media X at Stanford University

BUILDING EFFECTIVE VIRTUAL TEAMS:

Tools, Techniques, Best Practices and Gotcha's for Creating and Leading Distributed Teams

A WORKSHOP BRINGING TOGETHER THINKERS AND PRACTITIONERS

Summer Institute@ Wallenberg Hall , August 1-3, 2007

Monograph

Media X at Stanford University

February 2008

Martha G. Russell, Editor

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Monograph produced with support from FX Palo Alto Laboratories, Inc.

MEDIA X

Media X is an industry partner program that stimulates and promotes interdisciplinary research at the intersection of people and advanced communication technologies at Stanford University and disseminates the results of those activities through coordinated events.
It is affiliated with the H*STAR Institute (Human Sciences Technology Advanced Research) Institute.

RESEARCH THEMES

PARTICIPATION

Fusion of virtual and real environments. Research that explores the processes and tools by which experiences in virtual and physical worlds are harmonized and synchronized for advanced human communications.

Online media content. Studies of online content that evaluate consumers as publishers or establish ontologies of content.

Learning and training. Research about interactive technologies related to learning and training, focusing on the integration of technology and an understanding of human psychology and social behavior to enhance understanding and performance.

COLLABORATION

Interactive technologies for social interaction and collaboration. Research about interactive technology used in social interaction and collaboration in productivity contexts, including synchronous and asynchronous uses of text, graphics, voice and video.

Use of mobile devices in collaboration. Research about mobile device centric interactive technology used in collaboration in the context of multimedia.

HUMAN-MACHINE INTERACTION AND SENSING

Human-machine interaction and sensing. Research on human-machine interaction and sensing that focuses on the detection or sensing of human-comprehension, emotional states, gestures or touch.

Sensing and control. Research on the integration of technology and the understanding of human psychology and social behavior that can lead to new technologies that enable natural interaction with information and physical world.

Emotion detection from video detection of facial expression. Research on emotion detection from real-time video capture of facial expressions to enable vehicles to automatically perceive driver emotions and determine the driver's alertness/fatigue in order to provide a reliable and actionable safety index.

IMAGE, SPEECH AND LANGUAGE PROCESSESING

Natural language research. Basic and strategic research, training and technology transfer in speech and language processing.

Video processing, cataloging, retrieval, and reuse. Research about interactive technologies related to video processing, cataloging, retrieval and reuse, with a view to the development of automated systems to support video libraries.

FORM FACTORS

Mobile devices and alternative form factors. Research about mobile communication devices and services focusing on the device itself, the use cases for that device, the interface employed to render that device useful, and the connectivity opportunities and needs required to make that device part of the "connected" computing ecosystem.

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ACKNOWLEDGMENTS

Media X at Stanford University is a collaboration of Stanford and industry members that brings together Stanford's leading interactive technology research with companies committed to technical advancement and innovation. Media X is affiliated with the HSTAR Institute (Human Sciences Technology Advanced Research) at Stanford University.

The Media X research network sponsors new research by Stanford faculty and researchers on basic issues regarding the design and use of interactive technologies. The multidisciplinary projects that result influence the next generation of commerce, learning and entertainment. Media X research focuses on people and technology — how people use technology, how to better design technology to make it more usable (and more competitive in the marketplace), how technology affects people's lives, and the innovative use of advanced communication technologies in research, education, art, business, commerce, entertainment, communication, security.

Wallenberg Hall offers state-of-the facilities for a wide range of Stanford classes and research in learning and interactive media. In 1999, Building 160 was chosen to showcase the University's commitment to advances in the education process. The interior was completely redeveloped with a generous $15 million grant from the Knut and Alice Wallenberg and Marcus and Marianne Wallenberg Foundations in Sweden. The Wallenberg Hall gift is the largest such grant from this foundation, and the first made outside of Sweden. From the soaring Peter Wallenberg Learning Theater and technology-enhanced classrooms on the first floor, to the research center on the fourth floor, Wallenberg Hall is a working laboratory where the learning tools and methods of the future are being forged.

The production of this monograph was made possible through generous support from **F/X Palo Alto Laboratories, Inc.** whose user interfaces, multimedia systems and applications, smart environments, document processing, and collaboration technologies are used in interactive multimedia documents and in distributed collaboration.

This digital document is formatted for horizontal, two-sided printing.

EDITOR'S NOTE

Many thanks to Chuck House, whose vision it was to organize this workshop and bring these thinkers and practitioners together to share their knowledge, concerns and inspiration. The concept for this monograph originated with the desire to memorialize the great ideas and suggestions for integrating new insights into the opportunities for research conducted under the auspices of Media X at Stanford University. It is hoped that this workshop will be the first of many that bring together thinkers and practitioners on this topic.

Initially, only the last four presentations were summarized: Martin Fischer's "Connecting Groups: Summarizing Wednesday;" Renate Fruchter's "Who Uses Tools For What;" Neil Jacobstein's, "Imagine the Futures We Could Create Together;" and Byron Reeves' "Tackling the Intractable." Much of the meaning in these presentations was derived in reference to the presentations given earlier in the workshop. Thus, including summaries of all of the presentations was essential. Some of those presentations had been video-taped, and those reference videos were used to prepare summaries. These reference videos are available online through links at: http://mediax.stanford.edu/2007_BEVT/ Summaries of the remaining presentations were created from notes, reference materials, and handouts provided at the workshop.

Any misrepresentations in this monograph of the scholarly wisdom and personal insights shared by the participants and presenters are solely attributable to its Editor, whose intentions were honorable – and intended to retain the richness and breadth of the insights presented in order to make them available for the workshop participants and others.

The impact of this workshop on Media X research initiatives can already be seen at the time of this monograph:

- Regular Tuesday and Thursday discussions, virtual "tea times," were held in Media X Works for 3 months following the workshop;
  an online conferencing system was used for several months.
- Online reference videos of many of the presentations also extend the collaboration enabled by this workshop.
- The insight session at the 6th Media X Annual Meeting, "Collaboration: People, Creativity, and Media," evolved from this workshop.
- Tools adopted for ongoing use at Media X following this workshop, include:
  - NCast
  - Qwaq Forums
  - Sun Wonderland
  - Decision Theater presentation format for iRoom layout
  - Geographic visualization for community involvement

INTRODUCTION

Background on the Summer Institute

Charles (Chuck) H. House

The Wallenberg Summer Institute, in its 4th year, is a Stanford-sponsored program that takes advantage of the Wallenberg Learning Theatre and Learning Hall enabled by the Wallenberg Foundation for one of Stanford's oldest buildings in the Main Quad, fully restored for international educational outreach capability in 2002 after the Loma Prieta earthquake damage.

For the 2007 Wallenberg Summer Institute, Media X sponsored a Workshop: Building Effective Virtual Teams: Tools, Techniques, Best Practices and Gotcha's for Creating and Leading Distributed Teams.

This intensive workshop featured leading-edge research answers for companies using teams in multiple locations, especially off-shored or outsourced teams. New tools and methodologies as well as key research conclusions for what works and, importantly, what has been awkward, difficult or even disastrous were covered. Participants were expected to share their own approaches, results, and current concerns. Discussion was wide-ranging.

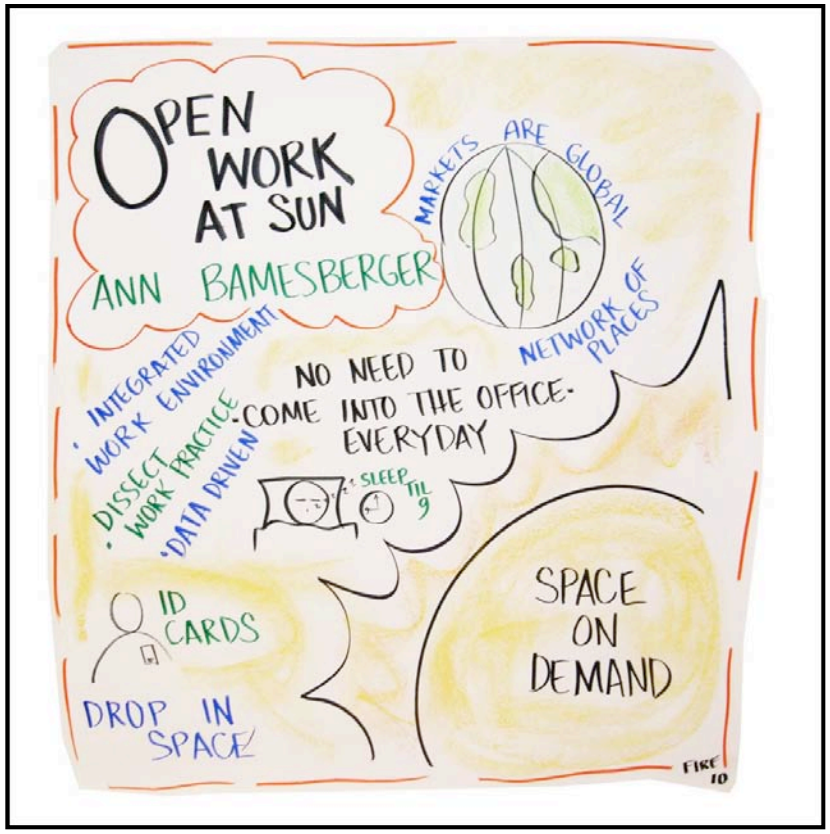
The impetus for Media X to conduct this workshop grew out of Media X research that revealed an astonishing set of facts – more than a million professional workers at six large multi-national high-technology firms were part of a study which showed that three-quarters of these workers work weekly with colleagues "at a distance", often on another continent. Two-thirds of this group work on three or more such "teams" in parallel. More importantly for the sociology of leadership and team contribution, twenty percent have never met their direct supervisor face-to-face, and half of them never expect to do so.

