ENGINEERING COLLABORATION TOOLS SELECTION

FOR THE WOODS EQUIPMENT COMPANY

By

Gilbert A. Blomdahl

A Research Paper

Submitted in Partial Fulfillment of the
Requirements for the
Master of Science Degree in
Management Technology

Approved for Completion of 2.0 Semester Credits
INMGT-735-280 Problems in Management Technology

____
Dr. Jerome E. Johnson Jr., Research Advisor

The Graduate College
University of Wisconsin-Stout
December 2001

The Graduate School
University of Wisconsin-Stout
Menomonie, WI 54751

ABSTRACT

Blomdahl Gilbert A
(Writer) (Last Name) (First) (Initial)

Engineering Collaboration Tools Selection for Woods Equipment Company
(Title)

Management Technology Dr. Jerome Johnson Dec 2001 33
(Graduate Major) (Research Advisor) (Month/Year) (No. Of Pages)

APA
(Name of Style Manual Used in this Study)

With Corporate America's consolidating efforts of bringing together organizations through takeovers, mergers and buyouts, more and more corporations are investing in ways to share information between different locations. Headquartered in Rockford, Illinois, the Woods Equipment Company is comprised of divisions in nine separate locations. The problem of this study is to select engineering collaboration tools for the Woods Equipment Company to increase cooperative exchange of resources, information and ideas among a team of colleagues focused on engineering projects. This research is directed towards helping Woods search through the maze of collaboration tools available in the market today and make the best possible selection for its needs. A variety of collaboration tools have been considered ranging from telecommunication, email, group ware, data conferencing, application sharing, video conferencing and shared 3D virtual reality.

TABLE OF CONTENTS

Acknowledgements

Many thanks go out to the following people who provided immeasurable help during this project:

Aaron and Kayla, my children for being so very understanding and helpful about the time their father needed to spend on this project;
Floyd & Helen Blomdahl, my parents for their support and proof reading of the paper; Dr. Jerome Johnson, my advisor;
Joseph Kovacich, CF Woods, engineering manager for obtaining additional related information and allowing the testing of collaboration tools during working hours;
Jim Reeves, Woods IS manager for technical information about Woods networks;
Steve Schriner, Woods operations manager for allowing cooperation of Woods for this project.

Chapter I

Research Problem and Objectives

Introduction

Re-engineered corporations had fueled much of the United States most recent economic growth. Companies were re-thinking ways to work, taking advantage of advances in communications and industrial technology, eliminating costly layers of management and going global to get new customers. This re-engineering, coupled with other factors, had led to investment in new high-efficiency, high technology equipment, as well as new plants, warehouses and office facilities. Meanwhile, corporate mergers were taking place at an astonishing rate. Many of these mergers were instigated by a desire to consolidate two or more companies, cutting employees who were in duplicated jobs and thereby creating more efficient, more profitable firms. However, the biggest cause of change was the tidal wave of new technology that was revolutionizing the workplace at all levels. Companies that were prospering were using new technology to communicate with customers, automating back office tasks and industrial operations to push ahead with research and development (Plunkett, 2001).

As corporate America mergers take place bringing together organizations, more and more corporations have to invest in ways to share information between different locations. Product development going global into multiple markets require design teams to work across geographical and organizational boundaries. Increased outsourcing involves an entire network of suppliers with increasing need for collaboration. The Woods Equipment Company (Woods) is comprised of nine companies separated by location. Woods is in the state of consolidation looking to create a more efficient and more profitable firm. At the same time Woods is investing in new product development. Woods is also looking to broaden its market with its network of independent dealers. The combination of consolidation with R&D and expanding markets is requiring Woods to look for new modern ways to communicate engineering ideas throughout the company. This research was directed towards selecting new engineering collaboration tools for Woods. In order to do so, various factors had to be accounted for and thoroughly weighed and analyzed, such as features available, costs associated, hardware required, to name a few.

Research Problem

The problem of this study was to evaluate engineering collaboration tools for the Woods Equipment Company, providing recommendations for their selection.

Research Purpose

The purpose of this study was to help the management of Woods Equipment Company select the appropriate engineering collaboration tools, through the maze of collaboration tools available in the market today, selecting the best solution to achieve Woods goal as indicated in Figure 1, to improve Profits.

Research Need

The Woods Equipment Company is a leading full line manufacturer of attachments and implements for the agricultural, turf & grounds care, and construction markets. The products are primarily sold through a network of independent dealers throughout North America, marketed under the brand names of Woods, Dual, Alloway, Gill, Gannon, and Wain Roy, Alitec and CF. The products are built in towns like Oregon-Illinois, Sioux Falls-South Dakota, La Mirada-California, Fargo-North Dakota, Hubbardston-Massachusetts, Brownsburg-Indiana, St. Paul-Minnesota and Schofield-Wisconsin. This study was conducted out of the Schofield Wisconsin facilities, which make Central Fabricators or CF-Woods product line of construction equipment attachments such as excavator buckets for all OEM makes, and models.

The design teams at each of Woods facilities had some similar and even competing products so there were many common tasks performed by each, such as CAD data creation and new product development at each location. The teams met on a regular basis with top management to go over corporate plans. The teams also communicated by Telephone conferencing on a weekly basis to interact with one another in a more technical manner. The corporation had recently decided to move some products lines to other plants consolidating the products to common areas or locations but still engineering new products at various locations. The telephone bill for the weekly engineering conference calls was costing the company over $5000 a week, so Woods was looking for cheaper and better solutions for communicating engineering ideas, hence this study.

