evaluation of the candidate tools. We chose Groove not only because it best met our criteria but it had not been previously used in a study of this nature, where the environment provided by the tool would need to be tailored for specific process objects.

Table 1. Technology evaluations

Technology	Complete Coverage of Process Objects	Easy Access for Participants	Ease of Use	Low Cost	Experience for Student Resumes
Blackboard	–	–	+	+	□
BSCW	–	+	–	+	□
Groove	□	+	+	+	+
GroupSystems	+	□	+	–	+
Intranets.com	–	□	+	+	□

Note: For each criterion, a “+” indicates a good choice, “□” indicates neutral, and “–” indicates a poor choice

3.3. Process objects: thinkLets

We define a process object, or thinkLet, as a codified process intervention that produces predictable, repeatable interactions among people working together toward their goals [8]. ThinkLets often encapsulate an expert facilitator's best practice for producing a known pattern in the behaviors of a group of people who collaborate. ThinkLets can serve as a pattern language for designing collaboration processes. In the context of our research laboratory, we referred to thinkLets as process objects that participants could select themselves or be advised to use as part of their collaboration process.

Several key design decisions had to be made with respect to the process objects in our laboratory. The first design decision concerned which process objects to make available to the participants. One option would be to provide multiple process objects for each pattern of collaboration. Although in theory this would be an interesting process to observe, the practical complexity of so many choices caused us to decide on presenting a single process object for each pattern of collaboration.

The following process objects have been implemented in the laboratory for each pattern of collaboration respectively. The title of the object is the thinkLet name [8].

1. Diverge: LeafHopper
2. Clarify: FocusBuilder
3. Reduce: BroomWagon
4. Organize: PopcornSort
5. Evaluate: StrawPoll (3 point)
6. Build Consensus: CrowBar

The second design decision was the extent to which we provided selection guidance on the specific process object that would carry out a particular pattern of collaboration. In the first study, we had a high level of selection guidance, because our interest was not in whether the participants understood that a specific thinkLet would support a particular pattern, but rather the sequence of patterns they chose. Thus, each Groove tool/process object had a template for how to carry it out and an instruction in the form of: "If you want to do something like X, consider Y."

The third design decision was the extent of guidance provided on the sequence of selection of process objects. In our first study, we provided no guidance at all, but clearly this is an aspect of the laboratory that is flexible to many different choices and setups.

Figures 1a and 1b show a sample of a process object implemented in Groove, including the different types of guidance that were provided.

3.4. Process support

A laboratory such as this requires extensive support for carrying out the gaming and experimentation process. We provided a help desk for the participants with the following attributes:

- A central email address to which questions could be addressed
- Support for both technical and non-technical issues
- Rotating staffing by one of the researchers, 17 hours every day of the week
- Almost instantaneous response to participants' questions
- Customized responses
- Logging of messages and responses to ensure consistency and support ease of handover from one shift to the next

The gaming process was supported by a detailed script that coordinated all the experimental procedures and that can be re-used independent of the specific task.

Finally, a set of messages was developed, some of which were for all members of a team while others were specific to a role. The messages served to trigger a sense of urgency and the pursuit of each role's own interests.

3.5. Data collection instruments

To enable analysis of the teams' collaboration process, the following data were captured:

- Full backups of the Groove environment at specified points in time, three times per day
- Group deliverable
- *Ex ante* questionnaire on understanding of the task
- *Ex post* questionnaire on demographics, satisfaction, shared understanding of outcomes, shared understanding of the task, and shared understanding with respect to the team