Among the key questions the workshop was designed to address were – Can you say "no" to your boss' idea if you have never met face-to-face? Can you expect promotion as easily if you have never met? How do you persuade a group for scarce resources for a project if you've not met? Tools and techniques to aid these difficult interfaces, as well as methods and experiences in this realm, were brought and described to the practitioners who attended.

THE NEW TEAMWORK CHALLENGE

Open Work at Sun Microsystems

Ann Bamesberger



The new work realities include global markets, global talent, a workforce that is knowledge-based and working in multiple locations, and work activity that is more team-dependent.

Many private and public sector organizations will fail to yield maximum results promised by the new work realities because they are entering the participation age with a work environment that was developed for the industrial age. Leading organizations are looking to open work operational models to help bridge the cap – anywhere, anytime access for the enterprise: workspace, organization and technology enablers.

Employees have a growing desire for flexibility and choice. As a result, there are significant changes in work styles and work needs. Ten years into these changes, we are organizing for the reality that the computer is the network.

In the Sun Open Work Environment, an integrated suite of programmed resources support flexibility and mobility allowing employees to:

- Work from a connected network of places, reserving workspace in Sun offices and drop-in centers around the world, connecting with people and resources from anywhere;
- Choose among three work options: flexible work anywhere (48% of employees elect this), work primarily from home as “home assigned” (now 8%) or “Sun assigned [primarily from Sun office (44%)]; and
- Receive on-demand support resources, tools and services: work space files, telephony information, local and distant applications, training and education, collaboration tools, access to co-workers.

Bringing the work to the worker is changing the work environment significantly. People use their own money to buy stuff then expense it. There is a sense of empowerment and we see more renegade activities. Technology takes an enabling role – connecting the workforce with the people and information they need regardless of location. For example, employee cards have chips (“Sun-ray”) that hold their identity (utility computing), and the session follows the employee.

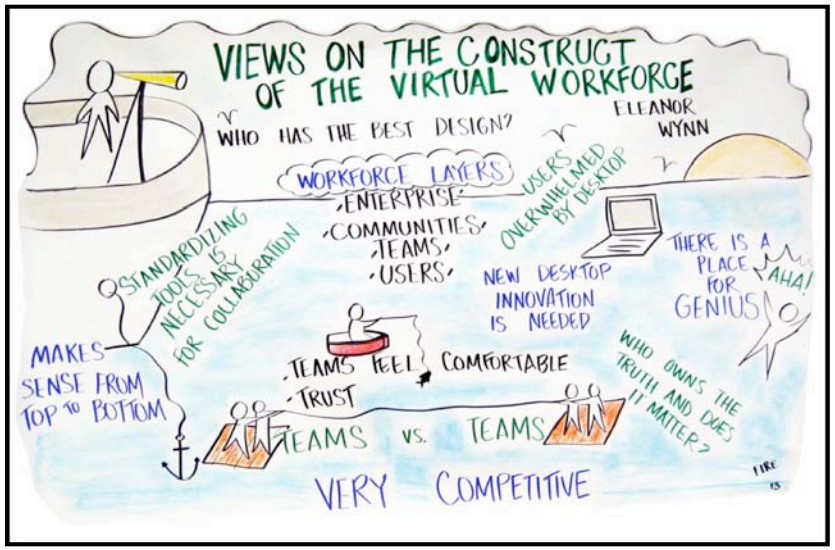
Open work also has green advantages and lowers employees' costs of working. Extensive commute times translate to higher personal costs of working and unnecessary energy consumption. In 2000 the 75 largest metropolitan areas experienced 3.6 billion vehicle-hours of delay, 5.7 billion gallons (21.6 billion liters) in wasted fuel, $67.5 billion in lost productivity. On average in 75 US largest cities, in 1982, commuters faced 7 hours of travel delay/year. In 2001, commuters faced 26 hours of travel delay/year [Source: Texas Transportation Institute, 2003.] I presume this is "additional delay" on top of "travel time"

Sun's Open Work services initially evolved from a corporate initiative to save money in real estate by identifying alternative work environments for employees; the early insights came from carefully examining work practices. Now Open Work is a revenue organization that sells products and services to customers, moving in the direction of virtuality. One of the challenges of bringing change into a corporation is dealing with really smart people, who have firmly held belief systems. For years Sun had technology that was very constrained because of loyalty to our own platform. Now we have a network of places – combining new best practices with new ways of using existing space.

The organizational and operational infrastructure continues to present some challenges. And, additional macro level issues arise as public and private sector organizations rethink how they operate their business. Our culture relies on proof by data – a belief in numbers. Sun uses a goals-driven process that is based on strategic choice to measure and manage business processes.

Views on the Construct of the Virtual Workforce

Eleanor Wynn



A "workforce" is a huge and amorphous concept. At Intel, a functionally distributed international company, I have found analytical layers to be useful when considering virtual teams; the layers I use are: the enterprise, communities, teams and users.

Social media, wiki-style applications, and social networking applications are fueling communities of practice, creating content. Teams, one or more people working on a deliverable, are globally distributed and departments are functionally distributed. Daily interaction, communication and sharing are vital to companies in which everything is distributed across the globe. Managers and executives are important players at each level, and they often participate in communities and on teams.

Intel employees work on a variety of teams. Roughly two thirds of Intel employees work on 3 to 5 (and up to 10) teams at one time. This is because the business in international, daily teamwork requires visualization of work flow across the globe.

How do you understand assignments you've received? And how do you backtrack through the layers of decision processes for the assignments that were sent to you.

An innovative enterprise consists of dynamic flows in the hierarchy of users, teams, communities and enterprise. When rapid change is mandatory – like today's turbulent, fast-changing environment – information flows must be optimized through strategy, information and training. Power to the edge, some call it. Network centricity, according to others, requires a flexible information infrastructure. There is an essential tension between "command-and-control" and tactical freedom. You cannot have total line-and-command total control in asymmetric situation.

The concept of "agency" among organizations and actor networks is that they are interdependent. Complex systems rely on an agent-based model. Actors and agents that are independent and can – in any given situation – respond in more than one way.

Social networks theories contradict the concept of the "lonely genius" working in his own thought world. While there is a place for an independent genius, innovation in the system generally arises out of the network and the communities in it. Communities can grow out of current teams, historical teams, wikis, people working in proximity, distribution lists, key topics, and social networking

Within small contiguous groups (which can mean distributed – infrequent communication) there's not that much new information. If you're randomly distributed or look randomly around the world for new information, you don't have the context of relevance of that information.

There's a network structure that facilitates throughput throughout an organization. Take the dense networks and build bridges across them. There's a certain amount of interdisciplinary robustness. You can't have everyone talking with everyone else. In a globally distributed organization of 85,000 people, this turns out to be pretty important.

We already have social networks that function quite well on a geographic basis. But if you want to reach out of your local community, the bridges can be helpful. The idea is that rather than going to a central place, extraction software filters your incoming/outgoing network, builds information about you and then describes you. People can find you by searching on various descriptors that they apply.

One of the things you get with networks is hubs. In a cross disciplinary network, hubs form vital components of the network. Not everyone can be a hub; some people need to be at the edge. Because people are distributed, they all need technology to network – whether they're at the center of a hub, or participate in many hubs, or are at the edge of one or many hubs.

Sociograms are static and presume established communities. More important insights can be established about dynamic networks. Sociograms are done by survey and take a snapshot of what you do. Thus they are actually recording what you say and who you're communicating with.

What I'm interested in is what's the network configuration that results out of using these types of tools. Do we change the network typography and is it the typography we want?

The objective is to help people be productive across time and teams, and cultures. Multiple teams, multiple tasks, multiple applications per task means an exponential explosion on the desktop, producing a cascading effect across several layers that can overwhelm users. People switch applications/windows once a minute and have a search/repeat rate – covering the same pathways – nearly one third of the time. Some believe that windows are not productive for workers in this context.

Desktop innovation is necessary for multi-teaming, multi-tasking, managing information, visual navigation, and coordination across time and space. Context retention is important in multitasking.

"Virtuality" in the enterprise is defined by discrepancies from past practice in working across time, space, business units, culture (native language and dialect), media (work practices and software tools), and responsibility (within the individual and multi-teaming.)

Discrepant software tools make work harder for users and communities. One of the best productivity tools for virtuality is standardizing on software tools. Multi-taking, multi-teaming.

People know how to think, they need to learn how to connect. When users connect, they have the ability to share language, share cognitive spaces, and share abilities to articulate. Social networks create innovation by spanning contexts. The highest rated measure of team performance is feeling comfortable with your team members. The second highest rated is trust.

IT infrastructure is an iterative stack that includes social/work/network analysis, application and user interface design for objects and with context retention, scalable architecture, infrastructure to support mesh networks, and extreme processing power. A design team, for example, might include hardware design, hardware engineering, software design, and software engineering; and even across those fields the boundaries are not distinct.

Exploring Virtual Worlds for Research Teams

Martha Russell

Early in 2007, Media X initiated an experimental virtual world, Media X Works, using the Qwaq Forums platform. Our goals in creating Media X Works were to open a wider channel for communication with Media X partners and to promote Media X accomplishments and research interests for the 5th Media X Annual Meeting.