Research Objectives

1. Identify the requirements for collaboration tools for use in engineering at Woods.
2. Determine the various engineering collaboration tools and features available in the market today.
3. Assess and choose the engineering collaboration solution that best meets Woods requirements.

Research Model

The methodology of this study was descriptive, focusing on identification of functional requirements of Woods, collaboration tools features available today, and the best solution to communicate engineering ideas within Woods. A system analysis diagram shown in Figure 1 describes Woods goal and the research steps needed to achieve it were as follows:

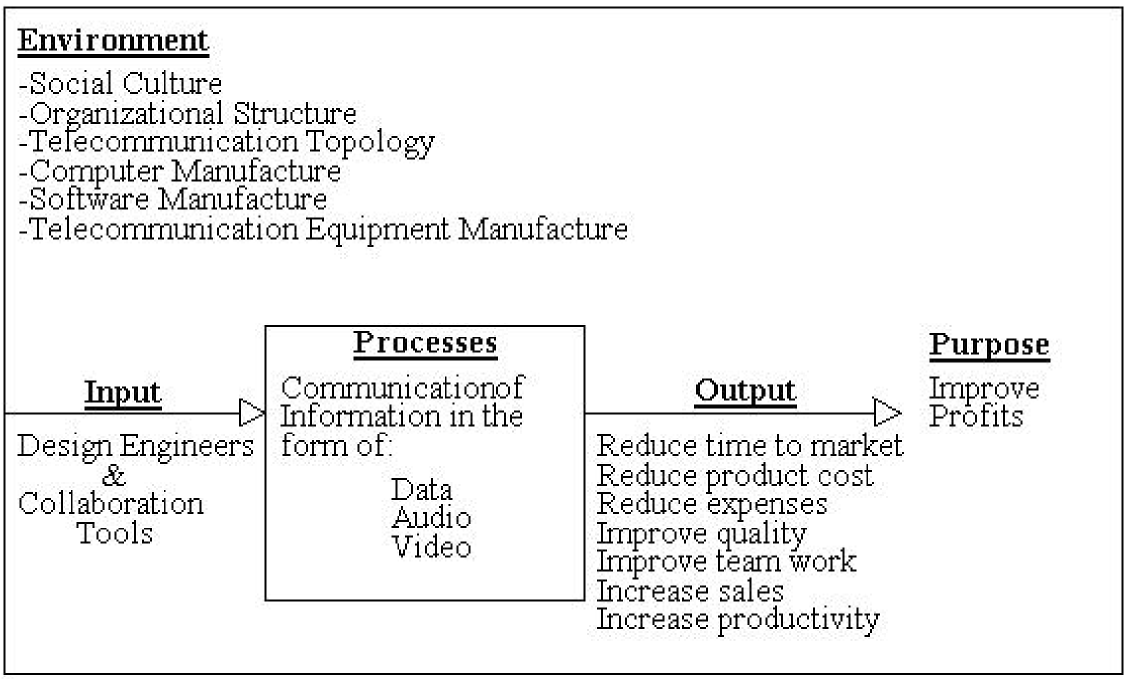

Figure 1: Systems Analysis Diagram

Research Steps

1. Identified and evaluated the requirements of Woods Equipment Company.
2. Identified the vendors dealing with collaboration tools presently.
3. Searched Web sites of vendors for the necessary information on the collaboration tools.
4. Gathered secondary data on various features of collaboration tools like file sharing, application sharing, 3D virtual white board sharing, audio, and video available in collaboration tools.
5. Compared and analyzed information received with respect to the requirements of Woods.
6. Selected the most suitable collaboration tools (between three to five tools) for actual demonstrations.
7. Identified the most appropriate system by a process of elimination, considering the trade offs between high costs and advanced features.
8. Presented the results, clearly mentioned the features available with the tools, and also the drawbacks due to rapid technology advances.
9. In addition to the secondary data, considerable amount of time was spent analyzing the various features offered by the multitude of collaboration tools at that time.

Definitions

Application Sharing - Running an application on a local system and allowing remote users to see and control the application. Any application that can be executed can be shared.

Bandwidth – A frequency measurement of the amount of information that can flow through a channel, expressed in cycles per second (hertz) or bits per second (bps). The higher the frequency, the higher the bandwidth.

Data Conferencing – The interactive exchange of information between two or more computers.

Desktop Videoconferencing (DVC) – Video Conferencing on a personal computer.

Firewall – A security mechanism on a network that prevents unauthorized access to the network. The firewall analyzes network packets for packet type (protocol port), and source and destination addresses. A firewall can be configured to prevent a certain type of packet from accessing the network.

Ethernet – The most widely used local area network (LAN) technology. Ethernet is a passive cable interconnecting all active network components.

Internet – The collection of networks and gateways that use the TCP/IP protocol suite and function as a single, cooperative, virtual network.

Whiteboard – A common area where participants can draw, collaborate, and share ideas.

