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VIRTUAL MEETING INTEROPERABILITY: DISCUSSING THE NEED OF SUPPORT FOR HETEROGENEOUS MEETING ENVIRONMENTS

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ABSTRACT
With more projects in today's industry being global it is important to support the people collaborating in these projects. Travel is expensive and time consuming and is not viable in the long run. Although some travel is necessary it is important for people to meet virtually instead.
In many cases it is difficult for companies to collaborate because they do not use the same tools for these virtual meetings. Due to restrictions with IT security it is also difficult and expensive to implement every new tool their partner companies use.
One solution could be a portal that facilitates connecting users with different virtual meeting tools. Using Web Services to bridge the different protocols it would be possible to connect two software packages that are using different standards for virtual meetings.
With a tool as this it would be possible for chosen companies to collaborate closely online although they have incompatible software packages. Companies can select their solutions on the basis of their needs and do not have to implement a new solution or modify their existing setup to accommodate new partner needs. Finally, people would only need to learn the one tool which is available in their own company.

KEY WORDS
Web-based Collaboration, virtual meetings, heterogeneous interoperability, web services

1. Introduction

This paper discusses the rising need to support the use of differing virtual meeting tools in today's global manufacturing industry, such as for instance in the aerospace domain.
The paper is based on experience from working in a globally distributed product development project for one year and primarily from working with distributed tools for six months when doing a master thesis in the aerospace industry.

The global manufacturing industry in general and the aerospace industry in particular are often working in projects that are not entirely in-house and close collaboration with other organizations throughout the world is a frequent activity for them.
With companies moving towards globalization, such as for instance moving to a presence in China or one of the other BRIC-region (Brazil, Russia, India and China) countries both for reasons of saving cost, and for strategic reasons, it is important to be able to work and collaborate without having to travel all the time. Also, cross-organizational collaboration in, for instance, a virtual enterprise is another factor that is coming and is, today, greatly influenced by travel.
Many of the companies in these industries have a rather heterogeneous IT-environment, both between companies, but also within them. It is not uncommon that different companies use different virtual meeting tools as is the case with many other tools (e.g., CAD tools, simulation tools) [1]. In fact, different departments within an organization may even use different tools as different work routines require different support [2].
Knowledge and intellectual property may well be a company's biggest asset. It is important for companies in collaboration with other companies and also with activity on the Internet to safeguard their assets. Companies therefore carefully test and certify that the tools they are using is not harmful to their assets by running the tools in a special environment that is separated from the one used in the every day work. This is a time demanding and expensive process that the company cannot do with every tool they come across.
To sum this up, there is a need for companies to collaborate without travelling all the time and still being able to use the tools of their choice for collaboration.
Some providers of these kinds of tools have begun to use standards (i.e., H323, SIP, etc.) initiated by organizations such as the World Wide Web Consortium (W3C) when implementing functions. This would enable users of different tools to connect without either of them having to change tools. The problem is the providers of tools that have not adopted the standards thinking, whether they feel that standards inhibit the high quality in a function or if

they just do not want to conform to the standards because they feel it is bad for their business. This makes a standards solution to the problem a bit tricky to come by.
Hence, I will discuss the need to implement a solution that can act as a translator between all the different virtual meeting tools that companies possess. One way to do this could be to look into the concept of Web Services which has been useful in connecting various systems together on data level. In this paper I will present an idea of conceptually connecting two users in different organizations with different virtual meeting tools.
First, though, I will build my case for the concept environment that I am proposing in this paper by bringing up some background information about the aerospace industry, about the concept of the virtual enterprise and issues with global collaboration. Then I will move a bit more to the technical side of things and describe the virtual meeting tools and the IT-security issues that are limiting to some extent. Then I will move on to the concept of Web Services and a hub for connecting these virtual meeting tools.

2. Building the Case

In this section I will start by briefly going through some of the background to why I write this paper.