We began by using the virtual world as an enhanced website for the Annual Meeting, providing additional information about speakers and events, using the virtual environment in projects and classes and by documenting the experience for further understanding. Attendees were provided passwords for access, and student hosts established in-world presence to host visitors. Other in-world activities focused on courses, research projects, labs and teams.

Building on insights about avatars and interactivity, about attention and perception, and about access and rewards that have been developed at Stanford University through Media X, a research campus was created for a class on the Psychology of Media, in which student teams took residence in research cabanas – to create experiments that tested theoretical perspectives, and serve as respondents of each others experiments.

One team created a “war room” of exhibits and posters, reporting their research on “Wireless Video Networks.” Another team transferred a 3D replica of their lab into Media X Works, as an exhibit.

Media X Works was created as a tool for synchronous and asynchronous communications, with the objective of sharing new findings – a Virtual Community, by the classification of collaboratories developed by Bos et al.

CLASSIFICATIONS OF COLLABORATORIES

Bos et al.

	Tools (Instruments)	**Data** (Information)	**Knowledge** (New findings)
Aggregating (loose coupling, ~ asynchronous)	Shared Instrument *Keck Observatory*	Community Data System *Protein Bank Wikis*	Virtual Community *Learning Community, Community of Practice*
Co-creating (tighter coupling, ~ synchronous)	Community Infrastructure *Grid Physics Network*	Open Community Contribution System *Croquet Consortium*	Distributed Research Center *Host Response to Injury*

Engaging faculty members, researchers and students in exploring virtual worlds through Media X Works revealed different motivators for those primary interest was use of the virtual environment and for those whose primary interest was the creation of the environment itself. Although the experiences are still evolving, a few observations can be made.

Cultural practices of the research team were important for those motivated by the use of virtual environments. The most eager adopters came from teams in which students were able to enter this uncharted, ambiguous realm with minimal faculty involvement. Participants with a willingness to improvise in front of others moved faster than those motivated by creating a new backstage area for their personal experimentation. Virtual team culture in scheduling meetings in world and in presenting intermediary vs. final results appeared to be consistent with real world attitudes and behaviors. None of the early adopters choose highly unpredictable problem sets or highly urgent communication objectives for these early experiments.

The adoption determinants for those primarily motivated by the opportunity to create centered around the resources (mainly time but also media fluency) required to enter and navigate the virtual world, as well as to adapt existing and create new objects, artifacts and documents for the environment. In all cases, the early participants committed staff resources to create the virtual environment without the concomitant commitment to its ongoing maintenance.

Our early experience with this virtual environment for research teams includes several preliminary insights. There is strong appeal of a persistent, immersive environment for dialogue and visualization by virtual research teams, especially for one in which the interaction can be tracked and exposure can be controlled. Entering Media X Works requires the download and installation of client software, as well as use of a username and password. These requirements were easily communicated and supported in the classroom utilization. However, among research teams accustomed to open online access, and in spite of disseminating instructions for the protected access, traffic was modest. We attribute this to a possible disconnect between the open promotional objective (for the annual meeting) and the time and effort required to surmount the software/login thresh hold and to the possible absence of shared expectations among team members about what works, who leads/follows, and how other types of team communications may change to accommodate those in virtual worlds.

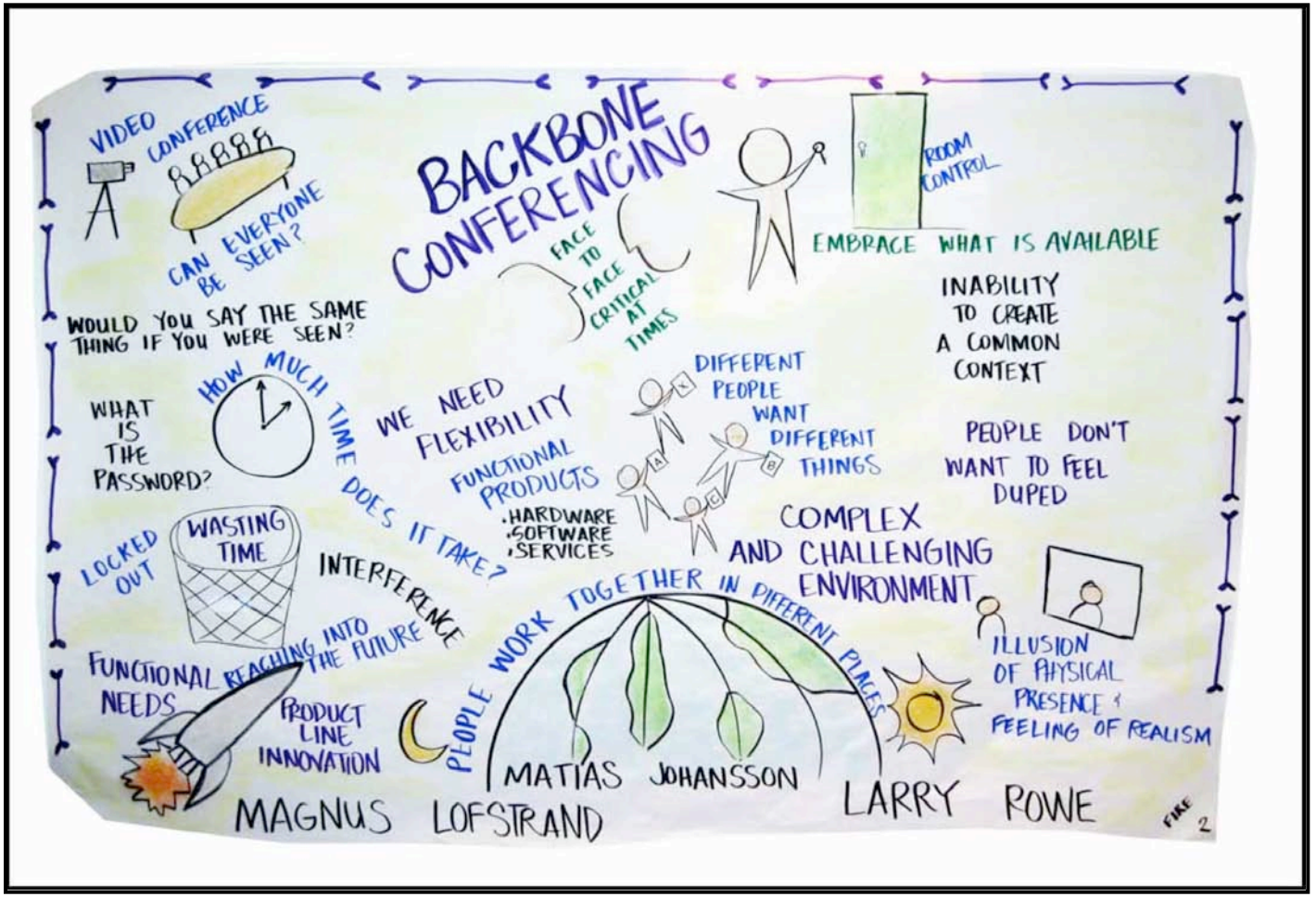
Our continuing explorations are motivated by several additional insight objectives.

- Regarding the common knowledge that teams build and share, how do virtual worlds assist team in indexing the larger context? Does the persistence of content in a virtual space aid individuals' retention content and ideas from that discussion? What is the impact of increasing the social cues and information on construction for the team's common knowledge about the discussion?

- Regarding the team's work itself, what aspects of virtual environments influence the efficiency and accuracy of forming impressions? When do team members' communication about their networks and organizational contexts facilitate their work as a team? What processes will expedite efficient flow of work across virtual and physical realms?
- Regarding trust and community, how do the media through which team members interact influence trust and a sense of community?

Experimental activities include risks and uncertainties. Taking cues from veterans of other risky activities – rodeo riding, for example – one important ritual is to acknowledge the effort, learn from all attempts, and to "Celebrate the Dismount!

TOOLS FOR VIRTUAL TEAMS



Backbone Conferencing

Larry Rowe

Things can be done on a small scale that may not work when you scale up a system for widespread deployment.

I will share some experiences and perspectives on three categories of challenges that I believe are important for actually making rooms usable: 1) lecture capture, 2) room and presentation control, and 3) collaboration at different times.

Lecture capture for on-demand replay works well. It is widely used in academic circles, with more limited use in commercial sector. At Berkeley, we built a lecture capture system for classrooms. We captured lectures, and we published the video on the web. Several tools that enable lecture capture include: the Berkeley Lecture Web casting System; the NCast Telepresenter – lecture web casting system, which permits high quality RGB capture, PIP function that allows slide and video combinations, as well as branding; and the FXPAL Projector Box, which allows slide capture and search using a searchable index based on the words on the slides. And several companies provide turnkey solutions: Accordent, AnyStream, NCast, Sonic Foundry, etc.

The technology is available, and people know how to use it. However, improved searching and authoring tools are needed to make these technologies more effective. Progress is underway. For example, the FXPAL Presentation Box (PBox) supports image searching. Automatic Synchronization Technologies support captioning and audio search. Video search is extremely challenging, and the best results are achieved by searching text metadata associated with video.

Many experiments are underway regarding tools for note taking functions in lecture capture systems. The U of Washington Classroom Presenter and Georgia Tech's Classroom 2000 are two good examples. The bottom line is that tools like these change what you do when you go to a meeting. When you know the capture system will let you revisit things that are presented, you can concentrate on the meeting rather than taking notes.

The real challenge is synchronous collaboration over distances. Some aspects of this challenge include: echo control and spatial audio; low latency end-to-end communication (<400 msec); and floor control and social interaction cues. High definition video conferencing tools (Cisco, HP and Polycom, for example) offer an improved environment for small groups, but at a higher cost The biggest challenge is to make sure people can see each other. Seeing the nonverbal cues for question asking and turn-taking is key to the interaction.