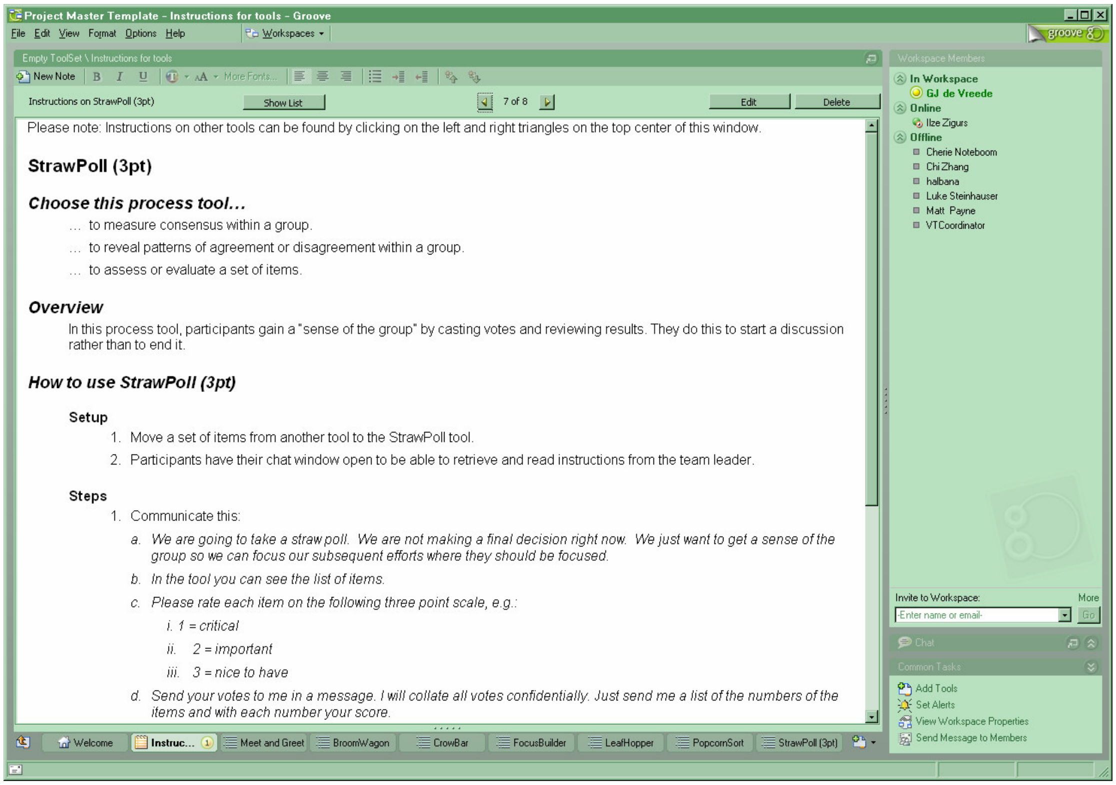

Figure 1a. Guidance for process object selection and execution

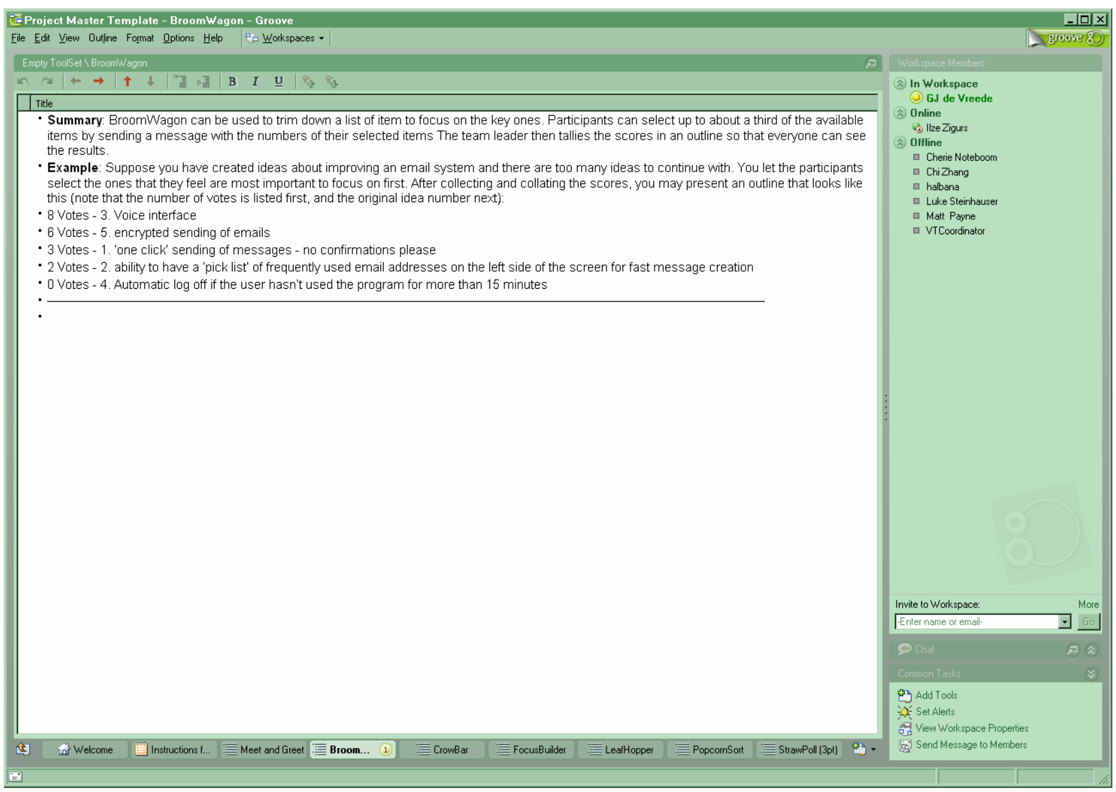

Figure 1b. Guidance for process object execution as a template in the Groove tool

4. Key lessons learned

To date, the laboratory has been used for a pre-pilot session, two pilot sessions, and the first complete study. The study involved fourteen teams of students from three different universities. Several key lessons came out of these initial experiences, related to the themes of timing and rhythm of the experience, participant perceptions and performance, instructions and materials provided, support requirements, and technology use.

In terms of timing and rhythm, we found that participants joined the game at different times and became comfortable with the tools at their own pace. Thus, it was hard to predict when team members would start functioning as a complete and synchronized unit. Participants need sufficient time to familiarize themselves with the tools – even if the tools are simple and well-documented tools. Only when everyone has a sufficient level of experience can team members really start to rely on each other. This persistent difficulty with new tools flies in the face of vendor promises of easy-to-use, "intuitive" interfaces.

It was a challenge to stimulate commitment throughout the experience. This study was conducted as an extra-credit exercise in the three classes at the three universities that participated. The exercise came toward the end of the semester, when people were more worried about getting their required assignments done and, even though they signed up for the extra credit with enthusiasm, they did not all "show up" for it with equal enthusiasm.

Participants had a wide range of reactions to the laboratory and the task. Several teams did not start working on the task until it was close to the deadline for the deliverable being due, and this practice discouraged pro-active participants. Frustration was evident in cases where participants were late to join their workspace or failed to join at all. Teams generally used a limited number of process objects, rather than trying the entire range of available process objects. Time management was poor in some teams. Potential solutions are to require interim deliverables and require creation of collaboration norms. As always, there is a tradeoff between imposed guidelines to ensure best practices in teams versus the desire to study what teams make of their own environment.