2.1 Aerospace Industry

The aerospace industry is a global industry in its true sense. To produce a major airliner today companies literally spread around the world need to collaborate. The airframe may be designed and manufactured all across Europe, such as for instance in Germany, France and the United Kingdom, whereas the engines may be made in the US. Add to this that the suppliers of components and parts are spread out across the globe and there is real a challenge in coordinating the work.
Furthermore, the size and complexity of the products in the aerospace industry makes doing business a challenge as the investments in research, development, manufacturing, etcetera, that are needed to produce the products are considerable. Because of this, payback or break-even points are usually something like ten years or even further into the program.
The major investments make it important for companies to form partnerships on projects where several companies can share the risk and cost and hence also the revenue of a component.

2.2 The Virtual Enterprise & Global Cooperation Issues

The term Virtual Enterprise is a definition of networks of independent companies that are *"…linked by information technology to share skills, costs, and access to one another's markets. It will have neither central office nor organization chart. It will have no hierarchy, no vertical integration."* [3].
The term virtual enterprise is sometimes related to the term extended enterprise. One example of an extended enterprise is for instance a "risk and revenue sharing" partnership where a business opportunity may be to large for any single company to handle by themselves and therefore may need help with from the partners. The main difference between an extended enterprise and a virtual enterprise is perceived to be the fact that the extended enterprise has a natural governing authority in the form the *Original Equipment Manufacturer* (OEM) of the collaboration as they received the contract or the request for quotation from the customer. The OEM may also be a rather large company in relation to the other collaborators. In the virtual enterprise, on the other hand, companies collaborate on equal terms without one of them being the OEM that can impose tools and methods by which the others are required to conform.
The virtual enterprise is a network of independent companies. It is formed either on the basis of cost-effectiveness or product uniqueness [4]. Hence it is vital that the virtual enterprise creates the value that partner companies cannot create by themselves.
An important aspect of the virtual enterprise is the element of speed where partnering companies assemble to respond to a business opportunity.
The virtual enterprise is by definition not physically collocated, but rather geographically distributed, often over a vast geographic area. Although many companies are seeking the advantages of globalization there are downsides to it as well. Davidow and Malone (1992) [5] means that the virtual corporation will abhor distance and that means that physical proximity will be sought after in a virtual enterprise. It is for instance not as easy to have a quick chit-chat with your colleagues in the hallway if you are not in the same building, or as Allen's (1977) [6] concept of "radius of collaborative collocation" suggests; people situated more than 50 feet apart is not very likely to collaborate closely. It will therefore be important to support the companies in working closely together even though they are located far apart from each other.
Another ingredient of a virtual enterprise is the fact that it lacks a central office. It also has almost no employees or inventories. The independent partner companies contribute with their core competencies.
In the virtual enterprise, knowledge is the foundation [7], and as companies face competition for knowledgeable people, the virtual enterprise is formed partially on the basis that companies together can deliver a solution to a problem or a need in a better, more agile way than one company can do by itself.
Trust is a fundamental ingredient for working in a virtual enterprise because of the collaboration over vast distances. As partners are participating with their core competence, their knowledge, it is important to be able to trust the other partners. According to Handy (1995) [8] trust is not an impersonal commodity but it "needs touch".

Zheng et al (2002) [9] argues that although face-to-face meetings are important and facilitates the creation of trust best, other distributed activities such as "social chatting" are better than simply doing nothing at all. To work closely together in a distributed project it is not feasible or economically viable to only rely on physical meetings. The virtual enterprise is heavily dependent on information and communication technology (ICT), due to the nature of it being geographically dispersed. According to Walker (2006) [10] the virtual enterprise needs a standardized IT environment. Whether that is feasible or not, ICT is an enabler for close collaboration in the virtual enterprise since participants need to work together closely while still being apart.

After the business opportunity has passed, the natural thing is that the virtual enterprise dissolves. The virtual enterprise is only temporarily formed for the duration of the project and dissolves either when the project ends or when the business opportunity has passed. Some virtual enterprises can live on to a new project where the same collaborators are forming a renewed partnership based on the success in the previous collaboration.