Limitations

The limitations of this study were:

1. The implementation of engineering collaboration tools was relatively new for most companies who had it. As a result, there may have been a lack of information to share on the subject.
2. The number of companies that had implemented engineering collaboration tools was so small that the amount of information pertaining to the subject was limited.
3. Engineering collaboration tools were developing so fast that this study may not provide the latest information from the best sources. By the time someone wants to use this study new development may come up. This study should only be used as a guide or starting point for developing more knowledge of the subject.
4. This paper was limited to engineering and not to the organization as a whole; therefore this research may be incomplete for a company wide implementation of collaborative engineering.
5. This research was limited in scope to selecting collaboration tools and did not go into the process of implementation.
6. The selection of engineering collaboration tools is only 20 percent of what makes collaborative engineering work in an organization. The other 80 percent is people.
7. The evaluation of actual performance of all collaboration tools by way of demonstration was beyond the scope of this research.

Assumptions

The Assumptions of this study were:

1. Equipment for demonstrations with engineering collaboration tools would be made available when needed.
2. The completion date for the study: Dec 21, 2001.
3. Vendor information was believed to be reliable.

Company Background

Headquartered in Rockford, Illinois, Woods has been around since 1946. Leonard Keith and Mervel Wood built the first successful tractor-mounted rotary shredder. Woods manufactures mowing, cutting, landscaping, and material handling equipment. The companies in the Woods family have over three hundred years experience building tractor-powered tools. Dozens of patents and hundreds of products have come out of that collective history. The Woods Equipment Company Website is at www.woodsonline.com.

Since 1945, DuAl manufactures material handling tools for farming and commercial applications and tractor-mounted loaders.

Beginnings in 1946 as a blacksmith shop in Caldwell, Idaho, Alloway Manufacturing manufactures specialty agricultural equipment, shredders and cultivators for farmers nationwide. Alloway is an innovator in sugar beet defoliation.

Roy Gannon patented the Earthcavator, the world's first scarifier scraper, in 1948. Gannon Manufacturing manufactures excavator and tractor-loader-backhoe attachments and industrial-grade material handling components.

In 1946, Frank and Edwin Gilreath invented a landscaping tool called the Gill Pulverizer and formed a company, Gill Manufacturing. Gill manufactures pulverizers, seeders, core aerators, and other tractor-mounted grounds care tools.

Victor and Ella Baert established Baert’s Metal Products in 1951. In April of 1997, Woods Equipment Company acquired Baert’s. BMP products include excavator buckets, bucket clamps, quick couplers, hydraulic vibratory plate compactors and bucket thumbs.

In the 1940's business partners Vaino Holopanien and Roy Handy attempted to use a rear loader with the bucket turned around as a trenching machine. In 1947 the first all hydraulic backhoe was invented and patented mounting the boom, dipper stick and bucket to be swung independently of the tractor starting a worldwide multi-million dollar industry. In 1948 the first all hydraulic backhoe was sold to Connecticut Light and Power Company. Wain Roy now manufactures quick coupler systems, grapples and specialty buckets.

In 1999 Woods acquired Central Fabricators, Inc., Alitec Corporation, and Tru-Part Manufacturing, known as TISCO. Central Fabricators based in Schofield, WI, manufactures a line of pin-on excavator buckets. Central Fabricator’s has expertise in excavator attachments and strength in the Midwest construction market.

Alitec, based in Brownsburg, IN, manufacturers hydraulic powered attachments for the skid steer market. Alitec’s line of skid steer attachments, including cold planners, vibratory rollers, augers, stump grinders, rock wheels, and tillers.

Based in St. Paul, MN, TISCO is a distributor of replacement parts serving the agricultural market. Since 1937, the Tractor Implement Supply Company has been manufacturing and distributing "All Makes" agricultural equipment parts. Regional distribution centers are located in St. Paul, MN, Richmond, VA. Nashville, TN ,Dallas, TX , Sacramento, CA , Oregon, IL.

Chapter II

Related Information

Engineering Collaboration

Gartner Group Inc., a Cambridge Mass., technology-consulting firm first coined the phrase “Collaborative Commerce” (or ”c-commerce”) in August 1999 that predicted that collaboration would become the dominant business model by 2002. Dot-coms and e-commerce solution providers quickly rewrote their product descriptions and press releases to include collaboration as a key feature of their offerings. Collaboration, such a broad term and the advanced pace of its adoption made a great deal of confusion about what collaborative commerce really was. Under loose definition, companies that sent e-mail back and forth could claim use of collaboration (Reese, 2001).

Collaboration is the ability to communicate verbally, visually, or otherwise to share information and ideas so as to create a shared understanding or cooperation among two or more people to accomplish a common creative objective (Mills, 1998). The application of collaboration in design is getting the most attention because it offers the potential to reduce costs and speed time to market. Gartner Group also labeled Collaborative design as, collaborative product commerce (CPC), allowing multiple divisions to share engineering resources globally and involving both customers and suppliers in the creation of new product (Reese, 2001). The application of team-collaboration practices to an organization’s product development endeavors is engineering collaboration. Engineering collaboration tools are the technological software applications that must be coupled with proper network systems infrastructure to work in a collaborative engineering environment. The collaboration tools were either derived from CAD oriented companies wanting to share data throughout an organization or derived from Web enabled product data management (PDM), project management, b2b, or e-commerce technologies (Reese, 2001). Regardless of the technology, engineering collaboration tools must meet the requirements of the collaborative environment to achieve their goals.