We provided extensive instructional materials and support. As a result, some participants perceived the task as too complex for them. This perception may have been triggered by the long instructions, and it may be better to provide instructions in separate "dosages" rather than all at once. This is an inherent challenge in providing an environment that is designed to be close to real situations. Potential solutions are "chunking" of the instructions provided, careful timing of the process, and management of expectations at the start of the project.

One of the most important aspects of this kind of environment is the reinforced lesson that continuous support is critical. The online help desk was crucial for progress of the participants. Prompt responses from the help desk gave the participants a feeling of being important.

In terms of technology, one appealing factor of the environment is that it provides a variety of communication channels for participants to use. These initial experiences showed the importance of synchronous communication (chat), which was used intensively for coordination and quick decision making. Groove also has the benefit of preserving conversations so that they can be retrieved for further analysis. Clearly, the chat function needs to be preserved, with a careful delineation of chat from the workspace where results are created and managed. However, one limitation of Groove is the lack of access to participants' messages sent via Groove instant messaging. For this reason, we were not able to analyze communication among team members that took place via instant messaging.

5. Conclusion

We have reported on the development and initial experiences with a gaming laboratory for the study of distributed collaboration processes. The laboratory was designed to be a more complex environment that would support studies that are more complex than a typical experiment. We detailed the many criteria that drove the design of different aspects of this environment, and presented lessons learned from its initial use.

The next stage of evolution of the laboratory will focus on enhancements in several areas. We plan to add additional process objects to allow participants a chance to choose from among different objects for the same collaboration pattern. Certain technical issues will likely be automated, to lessen the burden on the researcher. A library of questionnaires will be built, to provide a choice and consistency in measuring a variety of constructs for research.

In terms of technology, a database of frequently asked questions will help to reduce the support burden while making it easier for participants to adapt more quickly to using the tools. Alternative technology implementations may be tested.

With respect to research, future steps include additional studies of leadership styles and in-depth analyses of how groups design and execute their own processes in the light of the level of guidance provided. A more narrowly-focused comparison of different process objects for the same task is also easily implemented within the laboratory.

The vision of the project is to continue to enhance the gaming laboratory so that it provides an adaptable yet consistent environment in which to advance the study of collaboration processes, technologies, and the relationships among them.

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Silence, Attribution Accuracy and Virtual Environments:
Implications for developers and facilitators

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Abstract

This research studied virtual teams using an Internet based software tool to collaborate to explore the question: what virtual or physical environment constructs influence the attribution accuracy of silence among virtual team members?

Contextual information relating to team members was given to one half the teams and the other half was not given the cues. It was found that team members given the cues made more accurate attributions as to the meanings of silence than the team members using the software without the cues. Based on these findings we make recommendations to designers, facilitators and users of groupware tools.

1. Overture

Today, knowledge work increasingly is undertaken by virtual teams. By 2006, Gartner Research [5] predicts that eighty percent of knowledge work in global enterprises will be accomplished virtually. Virtual teams require electronic communication and collaboration technologies to bridge the physical gap among team members. While the basic concepts of communication mediated by technology remain the same as with face to face communication, the limitations of tools chosen for communication – and collaboration – present barriers and constraints to effective interaction. Silence in distributed teams can be a significant problem as members strive to assign meaning to the void. This research investigated the impact of providing information about remote communication partner context on the making of accurate attributions about the periods of silence that occur.

2. Can You Hear Me Now?

Most of us have experienced the frustration of a failed communication link. We send an email and wait for a response, and we question the reception of our message when we don't hear a response back within the time we deem appropriate. Who among us has not checked the connection on a cell phone when we are met with silence? While amount of time we are willing to wait depends on the technology we use and the type of communication involved, the issue of silence is common across media. The assignment of reasons for the silence (attribution) can have an impact on our willingness to put forth additional effort toward future communication. Positive attributions tend to lead to further efforts while negative ones will not [9]. With most current collaboration environments (groupware) there is a distinct lack of cues that would assist in making accurate attributions for unexpected behaviors.

Designers of groupware tools and virtual environments have been working to improve the feature sets of their products. But, without a deep knowledge of the constructs of computer-mediated collaboration to build upon, there is little reason to believe those products optimize virtual team communication. What is required for the development of optimized virtual environments is the development of rich causal theory explaining the constructs of virtual communication.

This research takes steps in that direction by exploring the attribution of silence in the framework of a causal model and then testing that model in a virtual environment. The outcomes of this research are a contribution to the development of communication theory and prescriptive requirements for virtual environment designers, facilitators and participants.

This study examines the relationship between theory and practice by uncovering new knowledge about the attribution of silence in computer-mediated communication and using that knowledge to inform the design of new groupware interface. This paper explores attribution accuracy in virtual environments; specifically: how the knowledge of contextual resources influences the accuracy of the attribution of silence in virtual teams. The foundation of this research is that the more team members know about the environment of their remote partners, the more likely they will be able to make accurate attributions. Work by Monson and Snyder [13], working with face to face dyads and covering a wide range of behaviors; found that the more information one has the greater the accuracy of attributions made based on that information. Failure to make accurate attributions can lead to wasted effort either by expending effort when there will be insufficient return or by failing to expend effort when there would have been a return. For example, Bob has not responded to my request for additional information because he is not connected to the communication channel. If I make an inaccurate attribution as to the reason for his silence and cut off all further collaboration the results of our efforts will be less than they may have been if I had made an accurate assessment. If I choose to try to continue the collaboration and his intent is to sabotage our labors, I have wasted my effort.