Another frontier is room and presentation control. The conventional solutions to the problem fall short. One needs to record information in a way that people can easily play back later. A presentation room usually includes a computer, a projector, an audio system and an internet connection. The computer may be permanently installed or may be a laptop that presenters bring in themselves. For legal reasons and to assist the hearing impaired, the audio projection may be enhanced. Some new tools are available (e.g., FXPAL USE/DICE) that evolved from FXPAL experiments (e.g., ePic, ModSlide, and NoteTaker.) Technology has improved the experience, but there are still many challenges, which include:

- Who knows the password on the permanent computer?
- What if the portable laptop does not work with the projector?
- Is the correct software installed on the permanent computer?
- How do you play a video tape or DVD?
- How do you connect a laptop to the network?
- Does the projector handle the laptop screen resolution?

These are straightforward problems that can be solved by careful room and system design and good operational support. But what happens if you want to switch between presenters during a meeting, use multiple screens, invite remote participation, capture the meeting for on-demand replay, point to physical objects from a remote location, or share applications?

Conventional systems that integrate the control of all devices used in a presentation room are limited. [Each device has a remote control.] With so many remote control devices and different ways to connect to the devices (e.g., analog, IR, serial or IP interfaces), configuring and using universal remote controls (e.g., Sony, Harmony, etc.) is complex. Commercial room control systems (e.g., AMX, Creston, etc.) that have replaced the remote control with embedded computer and custom-designed user interfaces do exist, but a "guru" is often required to operate the expensive and inflexible system. The FXPAL DICE system provides a task-oriented simple user interface with a scalable, flexible architecture. FXPAL researchers have experiments with different tools for improving presentations and meetings. For example, we have experimented with a gesture control interface for copying images projected on one screen to another screen during a talk. ePic is another tool we experimented with that allows a presenter to author off-line the sequence and location of slides and screen(s). This tool makes it possible to present a dynamic multiple screen presentation. However, neither system has been widely adopted by others in the laboratory for several reasons including reliability and flexibility. We are continuing to experiment with new tools and improved versions of these tools within the DICE system.

Two important problems for room control systems concern the equipment being used. Many pieces of equipment do not support all the operations needed. For example, a well-known problem with many audio/video devices is that you cannot execute the operation "make the device by ON." Typical devices do only support an operation to toggle the current state (i.e., "turn OFF if ON" or "turn ON if OFF"). Since there is no operation to test if the device is currently ON, you can't control the equipment if the power state is different than what the control software thinks it is. And second, we need a "plug and play" protocol for devices. Rather than having to manually configure the equipment in a room, it should be possible for the control system to "query all devices" to discover what equipment is in the room and how it is connected.

Everybody here knows about collaboration tools. However, many of you may not have seen the Access Grid for N-way collaboration, developed by the university and the government research communities. It uses a contiguous display that shows applications and videos from remote sites. One commercial company is supporting this product (IOCOM) and there's a large research community experimenting with the technology.

Some technology developed at FXPAL, the iLight System, allows remote people to collaborate using a physical object at one location. The object has both a camera and projector pointing at it. A software system grabs video images and sends them to remote participants. So, remote people can see the object. They can also draw annotations on the video displayed of the object. These annotations are projected back onto the physical object so that local people can see annotations made by remote people. And of course, annotations drawn locally are captured by the camera for remote people to see. This technology is currently being commercialized by Fuji Xerox.

Let me also show a remote avatar for remote conferencing, built by FXPAL. This avatar is a physical object, a screen with an image of a person, controlled by a motor that can tilt and pan the screen. A camera is mounted on the screen so the remote viewer can control who or what he looks at. There are also microphones and speakers on the avatar so the remote person can communicate verbally with other participants in the meeting. You put the avatar in the remote room and control it by a joy stick. You can even use the screen position to show emotion. The screen tilts down to show lack of interest; the screen can nod for agreement or disagreement. Interestingly, the screen doesn't go away if the user leaves the room.

Collaboration at different times requires high quality video teleconferencing, physical object collaboration, and remote physical avatars. The opportunities for collaboration technologies are substantial, because globalization requires teams that work together at different times and places. Collaboration is difficult even when in the same time and place. And technology can provide tools to improve collaboration. It does surprise me that many of these tools have not taken off at a faster rate than they have.

Alkit Confero Software

Mathias Johanson

I'd like to tell you a bit about a system called Alkit Confero, developed at Alkit Communications in collaboration with Lulea University of Technology. We have used this system to connect groups in different locations so that it appears as though they were sitting in the same room.

It is software solution for collaboration. It runs on Windows and Linux machines and soon will run on Macintosh as well. One of its main benefits is its flexibility to run on both low end and high-end systems; the output quality scales with the bandwidth. It's efficient in terms of multipoint communication through multicast or reflector, and it's based on IETF standards.

Alkit Confero has advanced properties, which include robust video transmission through adaptive forward error correction. Different video codecs with different characteristics can be used. It will handle advanced video processing, such as stereoscopic video, chroma-keying, open captioning and graphical annotations. It supports transparent firewall traversal, adaptive (congestion) rate control, remote camera control, and high definition (1080i) video support. It can support multipoint sessions.

We expect it will used in distributed collaborative engineering and design, such as synchronous sharing of complex product models, meeting documentation support. In our system when you have a session going on you can make textual annotations that will be stored with the media; a snapshot of the video at the time of the annotation is created and stored. Any participant can contribute to these annotations. And we have experimented with video communication in natural size to increase the illusion of physical presence and the feeling of realism – using a 50" plasma screen in a portrait orientation. When you want to convince someone, you want to be able to use your full body language.

When promoting these technologies with new groups, people's perceptions about using the technology are very important. It's very difficult to try to sell the concept to people who do not have a technology background, who aren't comfortable with the technology. Some say good audio is more important than video. I disagree with this position, because video has the added benefit of providing "presence." This feature is important for uses such as interpersonal video chat and distance education.

Another feature of our system is stereoscopic video communication; this requires two cameras mimicking our two eyes, to give higher realism and true depth perception through stereopsis. We also expect this feature of the system will be used in telemedicine, especially remote robotics applications.

Challenges in Distributed Work at Luleå University of Technology, in Research and Education

Magnus Löfstrand

I'm going to challenge your thinking about productivity based on collaboration and some challenges we have identified in the Faste Laboratory, based at Luleå University of Technology in Sweden and at the Division of Computer Aided Design.

In our research we consider how we develop things we want to sell as functions rather than as products, for example torque per hour rather than a motor. We believe this perspective makes a difference in how we develop technologies. We want to develop innovative methods and tools to support industrial innovation as well as development and sale of productivity based on functional products.

For us the functional product includes a composition of hardware, software and services. The main driving forces are total life cycle commitment, the extended enterprise settings, issues of sustainability, ecology and economy, and – of course – added value. We work within multiple business models that include traditional transactions, business partnerships, and extended enterprise models.

In our approach we simulate outcomes before actually developing the tools, using a simulation driven approach. The application areas include engineering and work processes to support business processes. The simulation driven approach simplifies knowledge reuse and allows for shorter reaction times to changes in the business domain.

This is the setting in which we at the Faste Laboratory look for business problems and research issues. Our network includes nine companies around Sweden and six divisions at the university.

In our distance education various tools are in use and teachers and students naturally have different needs, experiences and preferences that need to be taken into account. Breaking through old paradigms must rely on meeting people's needs. These issues are an important input in developing methods and tools that support effective and efficient virtual work.

Thus, in research and education we see a need for a support system that will make working with media technologies over distance easier. We need stable and flexible collaboration environments that are interoperable, accommodate the extended enterprise, and support total life-cycle commitment. Creating a productive, distributed environment is challenging! Creating tools that improve productivity makes it even more so.

Interoperability and usability needs further work before we can create support systems for effective virtual work that truly supports productivity. With a commitment to the total life-cycle in an extended enterprise setting we work to harness the diverse cultures and competencies of a global team to optimize creativity.

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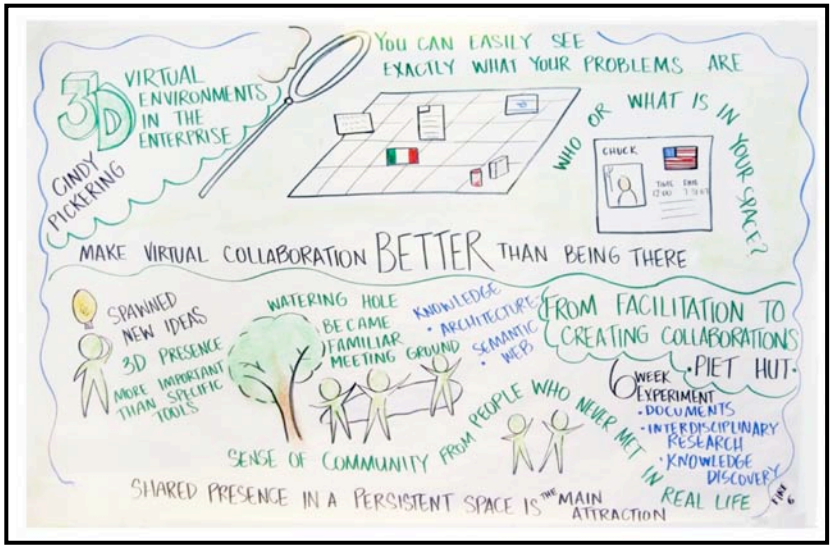
3D Virtual Environments in the Enterprise

Cindy Pickering



Intel IT's vision for global teaming is to make virtual collaboration better than being there. Our research has identified several unique requirements for global team collaboration at Intel. We discovered that two-thirds of our employees work on distributed teams and the same percentage also belong to multiple teams. Many of these teams are distributed across 2 or more global regions with large time differences in their normal work days, making it difficult to meet in real time. Some people have never met the other members of their team(s) from international sites. English is often spoken as the second language, rather than the native language. These and other data led us to seek a solution that would seamlessly support the complexities and challenges discovered while enhancing team and personal productivity.