Software Benchmark

Critical areas of the business not meeting competitive challenges may be in part due to the software tools being used in that business. A wise business continually examines its processes and the associated software tools to insure working smarter to decrease costs while increasing profits. As technology rapidly advances, evaluating software tools for business needs to keep a competitive edge is constant or should be.

In a simple example, a carpenter using a pneumatic nail gun has the potential to be much more productive than a carpenter who uses only a hammer. In a carpenters case much of his knowledge of the tools of the trade that make him competitive come from his experience by trial & error and common sense. A carpenter must weigh the advantages and disadvantages of using the hammer vs. nail gun in a way that makes sense to him and his business. A rough framing carpenter may make that decision differently than a finish carpenter depending on his needs and the tools possible uses and features. The selection of software to make a business more profitable is much the same but the tools are often more complicated than tools of a carpenters trade and complications not so obvious. Some businesses may still rely on experience alone to determine its business needs while others may try to take a more objective means of selecting its tools of the trade through a software benchmark.

A common methodology in evaluating and selecting software tools is the benchmark, using a scoring matrix to rate a system's ability to meet the criteria, to factor in the importance of the desired criteria identified during the evaluation, and to apply an overall speed factor for the final results. A benchmark can also be simply taking the time and effort to train on a few systems and install them to evaluate how well software will satisfy needs. The steps of designing and conducting a benchmark for software Tools can be applied to selecting collaboration tools as follows: Create a list of requirements for the collaboration system. Generate an initial list of collaboration tools available that appear to meet needs of the company. Construct a matrix, listing requirements in the left column and the collaboration tools in a row across the top. Based on the results of the completed matrix (via marketing and industry literature, vendor responses and product demonstrations), one should be able to narrow down collaboration tools to two or three candidates. Design and conduct a meaningful collaboration tools evaluation between the final candidates. Based on the results of this benchmark and pricing, make a decision for the collaboration tools that best meet the company's business goals (Reese, 2001).

Designing a benchmark is a challenging and time-consuming task. The benchmark must be hard enough to test for desired results while at the same time easy enough to complete in the allotted time. Procedures are often required to perform a comprehensive and unbiased evaluation to insure valid results of selecting a collaboration tool that truly works for the business needs (Kurland, 1994, 1998).

Implementation Planning

In light of collaboration tools objectives, costs of the tools themselves, infrastructure, training and administration must all be taken into account in order to make sure the benefits of the tools justify the cost. A proposed budget should include costs of planning, pilot program, organizational training, infrastructure including hardware, software, network, training, and initial support and administration.

Types of Engineering Collaboration Tools

Engineering collaboration tools functions are characterized by the types of interactions that takes place. Most of these characteristics are interrelated. Collaboration interactions have the following characteristics:

People vs. Data Centricity

Collaboration Tools allow remote interaction between two or more people or data. The tools can be characterized as more people centric if two or more people interact or can be characterized as more data centric if people and data are involved. Some collaboration tools provide more functions that are people centric such as text instant messaging, audio conferencing, or video conferencing. Others provide more data centric functions to manipulate all kinds of data. Some data centric tools are considered general collaboration tools that can only handle general office data while others are engineering collaboration tools also handling robust engineering data such as CAD 2D drawings and 3D models. Ideally one would want to have it all in one collaboration tool but because of network bandwidth technological issues collaboration tools tend to be focus as either more people centric or data centric. Collaboration tools functionality will be weighed between people centricity vs. data centricity until technological issues are addressed by increased available digital bandwidths or compressing data allowing both people and data centricity to function in the same collaboration tool.

Synchronous vs. Asynchronous

Collaboration tools can function in real time (synchronous), requiring all parties to participate simultaneously. Collaboration tools can function at different times and in different places (asynchronous). Some collaboration tools provide more functions that are synchronous allowing all members to view and markup the same 3D model at one time. The telephone is a synchronous communication tool but only people centric. Other collaboration tools provide more functions that are asynchronous allowing member to view and markup 3D models in there own time when wanted and save there markups for others to see at a latter time and date. The telegraph, Email and Facsimile, and voice mail are all asynchronous examples. Ideally both types of functions in a collaboration tool would be beneficial.

Collaboration Period

A collaboration tools function can occur indefinitely programmed, when required or at a predetermined schedule. Some collaboration tools allow session meetings to be scheduled with email notification. Collaboration tools meetings can be set up to begin and end at a scheduled time either not allowing extension beyond the scheduled time or allowing it to be extended.

Collaboration Exclusiveness

Setting permissions to access a collaboration tools session or its data can be another handy function. This is a security feature that is usually controlled by a managing user or administrator of the collaboration. It can provide for private, group or public exclusive access to the collaboration.

Collaboration Direction

A direction of collaboration is a function of how the tool allows collaboration to happen, or what mode, one way, two ways or multiple ways. In voice communications this difference can be considered as half duplex or full duplex or multiplex. In data sharing of 3D models, this can be the function of allowing only one member leader to take controls of the 3D model at a time. Otherwise allowing all to markup the model at one time.

Collaboration Interaction

Interaction is the manner in which the participants are able to extract from or add to the collaboration session. Interaction can be read-only, write-only or read-write.

Collaboration Access

The way in which the Interaction is accessed can be either centralized or distributed. With centralized access participants must manually retrieve content from a central location. With distributed access content is forwarded to participants in an automatic fashion to local areas. Information can be passed on between collaborating participants by participants manually accessing a central file server or information can automatically be passed on to participant's local client computers.