Silence is a problem even for communicating partners who are in the same location and even in such a situation understanding the reasons for the silence can be difficult. Adding differences in time and space to a communications context makes it exponentially more difficult (and more frustrating) to decide why the silence happened. Add technology to the mix and it is a wonder that we ever get it right!

Silence to a request for response most often takes one of four forms: an answer is unknown; an answer is known but there is reticence to providing it; there is active information processing (searching for an answer) and the resulting delay is seen as silence; an answer is not being provided for reasons of anger or hostility [7]; [6] . This is not an exhaustive list of the causes of silence and we could spend a great deal of time looking for them. Ultimately, however, it is the receiver's perception of the cause of the silence (attribution) that matters. For this research we are most interested in the following three conditions which can lead to silence: failure of the technology, lack of access to information necessary to respond and excessive environmental distraction. Because we are measuring the accuracy of the attribution perception, a discussion of attribution (the process of assigning meaning) is necessary.

2.1. Virtual Teams

Virtual teams are groups of people with a common purpose who carry out interdependent tasks across locations and time, using technology to communicate much more than they use face-to-face meeting spaces (adapted from [10]). Over the past two decades, several generations of synchronous and asynchronous collaboration tools have been built and tested to support virtual teams.

Affordable access to and improvements in collaborative tools have led to an increase in the number of groups working together despite significant geographic distance. Distributed collaboration helps organizations take advantage of inter-organizational and international opportunities and maximizes the use of scarce resources. This trend is likely to continue [1]; [3]. By 2006, 80% of knowledge work in global enterprises is predicted to be accomplished by virtual teams [5].

With the large volume of knowledge work expected to be done virtually, design and implementation of distributed collaboration tools has become a hot topic. New software is introduced on a regular basis, at least 15 new collaborative work environments in the past 6 months [22]. To improve the usability of these tools, design principles for collaboration tools have been suggested [15] including:

1. *Subtle difference in user interfaces can make large differences in group dynamics;*
2. *Group interfaces must be kept very simple;*
3. *Successful meetings require both structure in the group's approach to its task and flexibility in adjusting its approach as new information is introduced during the course of the meeting.*

These findings, from field and lab research, form molar guidance toward interface design. More focused laboratory studies – such as this one – enable more detailed design guidelines to emerge.

2.2. Attribution

Attribution is defined as assigning meaning to the behaviors of ourselves and others [9]. There is much discussion about how humans make attributions [9], [20], [8] but for our purposes it is only important to realize that all humans use attribution at a minimum to help them make sense of their world. The process of attribution can have many qualities but the one we are most interested in is accuracy. Attribution affects our feelings about past events and expectations of future ones. It also affects our attitudes toward other persons and our reactions to their behaviors.

Accuracy is defined for this research as how closely the attribution (and by definition it is a perception) comes to the "real" cause of the silence behavior. Failures of attribution accuracy can impact the quality of relationships within a group [16], the structure of a group, and how well a group performs [2]. Cramton's groups reported that it was difficult (and some of them reported it as a significant problem) to make the effort to expose the reasons for the silence, but that failure to make this effort adversely affected group cohesion [2]. Groups that made efforts either to avoid the misconceptions (e.g. by setting rules for silence behavior), or to clarify them when they occurred (by asking for more information as to the cause for the silence) were more satisfied with their experience and reported greater "groupness". All groups reported that silence was a significant problem and most reported that they found it difficult to exchange and track contextual information about their remote partners. This work on "mental maps" is continuing but has not to date addressed the specifics of environmental conditions [4]. The failures of attribution accuracy exist regardless of group's interaction type (by this we mean face-to-face; same-time, different-place; or different-time, different-place). Face to face groups have more opportunities to rectify the problems because they have more cues as to "actual" cause. Low attribution accuracy can be a greater problem for computer mediated groups because the opportunities to fix a bad perception can be few and require significant effort.

When groups are distributed both across time and space (different locations in different time zones) the mental maps about context become even more difficult to maintain. Attribution of silence has some interesting aspects in these situations. Lacking any information to the contrary, participants will tend to assume that their remote partner's context is similar to their own [13]. This is why so many facilitators working with distributed teams insist that members share biographical information or have a face-to-face meeting prior to beginning task work [11]; [12] [14]. Pictures, personal interests, expertise can all be important puzzle pieces in building a mental map about the communicating partner. This personal information can lead to improved trust and more favorable attributions (or at least more of a disposition to make favorable attributions when presented with unfavorable behaviors) [9]. In addition, when we believe that others are similar to ourselves we tend to make more favorable personal attributions and more negative situational attributions. Personal attributions are those that place cause with the person or a characteristic of the person. Situational (or environmental) attributions are those that place cause for the behavior with the situation, context or environment rather than with the person. Positive attributions are those that give credit while negative attributions are those that place blame [20]. So on our way to a causal model we make the following base assumption.

Assumption: The more that is known about a remote communication partner the more accurate the attribution that can be made about unexpected behaviors.

There are three antecedents to attribution: beliefs, motivation and information [20]. Beliefs and motivation are highly personal and may change from moment to moment. The most valuable antecedent to this research then is information (and it is the one we can do something about).