The virtual enterprise is not the only thing that builds the case for supporting virtual meetings. In a report made by non-profit organization RAND [11], it is suggested that many companies will move not only production to countries with lower labor cost, but that this trend will evolve to more knowledgeable job positions. Knowledgeable employees at lower costs coupled with the possibility to do work around the clock, as in the cases with a number of call centers in recent years where operators are situated in India, servicing customers in the US or in Europe, will be more attractive for companies. Many companies either move departments to developing countries or do some business with companies there as part of their strategy. Moving development centers closer to important markets is an important factor for many companies. Traditionally many European and Japanese companies have placed design offices in the US, such as in Silicon Valley and at other places, as the US has always been an important market. Now the BRIC region will be an important market place for companies as consumers in these rather densely-populated countries will begin to have thicker wallets and more spending power. The still rather cheap labor costs makes placing development offices there feasible.

Moreover, as people also tend to work increasingly from their homes there is a case for improved support for virtual meetings and online collaboration, especially at an easy to use level where a dedicated collaboration studio is not a requirement.

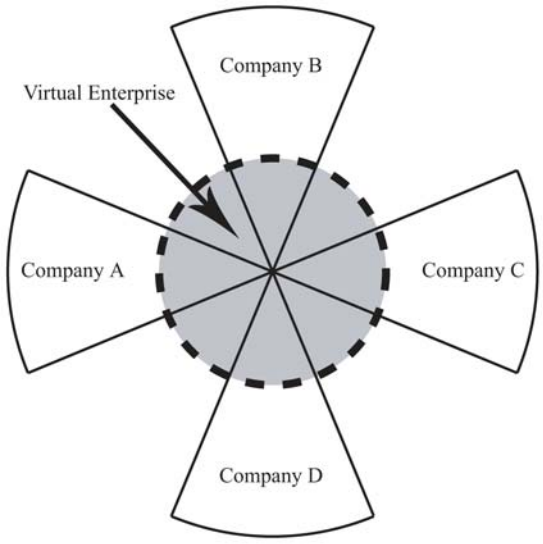

Figure 1. The Virtual Enterprise

2.3 IT Security

Viruses and hacking attacks are things every company today has to protect itself from. Whether the attack just knocks out the computer infrastructure or if information is actually stolen from the companies it is something that is hurtful for the companies with lost productivity as a result.

IT security is usually on the top of the requirement lists when any collaborative application is to be implemented. As many of the companies are also involved in military programs the IT infrastructure (i.e., LAN, DMZ) needs to be secure and any traffic going through non-secure environments (i.e., Internet, servers) needs to be encrypted. Normally these servers are placed on the demilitarized zone (DMZ) of the network see Figure 2 below [2]. One common policy in this industry is that any server that is needed to power the collaborative application needs to be physically situated within the premises of the company and needs to be on a controlled and secure environment on the network infrastructure, in order to allow the employees to share and work on secure data. This is a factor that greatly reduces the number of solutions available to the companies.

The sum of all things stated above means that any application that a company wants to implement needs to checked and certified for use, primarily outside of the firewalls. This is an expensive process where use in a controlled test environment is needed before any software is trusted.