To adequately represent the complexities, we needed an object-oriented information workspace where the use of a 3D user interface allows users to experience shared presence in a persistent space and retain multiple contexts. We chose an environment already developed by Intel Research, Miramar, as a prototyping vehicle

Miramar was originally designed and constructed as a single user 3D workspace for Intel employees to organize documents and other information. Its simple, easy to use navigation and intuitive visualization represented groundbreaking research in 3D human computer interfaces that also culminated in 10+ patents.

Miramar's transformation into a multi-user collaboration workspace - while still retaining its core capabilities – has posed significant challenges, some anticipated, some empirical.

What is really unusual about Miramar as we know it now is that it aligns across several vectors: it has a very robust usage model based on four years of workforce trending data, machine learning data, and ethnographic data; it has a phenomenal user interface that, previous to this usage model was an application in search of a need; and it overlays an attractive navigational face onto a state of the art scalable architecture, that without that UI and that usage model was just a cool open source developer playground.

They all line up, which is an example of how technology innovation really ought to work. It can take time to get that convergence—just as there was a long interval between the development of TCP/IP and the full-blown Internet/World Wide Web as we know it.


ANIMATING THE ARCHIVE USING SECOND LIFE
HENRIK BENNETSON
WHY PUT A ROOF ON IF IT DOESN'T RAIN?
HOTEL DANTI
•ENABLES SHARED EXPERIENCE
•WHAT'S THE INTERNET ALL ABOUT?
WEB
INTERNET SPACE
A ROOM OF YOUR OWN
GREG NUYENS
You can put the web in your virtual space
ENVIRONMENTS FOR BUSINESS OR CHILDREN
SHOULD IT CHANGE IMMEDIATELY TO WHAT YOU DO?
PEOPLE MORE RESPONSIVE TO COLLABORATION
WE WALK BACKWARDS INTO THE FUTURE
SENSE OF COMMUNITY
HOW REAL IS THE VIRTUAL AND HOW VIRTUAL IS THE REAL?
MEDIA X
MARTHA RUSSELL
CELEBRATE THE DISMOUNT
TOOLS DATA KNOWLEDGE
PEOPLE WANT TO BE SURE OF WHAT THEY ARE DOING
NO SURPRISES
PERSISTENT IMMERSIVE ENVIRONMENT
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5

Qwaq Forums: Virtual Spaces for Real Work

Greg Nuyens

Like physical offices and meeting rooms, Qwaq Forums provide virtual spaces where you can work, collaborate with co-workers, and manage your projects.

To get started with Qwaq Forums, you:

- Create a virtual space, choosing from a set of ready-to-use designs.
- Add your materials, by dragging and dropping files from your computer into your virtual space.
- Invite your co-workers to join you. You can share files and work together with applications. Built-in text chat, Voice-over-IP, and webcam support make communicating easy.

You can occupy many different virtual spaces as you work on different topics or with different teams. Using Qwaq Forums is like having your own skyscraper -- you will never run out of working space. Qwaq Forums is designed for collaboration; it has powerful features that simplify setting up and working in highly collaborative environments.

Content is easy to share; simply drag and drop materials from your local folders or desktop into Qwaq Forums and it will be automatically uploaded and made available to other users. Your co-workers can also contribute to the meeting by adding materials as well. Using Qwaq Multi-Share™, you can edit a document together, view web content, or collaborate using an application. Once a task is completed, you can save the material back to your local desktop for further processing.

Qwaq Forums' 3-D environment provides strong feedback on what your co-workers are doing. Using avatars and a unique 3-D pointer makes it easy to see where people are, what they are looking at, what materials they are working on and how they are using applications. Qwaq Forums built-in voice-over-IP (VoIP), webcam support, and text chat provide important social cues to help you work most effectively with co-workers. A Qwaq Forums workspace provides a simple way to link and associate materials with each other and with workflows and business processes. Whether using drag-and-drop to link virtual spaces or simply choosing the spatial relationship between materials in an existing space, you can establish areas of focus for work and for collaboration.

All the work you do in Qwaq Forums is persistent; you and your co-workers can see all previous changes and additions. Everyone on the team can contribute, stay up to date, and hand off work to others as needed. The saved state includes any editing made to documents or materials in the space. This capability provides a powerful way for you to work on projects that cannot be completed in one session and makes Qwaq Forums and ideal environment for on-going projects.

Life Squared in Second Life

Henrick Bennetsen

Life Squared is an encounter with the work of Lynn Hershman Leeson ... in a mixed reality animated archive. On an island in Second Life, building has commenced, constructed of traces, of remains of a past … of regenerated bodies.

For over three decades, in performance, photography, installations, artificial intelligence agents, artifacts, web presences and in movies, Lynn Hershman's work has dealt with what it is to live in a world of mediated, surveilled, documented, translated, manipulated, transformed identities, corporealities, and presences. Ninety boxes of the remains of much of this work now lie in an archive in Stanford University - papers, photographs, tapes, movies, sound recordings.

Documenting the past, we propose, is to actively reshape and rework what remains (of the future). Life Squared is a place where anyone, in the guise of an avatar, may encounter such a prospect - of revisiting and reworking the past. Lynn herself and a team of people are interested in what becomes of what was, in how to document work that has no simple material manifestation (that may be conserved), interested in the nature of the digital archive, in building creative encounters with what remains of the cultural archive, in the memory book, the art museum of tomorrow.

The issues studied in Life Squared include memory, document, encounter, and the sense of self. Memory and documentation are important to understand in terms of how they revolve around characters and architectures, stories, scenarios and "game play." Our argument is that digital worlds, games, online chat rooms and forums like Second Life are not "virtual" worlds, but are precisely "life to the second power" - augmentations, mixed realities (as are memory practices), and enriched encounters. We are exploring a 3D interface for an archival encounter that challenges (perhaps) the metaphoric basis of current machine/user interfaces. For a couple of decades the human-computer interface has been commonly presented as a metaphor - a desktop, with documents, files, trash cans. We are building instead a mixed reality, and it is arguably not an interface with a machine at all, but an extension, an augmentation of experience, of self.

This connects directly with the fundamental issue of our sense of self - so connected with memory and remains of the past. Life to the Second Power proposes that our sense of self is clearly distributed - by this we mean it is made of encounters with friends, family and others, of memories and remains, associations with things, events, experiences that hold no one or particular material form, but constitute, precisely, a mixed reality.

And the memory palace that is Life Squared is itself already distributed across our machines in all sorts of different places - reconstituted in every encounter. Overall we are exploring potential futures for the (art) museum that life is becoming.

HP Halo

Harlan Baker

HP Halo is a telepresence solution that brings meeting attendees from around the globe into an environment that feels as if they are in the same room.

Designed by DreamWorks Animation SKG™ in partnership with HP, Halo is a global, fully managed end-to-end solution that runs on a private network designed specifically for video collaboration Halo delivers fully duplexed audio, company-to-company connections via the Halo network and 24/7 support with concierge service It can connect multiple studios around the world at one time via HP Halo Multipoint

The Halo Meeting Room is specifically designed for installation inside an existing conference room or meeting space. No build out is required, reducing site preparation time and costs and providing more location alternatives.

In the Halo Meeting Room, it looks, sounds and feels as if collaborators are just across the table; participants are seen in full size with natural eye contact and have a "no-perceived-delay" experience.

DreamWorks used the HP Halo Virtual Collaboration Studio to accelerate its production processes and ease collaboration among top animators.

First Responders in Forterra

Parvati Dev and LeRoy Heinrichs

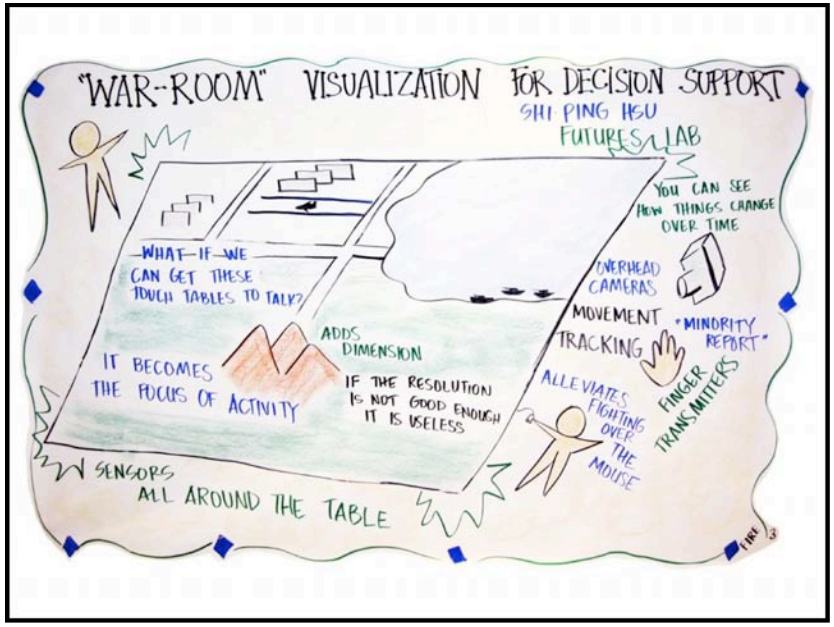
Stanford University Medical Media and Information Technologies (SUMMIT) has partnered with Forterra Systems to develop an application using multiplayer game technology for training medical first responders on hospital management of chemical, biological, radiological, nuclear events, and high explosive events. The application uses scientifically based medical modeling for a real-time distributed multi-user 3-D virtual environment for in-hospital medical first response.