Proposition: Accuracy of Attribution is a function of Knowledge of Information Resources.

With no prior specific research on attribution accuracy and context information available the researchers relied on conversations with experienced virtual team leaders, facilitators and managers to suggest the three contextual constructs to build a new model based on attribution research of Thibault and Reicken [20]. Specific areas chosen involve the partner's ability to access information about group history and task related documents; the partner's level of distraction; and the partner's connection to the team workspace (communication medium, team tools, and supporting software). The level of distraction was reported as being the issue of greatest interest to managers of virtual employees (and even employees who only seemed virtual!).

As a beginning point, the researchers decided that these three areas would cover a sufficient cross section of information about context to be useful in investigating attribution accuracy. The figure below shows the causal Model of Contextual Influence on Attribution Accuracy (CIAA) derived from the literature and the proposition above.

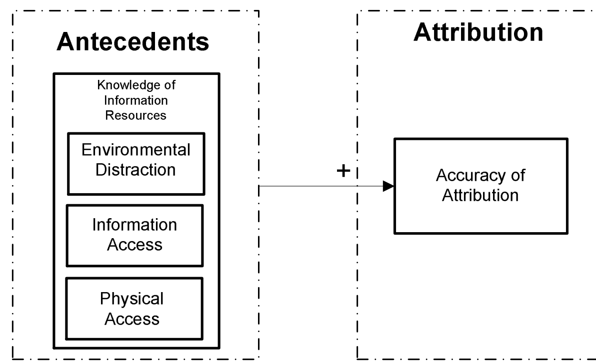

Figure 1 Model of Contextual Influence on Attribution Accuracy

From the model fall the following hypotheses:

H1: The participants who receive reference cues that highlight the importance of context will make more accurate attributions of behaviors influenced by context than participants who do not receive the reference.

H2: Participants who are provided a contextual cue regarding environmental distraction level of the remote partner will make more accurate attributions regarding partner silence caused by increased environmental distraction than participants who receive no such cues.

H3: Participants who are provided a contextual cue regarding remote partner's information access ability will make more accurate attributions regarding partner silence caused by difficulties with information access than participants who receive no such cues.

H4: Participants who are provided a contextual cue regarding remote partner's physical access to the communication medium will make more accurate attributions regarding partner silence caused by lack *of physical access to the communication medium than participants who receive no such cues.* ***[Note: Future research.]***

3. Methodology

We recruited student volunteers to participate in 3 and 4 member teams working on an intellective task (one that requires more than one person to complete). We used a modified Wheeler and Menecke School of Business task [21]. Team members were randomly assigned to one of several similar computer labs on campus (each on a different floor of the building).

All groups were supported with a web based groupware called Cognito™ (a product of GroupSystems.com, now named GroupSystems2). The software provided significant process structure to the decision-making process. The software presented all members with a common set of instructions, a brainstorming tool, a tool to reduce the brainstorm list (data was automatically moved from tool to tool), and a voting tool. All groups were also provided a back channel Chat function. In addition, each screen provided a panel containing an html page for each of the other group members. The html page for the treatment groups consisted of the name, avatar and cues representing each of the independent variables; information access level, and environmental distraction level.

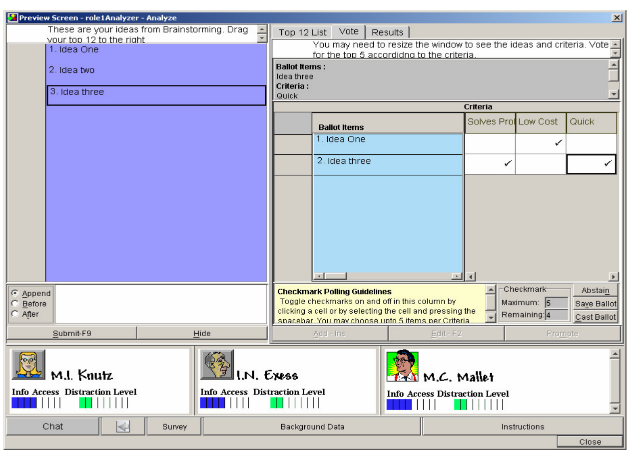

Figure 2 Screen with cues for treatment groups

For control groups the page consisted of the name and an avatar representing each of the other group members.

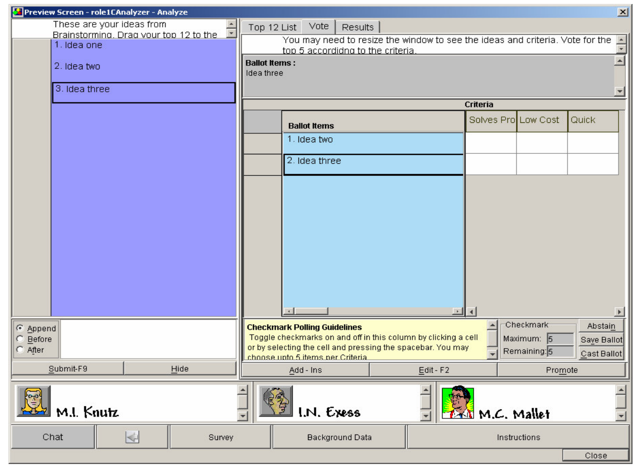

Figure 3 Screen without cues for control groups

The Information Access level cue is a blocked bar graph representing the perception of how accessible information is to the affected member. All members but the manipulated member had access to information that was online and information that was in printed form. All members received their Letter of Instruction in hard copy. The member with Low Information access received little or no information online but was directed to ask the facilitator for their data. The data was provided one table at a time by providing a URL to each table via a private chat session. Those participants with High Information were given all their data online.