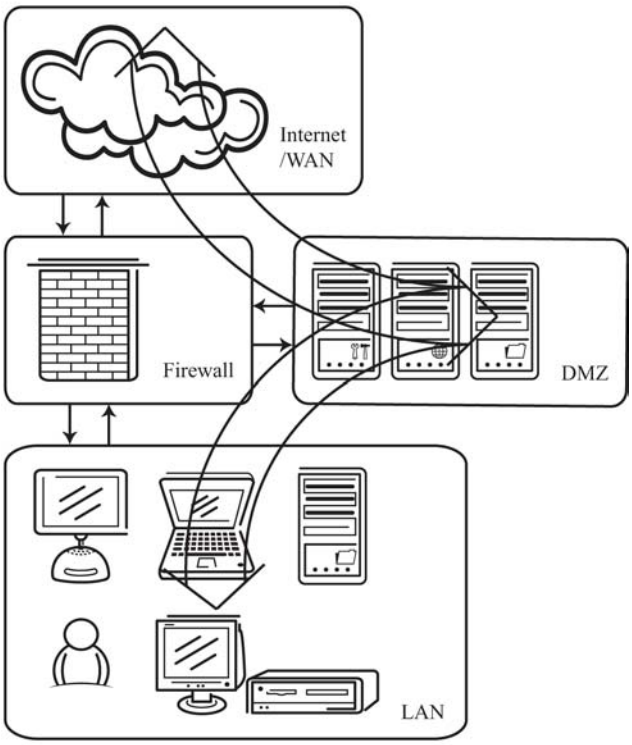

Figure 2. IT-Security architecture with LAN, DMZ, Firewall and the Internet

2.4 Virtual Meetings and Web-Based Collaboration

Groupware is a term that is used to describe the tools that support Computer Supported Cooperative Work (CSCW). Groupware or Group Support Systems (GSS) is described as a *"computer-based system that supports groups of people engaged in a common task (or goal) and that provide an interface to a shared environment"* [12]. This is a broad term that includes all sorts of hardware and software that supports co-operative work.

In this paper, the focus is more intended to be on the tools that support synchronous communication and work, and meetings in particular.

Groupware technologies that support synchronous distributed meetings include for instance video conferencing and web conferencing technologies. Virtual meeting services can be seen as a general term for all sorts of distributed meeting tools.

Functions included in a virtual meeting service can be seen in Table 1, where synchronous groupware include for instance desktop sharing, collaborative authoring, whiteboards, etcetera whereas asynchronous groupware include functions such as discussion boards, etcetera. The classification of the different functions stems from theory of media synchronicity [13]. Here it is stated that there is not *one* application that is the silver bullet, but that different situations call for different support tools. Sometimes a high feedback rate is needed and hence a high quality video conferencing system is what is best. In another situation there is a need for being able to re-examine what happened during a meeting and a video conference is then not suitable. Therefore it is also not a big surprise that many companies have different tools at their disposal and that even different tools are used in different departments within a single company.

Having to use a large variety of tools is also quite expensive when it comes to training employees to use all the tools as overhead, i.e. more workload for the employee, is generally something that comes along with a new software package. Some people are fast learners and probably a bit interested in trying out new things, but that is not the case for all. Most employees are not there to be experts on the collaboration tools, but they are rather in a company to be good at their primary task, whether that is engineering or business activities, etcetera.

	A	**B**	**C**	**D**	**E**
Video	M - H	L - H	L	L	L
Audio	M	L	L	L	L
Chat	L - M	L - M	M	H	M - H
E-Mail	L - M	L -H	M	H	H
Synchronous Groupware	L - M	L - H	H	M - H	H
Asynchronous Groupware	L	L - H	H	H	H
Legend: L=low, M=medium, H=high					
A - Immediacy of feedback	Medium Enables rapid feedback.				
B - Symbol variety	The number of ways information can be communicated. The height of the medium.				
C - Parallelism	The number of simultaneous conversations possible. The width of the medium.				
D - Reprocessability	The medium enables fine-tuning of information before sending				
E - Rehearsability	A message can be re-examined within the context of the communication event.				

Table 1. Virtual meeting tools, adopted from *Dennis and Valacich (1999).*

2.5 Web Services

Today many companies are experiencing the problem of incompatibility when it comes to collaborating with other companies or maybe even within a company between different departments. The use of different computer tools makes it hard to just move files from one system to the other. In the world of Computer Aided Design (CAD), software customers, i.e. some of the major industries in the world, have demanded for the suppliers to make CAD software compatible with each other [1], hence the use of the IGES and later the STEP format. This can not be assumed to be the case for all applications and probably not entirely for virtual meeting software applications,

especially as there is still an alternative: travel as well as just using the phone or e-mailing as is traditional. There needs to be another way to make these software applications work with each other. This is where Web Services possibly can enter the stage.
Web Services is an approach that is being used more and more when it comes to connecting different computer systems and enabling them to work together. *"Web Services can significantly increase the Web architecture's potential, by providing a way of automated program communication, discovery of services"* [14] (p.2). Web Services use protocols such as XML, WSDL, SOAP and UDDI to communicate data between different distributed systems [15]. Web Services is created to be an open-standard based protocol and is therefore possible to use between different platforms, such as for instance Windows and Linux. W3C (World Wide Web Consortium) and OASIS are primarily responsible for developing and standardizing the protocol.
Wu et al (2004) [16] has explored the possibilities to use Web Services to connect heterogeneous virtual meeting collaboration applications. They have used a special XML-definition called XGSP (XML-based General Session Protocol) to connect systems based on H.323, SIP and MMUSIC protocols. These protocols have been designed to be an open standard and have features that sometimes can be compared; they are though not interoperable with each other. Further, they also implement a multi-point framework that features interoperable video and audio conferencing in a heterogeneous software environment.