The technology-based training system and a curriculum to provides simulation-based team training for the medical first responder community. Simulation-based training can fill gaps in traditional first responder training techniques by providing experiential training at a fraction of the cost of live training. Trainers can replicate emergency event virtually and can practice their response practiced numerous times with participants who need not be co-located at one facility.

Using avatars created with OLIVE, users can create persistent three-dimensional virtual environments capable of supporting thousands of simultaneous participants connected over a LAN, WAN, or the Internet. In the virtual world, organizations can train, plan, experiment, rehearse and collaborate and immediately apply knowledge gained to real-world problems.

Touch Table

Shi-Ping Hsu



Whether analyzing urban sprawl, terrorist threats, evacuation routes or mission operations, the way we think about and interact with information is changing. Analysts, planners and tactical personnel need to be able to visualize areas of interest while maintaining ready access to data sources. This, combined with the growing need for timely cooperation, calls for innovative approaches to visualization and collaboration, motivated Northrop Grumman to develop the Touch Table.

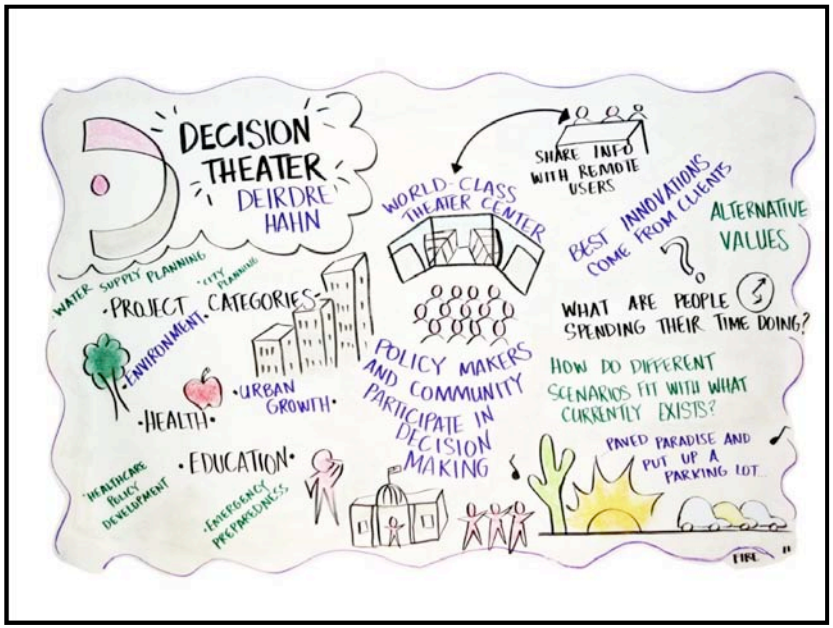
Created by Applied Minds Inc., the TouchTable is a display device that detects the location and movement of users' hands on its surface to dynamically change a projected image in real-time. Moving a hand across the surface pans the display, two fingers moving apart zooms it out, and two fingers moving together zooms it in. This interface allows users to easily change a view from miles above the Earth to a detailed layout of a single city block. Touching a single point on the surface brings up detailed information about that point.

Multiple users can collaborate around the TouchTable's large, horizontal surface and high-fidelity display, which facilitates viewing and manipulating complex data that cannot be easily displayed on standard computers. Multiple TouchTables and other computing devices can be connected to one another, allowing synchronized navigation by geographically distributed groups. This also enables mobile teams to view and quickly assimilate information, leveraging the knowledge base of the extended collaborative team, regardless of location.

The TouchTable can be used in project ranging from intelligence analysis and strategic planning to tactical operations management and emergency response. It combines seamless distance collaboration with the ability to visualize complex information and an easy-to-use interface.

The Decision Theater at Arizona State University

Deirdre Hahn



The Decision Theater at Arizona State University facilitates decision making through the coordination of immersive visualizations and simulations integrated into collaboration technology. This process is used to examine integration options in design and implementation phases, create alternative scenarios, analyze those scenarios and ultimately build solutions for complex issues. The Decision Theater consists of an interactive 3D immersive environment built with cutting edge graphics technologies. The core component, called the Drum, is a 260-degree faceted screen that can display panoramic computer graphics or 3D video content. The Drum accommodates up to 25 people and includes tools for collecting participant input and interaction. This advanced environment enabled individuals to see a detailed 3D representation of the consequences of behavior, decisions and policy in order to examine potential future scenarios.

The Arizona State University Decision Theater connects the science of ASU with the needs of the community. It's a home for policy makers, community leaders, business leaders and others to explore issues ranging from urban growth and the education to the environment and public health.

Decision Theater, coupled with vast intellectual knowledge network of Arizona State University researchers, provides new and emerging entrepreneurs and established organizations with an unparalleled resource. Resources include software applications, tools, solutions and services that extend into regional, corporate and national communities.

What sets the Decision Theater apart from other visualization centers is its focus on the community as client and the inclusion of policy makers as participants. Decision Theater enables decision makers to better "see" and understand the past and present, as well as predict the future through scenario planning. We achieve this by combining advanced computer technology with the expertise of our clients to explore all aspects of an issue or challenge. Our state-of-the-art visualization, simulation, and collaboration services are being leveraged by a wide range of public sector clients and commercial customers. In the past three years, about 6,000 people have used the theater to better understand issues such as how diseases could spread through the Valley, how development in cities such as Tempe and Surprise would look and what the future of the Salt River may hold. Other project examples include:

- Determining the impact of urban pollution
- Visualization water management issues
- Exploring city zoning issues
- Revitalization options for Arizona and California communities
- Understanding hyper growth

- Scenario analysis for Arizona's water resources
- Predicting propagation of West Nile Virus in Maricopa County
- Arizona State 2020 strategic planning for post-secondary enrollment
- Redistricting Arizona's non-unified school districts
- Developing a community park

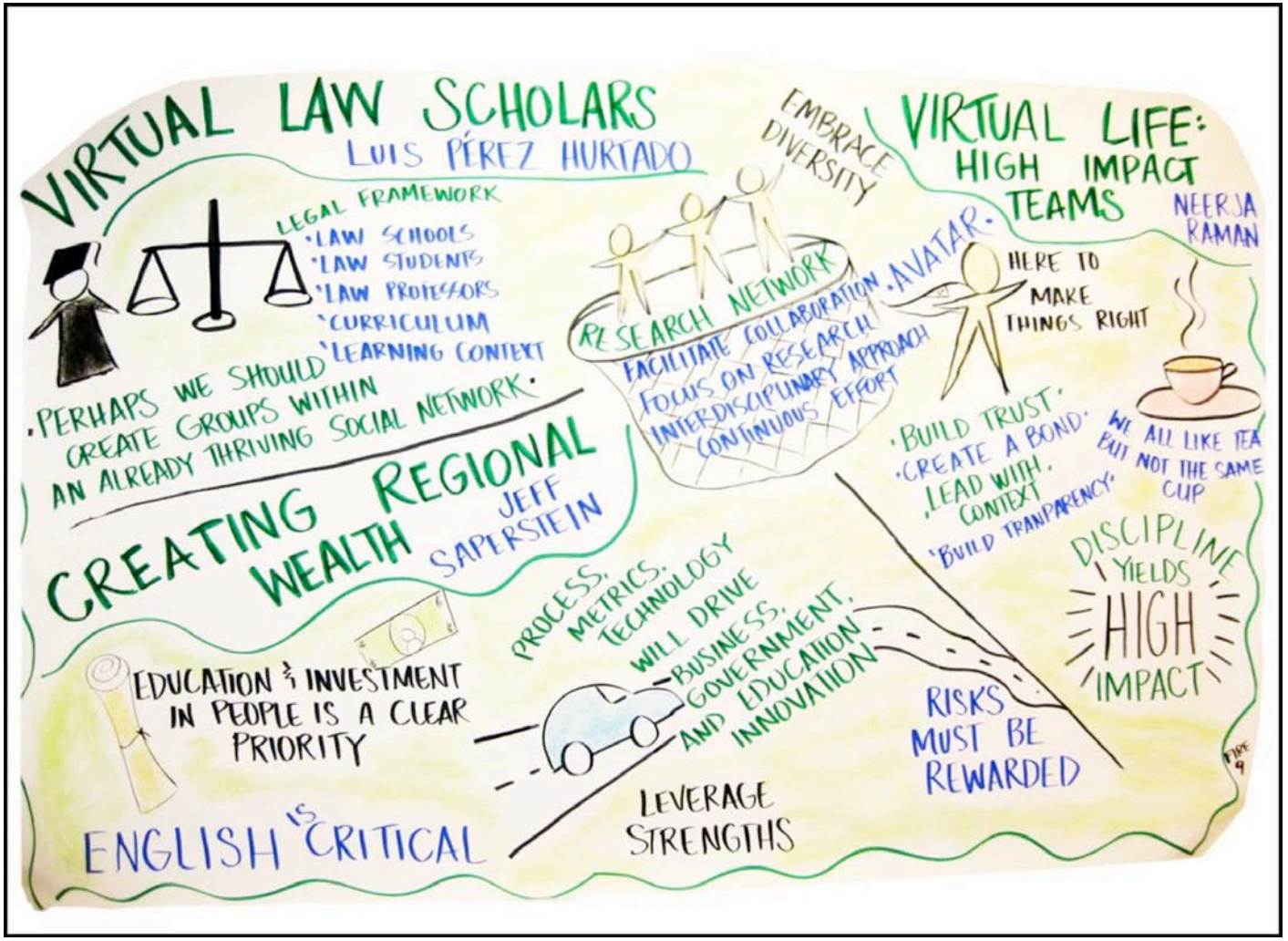
From a specific urban development perspective, the Decision Theater may bring together stakeholders fighting over a planned development - from developers and city planners to environmentalists - to actually see some of the things they're arguing about actually modeled at the Decision Theater.