For all participants, the software itself provided a base amount of distraction. The distraction level that was manipulated was above the base level. Low distraction participants were not asked to perform any additional work. High distraction participants were asked to participate in an additional chat session, perform a web search, and play solitaire. Non Manipulated participants joined only one chat session. While the teams were working on the task the related cues were modified (via preset timed manipulations) to give the appearance of change. For control groups the html control consisted of the name and an avatar representing each of the other group members. See Figure 3.

Post session, each participant was asked to complete a survey regarding their experience.

After the exercise all participants were asked questions regarding their attribution of the periods of "silence" from their remote partners. The three attribution specific questions are listed below:

If a team member was silent when a request was made for information, what did you think was the reason for the silence?

If a team member didn't respond, what did you think was the reason for the failure?

When members didn't participate as much as you thought they should was it because:

The potential responses were all worded similarly. These responses are not ordinal (meaning that the values assigned to the responses have no ordered numeric relations to one another). This makes the data qualitative in nature and impacts the type of statistical analysis available. Typical responses are listed below in figure 4:

they didn't receive the request or couldn't respond because the technology failed
they received, but didn't understand, the request
they couldn't get the information necessary to make a response
they didn't want to respond
they were too distracted to respond

Figure 4 Responses to attribution questions

The first response represents a physical access attribution; the third, an information access attribution; and the last a distraction level attribution. The second and forth responses represent personal/cognitive and trust/benevolence attributions respectively.

Since only the beta version of the software was available the researchers were not able to implement the physical connection cue and so the hypothesis relating to physical access was not tested.

In addition to the attribution questions a number of trust and demographic questions were asked. For a full discussion of the development of the model, questionnaire instrument and statistical analysis see [18].

4. Results

The dependent variable in this research was attribution accuracy. That is, were the participants accurate in making an attribution about the meaning of silence for their virtual partners? No specific partner was singled out although only one team member per group was selected for a treatment (low physical access, low information access, high distraction or a combination according to the treatment plan). Since the actual reason for the silence was manipulated in the study, there existed in each case a correct answer to the reason for silence. Therefore, it was possible to measure the degree of accuracy of the attributions made. A total of 21 groups were conducted with a combined total of 76 participants.

4.1. Hypothesis One: Any Cues

Essentially, Hypothesis 1 states that participants whose software included the cues will make more accurate attributions than the control groups which did not have cues. A percentage of correct attributions was calculated for all groups. Overall, participants not receiving cues were correct 35.2% of the time; while those receiving cues responded correctly 55.6% of the time (significantly better than would be expected from randomly correct responses).

The chi square p value ($p=0.0009$) indicates significance at greater than a 99% confidence level to reject the null hypothesis and accept H1. With this significance level we then conducted an odds ratio analysis to help expose the strength and direction of the association (see [18] for a discussion of the statistical procedures used in this study). A θ value of 2.441 tells us that the association is positive (i.e. the presence of cues increases the likelihood of a correct attribution) and that those with cues are nearly 2.5 times as likely to make a correct response as those without cues to make a correct response.

The rest of the hypotheses explore the specific contextual cues. All results are shown in Table 1 for easy reference.

4.2. Hypothesis Two: High Distraction Level

Some group's members experienced a high distraction level as their only manipulation; in other groups members experienced a high distraction level and low information access. Chi square tests show that when high distraction level is the only treatment we get significance at over 98% ($p=0.0165$) and when combined with other conditions, distraction increases in significance ($p=0.0002$).

The odds ratio results reflect the chi square test showing a much stronger association in situations with more than just high distraction with a value of greater than 5 times the likelihood of a correct attribution with cues than without cues. The high distraction only groups also showed positive association with still strong results of 3 times the likelihood of a correct attribution with cues. Therefore, we conclude that the null hypothesis can be rejected and H2 can be accepted.

4.3. Hypothesis Three: Low Information Access

Some group's members experienced low information access as their only manipulation, in other groups members experienced low information access and high distraction level. Chi square tests show that when low information access is the only treatment we get significance at over 99% ($p=0.0001$) and when combined with other conditions, distraction remains significant (p=0.0017).

The odds ratio results reflect the chi square test showing a much stronger association in situations with more than just low information access with a value of greater than 38 times the likelihood of a correct attribution with cues than without cues. The low information access only groups also showed positive association with still strong results of 3 times the likelihood of a correct attribution with cues. Therefore, we conclude that the null hypothesis can be rejected and H3 can be accepted.

Table 1 Summary of Chi square and θ test results

Treatment	n	Chi - p	Accept H_0	θ
H1: Cues	228	0.0009	reject	2.441
H2:HDL only	21	0.0165	reject	3.150
H2:HDL all	93	0.0002	reject	5.046
H3:LIA only	33	0.0001	reject	38.500
H3: LIA all	111	0.0017	reject	3.400

Based on the support of all tested hypotheses the Model of Contextual Influence on Attribution Accuracy appears to hold with the expected exception of Physical Access which was not fully tested.

5. Demographic results

As is routinely done in a study of this type, we collected demographic information about our participants in order to demonstrate external validity back to a larger population. We also checked for anomalies among our demographic subgroups and found surprising results that may shed light on virtual environment design issues.