Collaboration Permanence

Collaboration Permanence is the ability to save collaboration interactions for the record, either manually or automatically. Collaboration is temporary if no lasting record is created or kept.

Collaboration Data Representation

Collaboration tools transmit data remotely through the use of computers. Collaboration data is transmitted and received on the other end. The usefulness of collaboration depends on the amount and type of information being transmitted and the means in which it is transmitted. The more information being transmitted at any given time, the higher the bandwidth required for the transmission. Collaboration data can be in the form of text, 2D pictures, 3D models, audio, video or prototype.

Collaboration People Representation

Collaboration tools provide remote interaction that represents data and the people involved. The usefulness of collaboration also depends on the ability to transmit whom data is coming from. Collaboration can be in the form of vocal, facial or body language of a person. Emoticons or text representations of intentional human emotions are used as low bandwidth replacements but usually not for professional correspondence.

Engineering collaboration tools can have many of these interaction characteristics, which are important to the usefulness of collaboration tools. It would seem that the more characteristics the better the tool. Many characteristics require a larger bandwidth infrastructure but this does not automatically make it better. Whatever the characteristics of the tool, its usefulness really comes down to the desire, on the part of the people involved, to really communicate with one another. An organization may be better off seeking high-bandwidth people before worrying about high-bandwidth collaboration tools.

(Mills, 1998)

Engineering Collaboration Case Studies

Case studies were selected from companies that had performed some type of collaboration tools evaluation before selection. The examples of how other companies evaluated engineering collaboration tools are as follows:

Case Study#1

Scott Stagliano of Lockheed Martin Space Systems Company, Astronautics Operations gave a Design News Magazine Web Cast presentation on October 17th 2001. The presentation was titled, Implementing Virtual Collaborative Environments within Reusable Space Transportation Systems.

The Lockheed Martin Space Systems Company, Astronautics Operations is headquartered in Denver Colorado with various other locations coast to coast across the US. The division was primarily a government contractor providing engineering services for NASA and US Air Force. Product areas were human and reusable space systems including a second-generation reusable launch vehicle, crew return vehicle, and space shuttle upgrades.

The company used outside sources for engineering and production adding 50% design value and over 80% production value. One third of their cost was transitional, communicating and monitoring teammates and suppliers. Their collaboration strategy was to create a secure Web based environment for their extended value chain that promoted effective and comprehensive program collaboration within their geographically and functionally diverse teams using commercial off the shelf software systems.

Their goals were first to have their entire team to participate as a virtual team of Lockheed Martin, teammates, suppliers, and customers, domestic and international. Second was to provide synchronous and asynchronous collaboration in engineering processes and business processes. Third was to integrate with Parametric Technology Corporation (PTC) Windchill products for formal Product Data Management (PDM). Fourth was to provide program metrics reporting.

Lockheed Martin's evaluation process included a Preliminary Evaluation to research available commercial off the shelf collaboration tools selecting those identified worth running through pilot activities and then through detailed security evaluation. Evaluation started in December 1999 to deployment in June 2001. Tools under consideration so far were categorized as either general business collaboration tools such as Net Meeting, Sametime, WebEx, Quickplace or engineering collaboration tools such as OneSpace, eVis, WebScope, ipTeam. Also under consideration were commercial off the shelf PDM tools such as Windchill/Prointralink, Digital Dash board tools, Web Portal tools.

The research results showed that the general collaboration tools were inexpensive and easy to deploy but were not sufficient for use with engineering programs, meaning there environments were not sufficiently rich to communicate engineering ideas (2D and 3D engineering) but could be part of potential interim solution. Engineering collaboration tools provided the advantages of richer collaboration environments for engineering data with 2D/3D engineering visualization but with a more expensive price and more complications to deploy (integrating into PDM). Engineering collaboration tools provide a long-term solution for engineering team deployment. Lockheed Martin engineering collaboration tool of choice was eVis by EDS, a Synchronous tool for engineering reviews, change boards, and meeting, an asynchronous tool for library, action items, discussions, XML API's, connectivity to PDM's and legacy systems, meet Lockheed Martins Information Security. E-Vis collaboration tool had features such as Project management, Member administration, intelligent search, change notification application sharing, 2D/3D data viewing, file sharing, conferencing, and project vault.

(Stagliano, 2001)

Case Study#2

Moline, Ill.-based Deere & Co., was experimenting with collaborative design as part of ongoing efforts, started before the raise of internet-based solutions, to get closer to the customers for its construction and agricultural equipment, as well as to the manufacture's supply base. Jim Harl, manager for e-business in supply management at Deere: " In our equipment division, a few years back the company began to see that there was value in pulling the demand from our customers closer and tighter into our factory floors. The movement to get closer to the two sides of the supply chain was really rooted in some fundamental thinking along those lines." The objective of this effort was to come to market faster with new and improved product lines that better meet customer's needs." Harl says, "adding that c-commerce will allow Deere to move more quickly towards accomplishing this goal".

(Reese, 2001)

Chapter III

Selection and Evaluation

CAD Viewer Based Collaboration Tools

All Computer Aided Design (CAD) vendors seem to provide a means for non-cad oriented people in the design chain ways to view and markup CAD data without the use of there expensive complex CAD tools. CAD Vendors started out with solutions by removing certain features of the CAD application from the software to create a light version for the non-CAD users. These tools were stand alone software applications allowing the saving of markups for CAD users to apply to there designs in the CAD program itself. CAD vendors also made available on their Web sites similar tools or plug-ins for Web browsers to do the same. CAD viewers provided an inexpensive way to review product data created by that CAD vendor's software. The negatives of these tools were that no live connection for collaboration was provided for conferencing and the tools usually were only good for the file formats that were created by that specific CAD vendor's CAD program.