Using facilitated collaboration, simulations and 3-D models, clients can leverage the DT technology to explain the economic, social and environmental consequences of the plans. Sometimes, the reason groups are coming together is because they have reached an impasse about an important decision.

"Our clients don't come to the Decision Theater because everyone is getting along," Hahn says. "They come here because there is an issue they are facing that…is contentious and could have a major impact on the future of the environment of that community was well as the quality of life of its residents."

The facility is mostly used by clients, who pay for the services, but is open to the public for tours. The Decision Theater also provides services to Arizona State University researchers seeking to enhance their work through visualization representations. These representations can aid in making research proposals and subsequent results clearer and more compelling. Visualizations can also dramatically increase audience level of understanding as researchers attempt to communicate information rich in complexity and detail.

INTRIGUING OPPORTUNITIES



Virtual Law Scholars

Luis Fernando Perez Hurtado, Stanford Law School

In Mexico, legal education is offered by 930 law schools, which are authorized by over 65 different institutions; each one defines its own requirements. Yet, 11% of students in higher education study law. There is no national bar association; in fact, most states in Mexico have more than one association of legal professionals. Legal education is extremely fragmented. Additionally, there is a perceived gap between what is taught in law schools and the skills lawyers need in the workplace.

"Many attorneys work in complex teams distributed across multiple offices: nearly 80 % of lawyers surveyed belong to one or more work teams, with 19% participating in more than five teams. Yet only 12% of law students report working in groups in their classes."

"To teach students how to use technology and work in teams requires that the faculty members also know how to work with technology and work in teams."

A communication and collaboration network has been established, now with a membership of 32 schools, to share information across Mexican law schools. Significant questions include the business model for the network, requirements for participation, and processes for introducing lawyers to use of the new network.

Descriptive vs. proscriptive initiative? What's the resistance to adoption? How can the status concordance that governs social relations be accommodated in an online environment? How do you leverage external pressures to motivate attorneys to want the communication network?

Transformation through Process, Metrics and Technology: Global and Regional Perspectives

Jeff Saperstein

Changing business models for regions and their educational institutions demonstrate that the application of business processes, metrics and technology are transforming all sectors.

Attitudes drives accomplishment in the reverence for knowledge, openness to new ideas, flexibility to adapt, and capacity to work with people from other cultures. The permeable collaboration between government and industry has huge implications for individual career choices.

Where regional growth is created, institutions must work together. Teams must be formed that link low-cost manufacturing and service center to evolve into high end sophisticated regions. Teams must be formed between high end and low end markets (e.g., Taiwan and China.)

Transnational diasporas are great catalysts for regional development. Entrepreneurial risk must be rewarded.

Virtual Life: High Impact Teams Embrace Diversity: Using Images for Cultural Understanding

Neerja Raman

"Avatar" is a common word in the virtual world and an interesting example of the multicultural nature of the internet. The word "avatar" actually means "incarnation." For example, in some cultures an avatar, a God with superpowers, may take the form of a human being on earth to set things right.

As human beings we are distinguished by our differences, but our strength comes from our shared, common needs. Leveraging both these aspects is the key to building high impact teams. E.g. Tea is enjoyed in many cultures; what differs is how the tea is enjoyed in each of the cultures.

High impact teams are powered by people who trust one another, understand one another and are comfortable in their differences with one another. For teams spread over great geographic distances, how do you build a high impact team?

Virtual environments are one solution. But they can also be hazardous. Pretend, for a moment, that you have unlimited bandwidth and unlimited computing power as you do sitting here in Stanford. Now think about what would you do if you had no bandwidth?

In many areas of the world, most of life is low-cost, set up by non-tech personnel. Four billion people live on less than $4 a day. Teams consist of people with unlimited bandwidth as well as those with very limited access to resources.

But, the person behind the tool is the most important component.

And yet, people are together because they have tasks together. People are high impact when they are who they are. You're not going to BE that other person by participating in virtual life. What is important is that you understand who that other person is and that you embrace it.

For example, everybody knows about traffic. But traffic on 101 is not the same as traffic in Bangalore. Local understanding is about understanding what that person's life is like and designing product that caters to or satisfies an aspect of that context. We live in a multicultural environment. Never underestimate the importance of local knowledge.

Take, for example, a health care person in the field taking data, collaborating with another local doctor, who collaborates with remote specialist, who uses a remote database, connected through portal, some local information is matched for scheduling, medical records, etc. Each person on the team has role and status and does their own task within their own framework. All have individual roles – each one is an expert in what they do. High impact needs local understanding.

www.handheldsforhealth.org
Mobile Solutions for Disease Surveillance & Public Health

One is reminded of a syndrome called the Cathedral Syndrome. "Cathedrals are built by stonecutters but stonecutters can't build cathedrals."

To build with trust – use the stone-age behavior: create win-win situations. Global business is about being win-win. High impact teams are about win-win.

Build transparency: Lead with context (I, you, my job, my values, family, community) This requires discipline, but yields high impact. When stressed, we like people like ourselves. When relaxed, we like diversity.

Follow the Share Principle:

- Share status with a culture of trust and respect for the individual.

- Share information – employees deserve to know.
- Share wealth – employee profit sharing, fair wages, employee growth.
- Share the wealth – community is even more important for a glocal company
- Sharing is not philanthropy – make business decisions for sustainability.

We want to go virtual because it's good for business… and it can be fun!

From Facilitating to Building Collaborations

Piet Hut

The main reason that I decided to get into virtual environments was that in astronomy there are few astronomers, they are few and far between, and we always have to travel a long way to work with each other. I had been traveling so much in my life and felt there should be another way. I had been following these collaboration tools. Most were two dimensional and didn't seem to be too interesting, but when the 3-D tools became available, , I decided to try it out.

First of all, I came into this by chance. I was invited by a friend of mind, Michael Nesmith, one of the four original Monkeys and one of the inventorsr of MTV, to give a talk in one of his virtual worlds. Recently, apparently because of the success of Second Life, he formed his own company with virtual spaces – dealing mostly with musical performances, but he asked me to give a talk in his virtual world about astronomy. And it was so much fun that I thought I would use it with my colleagues to really get work done.

Then I came to the Media X conference in April 2007, and it was wonderful to hear that the technology was just about right to get started to do this. So I asked around. And everybody had ideas, and everybody had things in the pipeline, but there was only one company that was offering something I could use right away. That was Qwaq Forums. So, happily they were next door, so the next few days I spent some time at the company. I set up some organizations – one for my astronomy group and one for my interdisciplinary group, since in my work I split my time between astronomy and interdisciplinary studies. The interdisciplinary studies are broadly defined with philosophers of science, cognitive psychologists, neuroscientists, biologists, mathematicians – very broad spectrum. So I had two groups – a group of astronomers and a group of interdisciplinary folks. With both of them, I invited many people to join me.

I expected the astronomers to take off because they were mostly computational astronomers, into simulations. But for the first two weeks it was very hard to get any astronomers in there. However, right from the first week, the interdisciplinary folks came in and they were very excited about it, and it really took off. After a month we had daily meetings, weekly talks, and a few times a month, we had topical discussions about particular topics.

After more than a month – after six weeks or so – the astronomers started to catch on to it and then began using it faster and they immediately started working on projects, and wrote a paper together, using Qwaq – people in Amsterdam and Pennsylvania jointly writing the first virtual reality paper in astronomy.

I think the main reason that the interdisciplinary group took off right away is that there is very little structure for broadly interdisciplinary work. There's a lot of structure within each discipline, and there is growing structure at the boundaries between the disciplines . . . between mathematics and physics, biology and chemistry, mathematics and biology and complexity, etc. But for the really broadly interdisciplinary collaborations, there is almost nothing. So, by providing a forum those few people who are deeply interested in broadly interdisciplinary studies, it's like holding up a bottle of water in the dessert. People come immediately. It's like an oasis. That was very gratifying. And that is still going very strong. I don't expect them to start working together and building things and working with technological tools, they just treat this as a meeting ground, but that's fine.

If I had to build a new building on campus for working in interdisciplinary studies and I had to raise a hundred million dollars, nobody would give it to me because there's no vested interest. But I can build a virtual building for $100 instead, and there we go.

My specific interest in the astrophysics work has been the lack of documentation. The Achilles heal of any astrophysical computations has been the lack of documentation. This is true in any field, in physics, in all of science, in business, but it's especially true in astronomy. People have to write their own code, and time and money are always limited. There is no incentive. You don't get brownie points for writing documentation.