Our subject sample of 68% male, 32% female participants closely maps to the school's student population (75% male, 25% female.) A chi square test was performed on gender and attribution accuracy. The p value for gender and attribution accuracy (< 0.001) suggests a relationship between gender and attribution accuracy regardless of cues. This led us to explore the distribution of gender across treatments. Women had an accuracy percentage of just over 40% regardless of cues while the men registered 29.4% accuracy regardless of cues. The model provides no explanation for this anomaly. We discuss some conjectures in the discussion section and suggest research to surface the causes of this phenomenon. Additional analysis of the data is underway to explore the types of attributions made by each gender. Preliminary study indicates that males attributed the silence to either lack of information access or distraction 60% of the time. Females were very astute at identifying distraction (being correct nearly 70% of the time). Clearly gender distinctions will make fascinating future research.

Investigating age also surfaced interesting anomalies. Average age of participants was 27.39 years (range of 19 to 52 years and s.d. of 7.363 years.) This is consistent with use of both graduate and undergraduate students.

Checking for a relation between age and attribution accuracy (regardless of cues) we split the participants at the median age (splitting the group into equal halves at age 26) we found a significant chi square p value (p=0.00000123) and a very strong Odds Ratio of 3.922: showing a positive association with lower age. It appears then that younger participants are more likely to make an accurate attribution, regardless of cues.

This suggests that something younger participants experience may be aiding their attribution accuracy. We surmised that perhaps younger participants are more inclined to spend time in virtual environments, so we explored the relationship with groupware experience.

The area of groupware experience was addressed with one general and four specific questions. The general question asked for the number of times that the participant had been a member of a virtual team (one that primarily uses technology for group work rather than face to face meetings, i.e. different place). The general idea was that those with more experience would make more accurate attributions. The specific technologies used were further exposed by asking about experience with:

- real-time chat tools (synchronous, i.e. same-time),
- e-mail (asynchronous communications, i.e. different time),
- Listserv/bulletin board tools (asynchronous communications), and
- complex groupware (GroupSystems, PlaceWare, LiveMeeting, etc. i.e. either synchronous or asynchronous but including multiple integrated tools like brainstorming, shared white board, group writing and voting).

Nearly one-third of the participants had no experience with virtual teams (25/76). Comparing the attribution accuracy of this inexperienced pool against the experienced pool yielded no significant difference. (p=0.3438) An exploration of the specific experience questions yielded similar results.

We were surprised by both the gender and age differences surfaced in the study. While the age difference was not directly explained by experience in virtual environments, it remains plausible that a life experience that is shared by the younger generation is contributing to differential performance in collaboration environments. It is unclear exactly what this life experience is – or whether it is simply a learning curve difference – but this anomaly merits further investigation.

As to the gender differences we surmise that it is possible women – either through genetics or social conditioning – possess greater non-verbal intuition skills than men. We did not test this conjecture and suggest it merits future research.

6. Discussion and Future directions

The results of the study lend support to the construction of our model of Contextual Influence on Attribution Accuracy and several additional insights are gained for designers of virtual environments and collaboration tools.

6.1. Implications for tool development

Virtual team tool designers can be informed in several ways by the findings from this study.

6.1.1. Physical access cues. During our pilot work we gathered preliminary data that suggests the presence or absence of physical access cues were least likely to provide strong influence on attribution accuracy. Since we were unable to fully test this premise, it remains an open question. Our experimental manipulation for reporting information about physical access did not work properly and therefore the results of that part of the study are not reported above. Building physical access cues is relatively easy; a cue should appear any time the participant was logged into the virtual environment software and either change or be removed when the connection to the software was lost. This cue is already incorporated in most groupware. The cue could also reflect additional factors such as connection speed and connection type.

6.1.2. Distraction level cues. The data on distraction level validates anecdotal information received on the importance of knowing what else is taking up the time of remote partners. In talking with various students, administrators, and corporate virtual team members the unknown distractions are a prevalent and distressing fact of remote communications and are considered a major contributor to silence behaviors.

Several of the participants noted that a level distraction was added to by the software itself. That is to say, there may be a relationship between distraction level and learning curve. Giving team members the opportunity to become familiar with the software could reduce the base level of process losses associated with the software (reflected as distraction). The long-term implications of this cue are still under study as the cue could become more salient as the noise of the software no longer distorts it, or it could become less salient as participants feel less overwhelmed. Of all the cues, this is the one with the most potential to impact group performance. There are several ways to operationalize the distraction level cue.

- Self identification - each team member would set the distraction level for each project or session based on what else was going on in his/her environment.
- Modified self identification – each team member would set a hierarchy of interrupt protocols. Aspects of the selection would be represented to team mates.
- Keystroke counting - the software would count the number of key strokes to give a gauge of team member activity.
- Open application counting - the software would count of the number of open windows on the desktop of team members.

The problem with the last two is that they take into consideration only distractions directly connected to computer use. There are, of course, a significant number of distractions that have nothing to do with the computer or its applications (other people, non-computerized work, face to face meetings, thinking time, etc.). The issue with the first is that it requires trust that the team member will be honest in setting the values to reflect real conditions.

Other, and perhaps ancillary issues, are raised. For example, should the variables be updated or set at the beginning of each session or for the project or do we update the cue at shorter intervals? And if so, how often should the variable update?