Product Data Management (PDM) Based Collaboration Tools

3D CAD vendors provided a means to store, search and retrieve CAD data from a controlled database or Product Data Management (PDM) software program. These programs were also turning to Web enabled technologies as main interfaces due to companies' movement to global e-commerce. Many of these vendors were integrating Web browser plug-ins and java script programs that run through Web browsers into their

PDM systems. Most Web enabled PDM systems were providing a means to easily view 2D and 3D data from the database. The drawbacks to PDM systems were that expense was greater and tended to be more focused on managing the complex data. PDM systems were usually also limited to viewing certain file types and tended to be just a viewer and not providing the rich features needed for true engineering collaboration such as markups, measuring, and network communications. These systems tended to be web-aware or web-enabled but not Web centric or purely Web based.

Project Management Based Collaboration Tools

Project management systems tended to focus on tools for managing projects such as Gant chart creation, action items or to do lists with calendars. Most were derived from the Architectural Engineering and Construction (AEC) firms based on their need to coordinate multiple contractors from different businesses.   Engineering collaboration software was taking more notice for use in product design with product life cycle and supplier management a part of it. Project management systems were also beginning to integrate the idea of collaborative product commerce for getting customers or suppliers more involved up front rather than after the fact, reducing product design changes from the later. These tools were becoming more Web based but tended to lack any tools for engineering collaboration.

Web Based Collaboration Tools

Engineering collaboration tools that were Web-centric or purely Web-based, leveraged the opportunities for open communication among entities using different standards, such as Extensible Markup Language (XML) an enabling technology that allowed data interchange over the Internet. XML was a key enabling technology for e-Business.

Chapter IV

Conclusion and Recommendations

The best Engineering Collaboration Tools for Woods

Summary

The problem of this study was to evaluate a suitable engineering collaboration tool at Woods Equipment Company.

Visits to vendor Web sites, listening to Web casts, sending email enquires, talking with vendors and reviewing product demos had provided the author of this project with the necessary tools to successfully complete this study.

New engineering collaboration tools are being made available every day. Vendors are developing engineering collaboration tools based on users CAD applications, PDM systems, Project Management systems or Web technologies. Vendors meet the needs of users with features that take on all types of collaboration interactions. No one tool alone captures all features available because of network bandwidth restrictions. Vendors make a choice on what collaboration features to leave out of their product. The complexity of features makes it tough to decide on one tool.

A whole career could be made out of evaluating engineering collaboration tools but because of time restrictions, the scope of this project became more focused on Woods immediate requirements and picking out only the tools that could be proven in a quick demonstration to meet Woods requirements. Most demonstrations of the tools did not prove all that successful, therefore questioning the real usefulness of those tools.

After looking at the types of engineering collaboration tools available by feature characteristics it was clear that a company like Woods was in need of flexible engineering collaboration tools. The tools would have to accept the many file types at Woods, have a common Internet Web browser interface, and be easy to deploy. The Web based technologies held the most promise for Woods. Woods had set up an intranet network infrastructure already to support engineering collaboration.

Keeping this in mind the tools that were Web based received closest attention. Each engineering collaboration tool was selected for demonstration over the Internet. Notes were taken on how well the demonstration went including the installation of any necessary software. After demonstrations most vendors offered additional use of its product for pilot projects. Before any formal evaluation was performed a final decision was made to use PTC's Pro/Collaborate for a pilot project. Pro/Collaborate was found to be free to Woods as a maintenance-paying customer of PTC's Pro/Engineer software.

If Pro/Collaborate does not prove to meet all of Woods requirements in the pilot project a next possible step would be to develop a formal benchmark test. The benchmark test would further evaluate the most interesting tools from this study by a benchmark team of potential users and key managers. The evaluation ratings form in the appendix could be used to help collect data and fill in the benchmark matrix in the appendix.

It was hoped that with the implementation of an engineering collaboration tool at Woods, groups of divided engineers would collaborate together joining resources in making Woods one entity rather than divided companies of similar product.

Conclusions

Since Woods has so many divisions separated by location, which do similar work, it was essential for them to have an engineering collaboration tool that allowed engineers from all divisions to collaborate. Web based collaboration tools provide the most potential for flexibility and least costs for infrastructure, training and administration.

The pilot project with Pro/Collaborate will be used to test viability, functionality, robustness, and simulated scalability requirements of the engineering collaboration tool for Woods. PTC's Pro/Collaborate engineering collaboration tool provides Woods with 100MB of project space for every Woods Pro/Engineer License. Pro/Collaborate is hosted on a PTC's WindChill products server. The pilot project participants will include CF-Woods, Schofield, WI division using Pro/Engineer CAD software collaborating with the Rockford, IL division using SDRC CAD software. Redesigning efforts of Schofield products will begin with the aid of Finite element analysis (FEA) provided by the Rockford division. The project collaboration efforts will be a through test of Pro/Collaborate.