2.6 Portal

A portal is a tool that is frequently used to support groups that have users that normally do not see each other every day. It is a good tool to stay tuned with what happens in a project, such as what others is doing and what progress is made.
The idea is to expand a bit on the analogy of the portal, but instead connect the software that the users are running rather than connecting the users directly. Using a portal; users would be ale to easily set up a virtual meeting with their peers on other companies. For instance, two users having different specifications of video conferencing software would then be able to collaborate virtually anyway.
Figure 3 below illustrates how a user would collaborate with other users. They would then be able to collaborate although they do not have access to the same applications
The portal is owned and maintained either by the virtual enterprise or by one of the partner companies. This coupled with access control and sufficient security measures would allow for proprietary information to be shared and discussed between the collaborators.

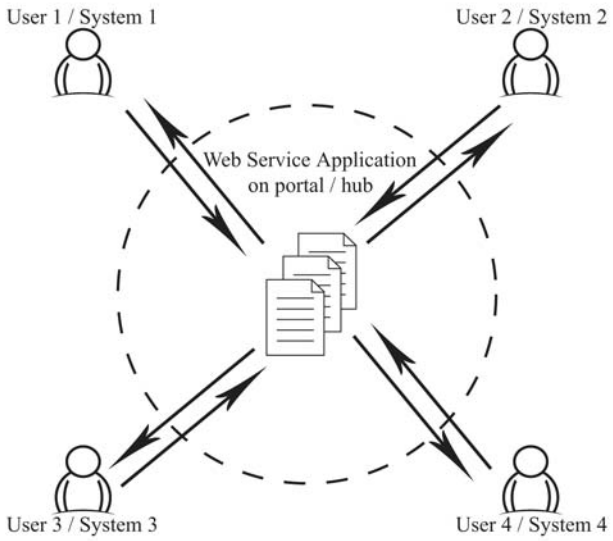

Figure 3. The hub in the wheel.

3. Conclusion

This paper describes some of the work that has been conducted in a master thesis where the market of virtual meeting tools was scanned as well as the needs of users in companies in the global manufacturing industry was investigated. During the work the need to support a rather heterogeneous IT environment, with companies collaborating closely across organisational borders being common, was evident.
Therefore, my contribution in this paper is a discussion about being able to connect different users that are using heterogeneous software packages, wanting to collaborate by having a virtual meeting. We would like to stress that our contribution has not been to implement a working tool or to draw up architecture for it.
Some work has been done in this field, by others, where Web Services is used to connect multi-point virtual meeting clients that are using different standards for handling video and audio signals.
The benefit of using a solution like this is that virtually any two tools can be connected to each other and thus enabling users to collaborate at their own turf. Having to adopt to partner's software packages all the time is a costly activity and is basically not possible in the long run. As a fictitious example engineers at Ford Motor Company can collaborate with, for instance, engineers at Toyota on a new and revolutionary security system for small children in a car virtually every day (if they like) without having to travel all the time. The users can just start up their application on their desktop workstation or their laptop and be on their way collaborating in an easy to use manner as they are most likely already familiar with their own application's user interface.
Companies get the freedom to select and buy whichever tool they like based on their own criteria, whether that is

money, performance, security or something else. For example, some users may have a high frequency of using CAD software and therefore want to have tailor made functions for inserting CAD- and simulation models into a meeting, while some users at for instance an accounting partner may want to be able to easily bring up excel spreadsheets and therefore favor a software package with such user interface. The third party may be a company that has a special deal with a software provider that simultaneously provides applications for life cycle management. In short we all have our different needs that require its individual solution; this is also true when it comes to virtual meeting software applications.

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