Other design considerations related to distraction level include:

Avoid unnecessary graphics, pictures, and video. Or, design the environment so that richness of graphics delivered is dependent upon the bandwidth of each team member. Many distant participants will have limited bandwidth for sending and receiving information. Even if their link to the Internet is normally fast and robust, the link could be slow on any given day due to conditions outside the control of the meeting leader [19].

Focus video on artifacts rather than talking heads when appropriate. For many structured activities, virtual team members would rather view shared information than see faces of team members. This may be an artifact of the poor quality of most video conferencing images today (with video conferencing of sufficiently high quality to read facial expressions this preference may change).

Use video only during process stages where it is beneficial. It may be beneficial to save the video channel only for transitions between process stages. During many structured virtual activities the video channel has been shown to be superfluous to the needs of distributed individuals [19].

One last comment on distraction is that it may not be as big an issue for younger participants than for older ones. Youth today are constantly bombarded with significant distractions and have become quite adept at multi-tasking and this may prove to be a non-issue for them. Research on this continues.

6.1.3. Information access cues. The information access variable provided us with the strongest Odds Ratio of 38.5. This was actually a little surprising, because we had expected the strongest relation to be with distraction level. It may be that the lack of information access was made more obvious by other cues such as lowered participation, lower levels of sharing. Interestingly, none of the low information access participants actually stated that they didn't have access to the information. Other issues associated with this cue include:.

Is it *all* information? One of the things not clear from this research is what type of information access is most important. For this research information access was broadly defined to include both the data for the task and any group history. Additional research should be done to distinguish between the types of information, its access and the impacts on attribution accuracy.

How would improved information sharing techniques impact this variable? For this research participants were each given different data. It was up to each one to decide how best to share. One of the comments received from participants was a complaint about the difficulty of sharing information within the software, claiming that in their real world work environment, shared documents were common place. This still doesn't change the fact that even in real-world environments each team member brings different information to the project and still chooses which of their unique data to share; this is the basis for much of the knowledge management research. There are several ways to operationalize the lessons about information access cues:

Encourage use of process support channels. Designers should make available process support channels such as chat windows and question queues to manage team hygiene without polluting the primary task channels. It will often be advisable to establish a communication channel specifically for process communication to allow for such interactions in parallel with on task communications. With process channels individual participants can ask questions of the team leader, side conversations for coalition building can occur, follow-up instructions can be issued, and social chatting can occur, all without disrupting group process. These back channels do, however, impact the distraction level issue. Each additional channel adds to the cognitive load of the participant.

Use process support tools to focus group attention on specific information. When the groupware in use contains tools such as shared cursors and matched views, facilitators should make heavy use of these features to help ensure that distributed team members are focusing on the same data [19].

However, do we create a cue for each type of information? The question then becomes how many cues are too many (adding to the distraction level). This research had two obvious cues (information access and distraction level), if the information access is split, what are the implications (does it improve accuracy or simply overwhelm the user with data overload)? It seems that there is a balance that must be found between enough information about remote partners and too much.

6.2. Implications for facilitation techniques

Although the data supports the use of cues to improve attribution accuracy, the question of whether or not simpler facilitation techniques can be used to improve the salience of the same cue-type information among virtual team members has yet to be explored. Can we accomplish improved attributions by making the sharing of this type of information more important through training and periodic reminders rather than changing the software? This should be an additional area of study. The researchers have spoken with a number of virtual team facilitators who have developed several of these techniques. These include easily accessed bios that include context information (the question becomes how to make it salient at the appropriate time); the inclusion of "response time guarantees" that tell partners what they can expect via various communication channel (i.e. 5 hour response to fax, 24 hour response to email and 1 hour response to voice mail). Anecdotal data suggests that some of these techniques can be effective if incorporated into the group's norms. Recent work by Intel uses multiple layers of data accessed through a simple click thereby allowing the user to zoom to the level of detail on partner context as required.

6.3. Implications for participants and business

The nature of first tests of a causal model necessitated the use of controlled experiments. Based on some of the demographic data there are implications for team composition. With the gender data, it would seem the addition of women to virtual teams would improve attribution accuracy thereby reducing group problems resulting from.

6.4 Limitations

This experiment used student subjects and as such may reduce the generalizability of the findings. It should be noted however, that nearly 60% of the participants were graduate students and approximately 85% of graduate students at the subject university are full-time working adults; approximately 70% of the undergraduates are also working. This should improve the generalizability to working adults. Additionally, the subject university makes significant use of online collaboration software for instruction and coursework.

One of the base assumptions of the experimental design was that there were no direct interactions between treatments (i.e. high distraction level and low information access being different from high distraction level or low information access). Regression analysis was conducted and interactions were determined to be insignificant.

The model developed consisted of three information antecedent constructs, physical access, information access and distraction level. Only two of these were fully tested and the impact on the validity of the model is unknown but suspected to be quite low (based on pilot data).

7. Conclusion

This research sought to answer questions relating to improved attribution accuracy for silence behaviors of distributed communication partners by utilizing information cues within the collaboration environment. The results indicate cues for information access and distraction level improve attribution accuracy. Making more accurate attributions can lead to increased efficacy for group members (improved effort expenditures), increased trust and greater "groupness."

Groupware designers can use the results to improve the design and construction of collaboration environments and facilitators can incorporate the knowledge into improved guidelines for distributed groups.

Future research should be conducted to include longevity studies, fully operationalize the cues and conduct tests as to the physical access cues implications.

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