Recommendations for the future

Based on the knowledge associated with the findings of this project, it is the author's opinion that the company, Woods Equipment Company, should pursue the following recommendations:

1. Woods should install Pro/Collaborate to run a pilot test.

2. Woods should consider completing a comparative pilot project with another Web based engineering collaboration tool before finalizing the use of Pro/Collaborate.

3. Woods should develop careful plans of implementation after finalizing its selection.

4. Woods should consider implementing collaboration tools throughout the Company as tools for use with customers, suppliers and product dealers.

References

Aptec (Company) (November 2000). Collaborative Planning Prevents Problems, Computer Aided Engineering, Vol. 19, Issue 11, p22.

Beckert, Beverly (February 2001). End Users to Dole out more Dollars for Collaboration Tools, Computer Aided Engineering, Vol 20, Issue 2, p12.

Desmond, Michael (September 2001). Get The Message Instant messaging moves to plug the gap between phones and e-mail. PC World, p144.

Gilbert, Alorie (March 19, 2001). Online Collaboration: No Guarantee Of Speedy Delivery. Information Week, Issue 826, p36.

Greco (January 2000). Group Efforts. Manufacturing Systems (MSI), Vol. 23 Issue 1, p38, 3p, 14c.

Kurland, Raymond (February 1998). Selecting an MCAD system: determine needs, and then benchmark. Technicom, Inc. Solid solutions Magazine. Retrieved Nov 20, 2001, from http://www.technicom.com

Kurland, Raymond (June 1994). Using a Benchmark to Select Mechanical CAD/CAM Software. Technicom, Inc. Retrieved Nov 20, 2001, from http://www.technicom.com.

Lange, Larry (November, 1997). EEtimes guide to Internet engineering. Electronic Engineering Times, Issue 982, p18.

Miller, Ed (Janurary 2001). Exchange: More than Marketplaces. Computer Aided Engineering, Vol 20, Issue 1, p54.

Miller, Ed (March 2001). Using the web to go global. Computer Aided Engineering, Vol. 20, Issue 3, p44, 4p.

Mills, Anthony (1998). Collaborative Engineering and the Internet: linking product development partners via the Web. Society of Manufacturing Engineers, Dearborn, Michigan.

Plunkett Research, Ltd (2001). The Almanac of American Employers 2002-2003. Houston, TX, Retrieved October 31, 2001, from http://www.plunkettresearch.com/careers/americanemployers_trends.htm#1

Porter, Paula (April, 2001). The Internet as Conference Room. Design News, Vol. 56, Issue 8, pW3.

Reese, Andrew K (2001). The Collaboration Question. isource Magazine, Retrieved Dec 5, 2001, from http://www.isourceonline.com

Stagliano, Scott (2001). Implementing Virtual Collaborative Environments within Reusable Space Transportation Systems. Retrieved Nov 12, 2001, from http://webevents.broadcast.com/slides/155/580/slides/powerpoint/slides/large/101701slide.

Summers, Bob (1998). Official Microsoft NetMeeting Book. Microsoft Press, Redmond, Wash.

Appendices

Window XP-64bit & Intel 64 bit architecture

At the same time Microsoft released its new version of its new operating system Windows XP for Intel's IA-32 bit cpu computers it also released a 64 bit version for Intel's IA-64 bit cpu computers. The 64 bit architecture is promising to deliver faster Web serving with large scale caching for Web hosting and secure communications. Most demanding server applications had previously used proprietary Unix 64 bit cpu computers. These new servers used to host engineering collaboration sessions outside those walls would provide greater security.

Woods Engineering Collaboration tools Requirements

General Systems Integration

Work with existing Woods Network Systems infrastructure. 100baseT network systems with CAT5 cabling.

Work on wintel platform computer systems supported at woods.

Access collaboration tool through Internet Web interface.

Commercial off the shelf products from established vendors.

Security

Storing engineering data securely for team members to access.

Blocking unwanted access to shared files and conferences communications.

If not sold with hosting service then it must work through existing Woods firewall.

File Sharing

Storing engineering data securely for team members to access.

Engineering file types, information created and used during the design, analysis, manufacturing and support of product or structure.

2D CAD drawing file types, AutoCAD (.dwg), Cad key (.prt), ProEngineer (.drw), Bills-of-materials (BOMs), MS Office (.doc, .xls, Image file types, procurement sheets, parts catalogs, animations, digital mockups, specifications

3D File Viewing/Markup

3D CAD solid model file types, ProEngineer (.prt, .asm, .drw) ProMechanica, SDRC-

Ideas.

Other 3D files types .igs, vrml, .stp, and .stl.

Application Sharing

Share software applications across networks and allow others to take control of the application.

Project Management

Create team members, to assign roles and access permissions to team members.

Conferencing

Communicate through white board, written messaging, audio or video communications.

Save or achieve important meeting communications or notes.

Engineering Collaboration Tools Vendor Web Sites & Demonstration

E-Vis, EDS

http://www.e-vis.com/about-evis/features.html

On 11/30/01 Mr. Tony Van Gundy provided a demo e-Vis. Installation of the e-Vis client software was a 29 MB download from an install link. Minimum of 28kbps is needed for a connection speed. Connection speed at CF-Woods tested as 424kbps (cnet.com test), which is a fractional T1 connection using Internet explorer 6.0. Application sharing is performed through client to server to client computer systems. Application sharing is providing by streaming video or bitmaps so performance was slow reacting or delayed while spinning a 3D model. File type for 3D is (.jt) format. ProE files have to be exported as .stl then published to (.jt) format by server. SDRC files RE exported as (.jt). Noted future features will be audio and streaming video conferencing as broadband bandwidths become more common. E-Vis provides conference scheduling with invites delivery by email. Advanced section allows for larger 2D/3D files to be downloaded to everyone's computer to increase performance. Taking control of the demo and take measurements of 3D model were simple. Cost per user is $89/month.

OneSpace, CoCreate

ftp://ftp.cocreate.com/cocreate/public/onespace/B001.html

Installation of onespace required ICA client install. Email was sent from onespace meeting leader Ms. Rosie Wierenga providing meeting schedule with link to join the meeting.

On 11/29/01 attempted to join an onespace demo meeting using Internet explorer 6.0 but failed to launch onespace due to a firewall port 1494 not being open to outbound traffic at woods. Onespace technical support sent 3-page email attachment on trouble shooting onespace installation. Asked IS to open port but received not approval.

Attempted to connect to a second meeting on 12/6/01 from home PC with 256kbps cable modem and connected successfully but meeting ended earlier with myself as only member present in the meeting. Successfully manipulated 3D model with similar results to e-Vis, slow reacting or delayed response. Tools available did not seem obvious to what there were, so experimenting was necessary. With no other members present meeting timed out after a few minutes asking to extend the meeting. Completed the meeting after trying out the few tool bars that were recognizable.

Connected to third meeting on 12/6/01 started out fine but after all three members entered the meeting the 3D model no longer appeared and an ICA error appeared. Meeting was rescheduled to 12/10/01.

Connected for a meeting with onespace on 12/10/01 with Ms. Rosie Wierenga. Entered meeting with no models present in 3D viewer or 2D viewer. Was able to drag and drop files into both. Two parts dragged separately into an assembly. Asked the question how the models knew there location without telling them but onespace could not answer and promised to get back to me with an answer at a later date. Observed PowerPoint presentation in 2D viewer about onespace. Observed 3D viewer presentation of project notes, model markup pointers, labels and model changes. Asked about required 3D file formats. An interface to each CAD program is provided which adds onespace menu picks to each program. The project ended with myself at the controls. Measure function was used on the models, which appeared to give point coordinates of model pick points only. Notes and pointers were used.

Productview (Pro/Collaborate/Projectlink), PTC

http://www.ptc.com/community/tools/procollaborate/index.htm

Installation requires downloading productview application and Pro/Engineer (ProE) CAD interface to save ProE files directly from ProE. Login and password are the same as company logins established for online accounts. License is free to ProE maintenance paying customers. Hosting server space for files depends on number of ProE licenses with paid maintenance. To create a project was easy but to save files from ProE to server took awhile to transfer files through java application. After files were transferred to the project files could not be viewed with productview because the files were ProE 2001 files and Productview did not support that version of ProE files until 12/7/01. New productview allows viewing and markup of 2001 files after being published on the server compressing files for application. Cost per user is the cost of ProE maintenance currently at $125/month.

WebScope, WebScope Inc.

http://www.webscopeinc.com/products/demo.html

Installation requires two java applications to be downloaded and installed. Demo was not setup in time for this study.

ConceptStation, Realitywave

http://www.conceptstation.com

Logged in to ConceptStation on 12/5/01 using Internet explorer 6.0, No software download was needed. Entered design project and manipulated, marked up, and commented on the project model. Asked about importing ProE models and an email reply explained file types supported. Exported .wrl part and assembly out of ProE and attempted to add model to project. Part went in to conference but was not complete geometry. Incomplete geometry May have been from ProE default export settings. Tried importing Assembly file into conference and it crashed the conference or locked up the browser. Mark-up, with associated model view, can be saved allowing participants to see others comments at any time during the project. Cost per user is $30/month.

Other Topics of interest

http://webevents.broadcast.com/cahners/DesignCollab

Engineering Collaboration Tools Functional Requirements for Woods and the corresponding evaluation rating

Vendor: ___________________________________

Directions: Rank engineering collaboration tools functionality and usefulness based on a scale of 1 to 10.

Check the appropriate rating where: 1 = least useful match, 10 = Most useful match

	Responses									
Requirements	1	2	3	4	5	6	7	8	9	10
1. Security	O	O	O	O	O	O	O	O	O	O
2. 2D/3D File Viewing/Markup	O	O	O	O	O	O	O	O	O	O
3. File Sharing	O	O	O	O	O	O	O	O	O	O
4. Application Sharing	O	O	O	O	O	O	O	O	O	O
5. Project Management	O	O	O	O	O	O	O	O	O	O
6. Conferencing	O	O	O	O	O	O	O	O	O	O

Collaboration Tools Benchmark		Engineering Collaboration tools				
		Productview	e-Vis	Concept-Station	OneSpace	WebScope
Requirements Match Matrix Requirements	Security					
	2D/3D Viewing/Markup					
	File Sharing					
	Application Sharing					
	Project Management					
	Conferencing					
Per Seat Costs	$K					
Costs	Normalized					
Probable Value Matrix Requirements	Security					
	2D/3D Viewing/Markup					
	File Sharing					
	Application Sharing					
	Project Management					
	Conferencing					
APV						
APV-normalized						

<u>Vendor Matrix</u> (Mills, 1998)