As a result, the code is twenty years old, and nobody knows how it works, and many patches have been made. If you could look over the shoulders of people writing the code twenty years ago, if you would have that luxury, it would be very helpful. But even the people who wrote the code have, by and large, forgotten what they did and why and how, if they are still alive, and if they are still in astronomy. And you just don't have access to that knowledge.

There are two problems. One problem is that many of my collaborators are far away. The second problem is how do I get my collaborators to write documentation?

The two problems can be addressed with one tool. If I have a remote collaboration tool, I don't have to travel around the world to work with a colleague. And if I collaborate remotely with somebody in Japan, every bit of information can be captured. We have our digital communication. If you capture everything, and if you have a certain line of code that you don't understand, you can click on it and you can get the five or ten minutes of the three-dimensional reality recording in which the decisions were made to write that piece of code. And if it refers to something earlier, you can rerun it and go back to that precedent.

You can, as an avatar, move into the virtual space in which the code was written. You cannot change anything, of course. It's a frozen past. But you're more than a fly on the wall. I call it the fly in the room. You cannot push anything around, but you can recreate the situation in which the code was written. And that can help answer a lot of questions.

http://arxiv.org/abs/0707.3021

Let's Make Micromobile Teams (NET)work

Patrick Punte

First of all, I'd like to make a distinction between global virtual teams and micro-mobile teams. Then I will present a theoretical framework that we use to describe and understand teams, and I will talk about a method to design micro-mobile teams. I'll end this presentation with a case study.

When I talk about virtual teams, I'm talking about teams consisting of several team members who are dispersed in location, in time and/or in culture; they use interactive communications technologies to cooperate, communicate and coordinate. Global virtual teams have great geographic distance and low mobility. The team members are more or less fixed to their locations, distributed globally. In contrast, micro-mobile teams are locally dispersed and team members are very mobile. For instance, service or emergency teams in an airport.

TNO is a research institute in The Netherlands. In a lot of our research, TNO focuses on micro-mobile teams: in military as well as civilian domains.

Micro-mobile teams are often focused on operational tasks, needing to react quickly to unexpected and changing situations to accomplish a common goal. Locally dispersed, all team members of a micro-mobile team may be within an airport, harbor, stadium, railway station, or hospital.

To understand team processes, we use a theoretical framework that distinguishes context/input, processes, and outcomes. The processes we consider are task-based and non-task-based – those needed to maintain the team. These processes include cooperation, communication, coordination, learning, social interaction, situation awareness, team awareness, and shared mental models.

Regarding the outcomes, we distinguish individual rewards, team vitality, and organizational outcomes. The context or inputs include individual qualities, team qualities, organizational qualities and technology – or means – to accomplish the task.

This theoretical framework is used to 'design' teams, their concept of work, their means, et cetera. We design micro-mobile teams by focusing on the outcomes first, then assessing the processes, then evaluating the qualities of team members and technologies to be used. Of course each of these components has constraints; it's important to clarify the constraints early in the process.

An example of a research that TNO has conducted is Virtual Teaming at Amsterdam Central Station, in order of the Dutch Railway Organization. The goal of these micro-mobile teams at the railway station is to

provide information to passengers and to coordinate processes during disturbances, incidents, and emergencies. These teams consist of dispersed service employees of different sub-organizations.

When we began, our first constraint to recognize was the separate organizations within the Dutch Railway Organization; cooperation and coordination occurred primarily at the top of the organization. At operational level, cooperation between employees is hindered by conflicting priorities, conflicting information, poor communication means and interoperability, and even distrust. Our task was to improve the integration of those departmental organizations within the larger enterprise. Our goal was to help teams of dispersed service employees evolve from centralized to self-organized teams for coordination and information.

To support the teams, we developed wireless PDAs (personal digital assistant) with five functionalities: team organization and task distribution, geographic information, team communication, situation awareness, and crowd communication.

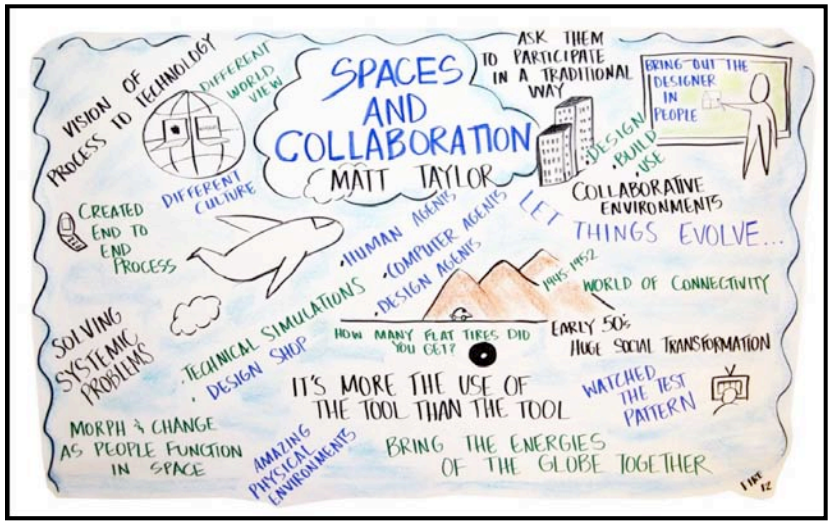
The team organization functions allowed them to know who was involved in a task, who was responsible for the task, and what the status of the task was. The geographic information included the actual locations of employees and their availability. The team communication functions used VOIP for direct communication to the whole team. The situation awareness functions included geographic information and camera operations. The crowd communication functions included direct communication between PDA and loud speakers at platforms or stations.

After evaluating the teams, we concluded that the speed of work processes were increased due to the direct available information on task distribution, the availabilities of colleagues, and actual location of colleagues. We found that it was, indeed, possible to introduce self-organization within teams of core departments in an organization. “Live” information of location and availability of team members was somewhat delicate information.

In the future, we want to further investigate how to motivate team members to share information with each other, how to help organizations change their culture of collaboration and cooperation, and explore the limitations of teams and networks.

Architecture for Virtual Teamwork

Matt Taylor



I usually make things. I'm a designer. I've been fascinated by how the design process is implied in very large groups, getting a very coherent, emergent result over time. The images I will show you are environments we've built over the last fifty years.

It was a world of networks, patronage, personal connectivity. The world today works by a different set of rules. And it was an entire transformation.

My work has been influenced by the time I worked with Frank Lloyd Wright. In particular, I am persuaded that an architect must have the experience of building in order to be able to design, and one must understand the use in order to build. I design, build and use environments for people to accomplish group teams.

At Arnold Engineering and Air Force Base, in Tennessee, a premier aerospace test facility was built in order to create a technological breakthrough. It was a Congressionally mandated facility operated by the air force, but at the end of the Cold War, it was loosing money.

We implemented our Design Shop, a three-day process with 175 to 300 people, in which teams of experts, facilitators and knowledge workers interact with a community of clients who will use the environment. It's a design process–scan, focus and act – not a decision process. In the scan phase all the alternatives are investigated. In the second day, ideas are focused. The third day involves creating a plan.

The Air Force began the Design Shop intending to "get out of this line of work." Through the course of the planning, it was decided that all of the capabilities they currently had would, indeed, be needed over the next 25 years. Getting out of business simply was not an option. Instead, we created a fiction in order to implement the Design Shop, created a plan, built the building, and every year we hold another Design Shop to evaluate opportunities and progress.

It turned out that Boeing wanted to build a 777 and was about ready to invest in the construction of the facility to test the engine for this. The data requirements for this type of facility were, of course, enormous. The engine companies decided to test there. Over the next ten years air force revenues were flat, but the facility still exists, meeting it initial 1952 mandate as a test facility.

All kinds of models were broken in order to do this. The time frames for testing were not tenable. With high motivation, the genius of people, and dedicated attention, representatives of the working and planning group figured out how to reduce the testing time from 6 weeks to 6 days. (They later reduced that to 6 hours.) It was the collaboration of the teams that provided the mechanism for the creative problem solving. This is an example.

In another example, a company that made cell phones was consistently late to market, loosing market share, offending clients. With a focus on the best new technology in a dream state, the Design Shop created an end-to-end process, including the supply chain, that could function

rapidly and actually took that product idea (the Motorola Razor) to market in less than 18 months.

In 1982 we drew the concept of what we wanted to have for remote collaboration, display, wireless, key word and graphic searches and other related real-time support for collaborative effort. Notice that the technology was transparent in this design.

In this current design for collaborative work, we want to be able to control all aspects of the environment and make all information available anywhere in the environment – walls of rolling and movable digital screen, continual digital capture of information, storage of all data flows for later retrieval, access to all data stores from any area – all based on the value web, allowing knowledge workers to take this information, processing it and feeding it back into the exercises people will be working on in the next hour or so.

What I'm interested in is how human agents, computer agents and knowledge agents can be brought together in real time learning an emergent process that is rigorous in its discipline but open-ended. This is design in the highest sense. Human can design in groups with the same efficacy and genius as individuals can. The World Economic Forum now uses this process – for global agendas.

So, the question becomes how do we manage the evolution of a planet, which will become a human artifact in our lifetime?

Systemic problems require multiple vantage points and skill sets in order to activate team work. The environment must morph with the evolution of the teams. We are now using this design process for all kinds of organizations. We want to have a network of organizations and buildings that are built for emergent activities. We need to have these globally distributed so that the energies of the entire globe can be brought together.

Our problems are not new; they've been around for decades. We simply are not adapting to the complexity of our culture at the rate we are making it. So, we need to create a collaborative process that enables a learning lab, where people can come and work to learn collaborative and cooperative processes.

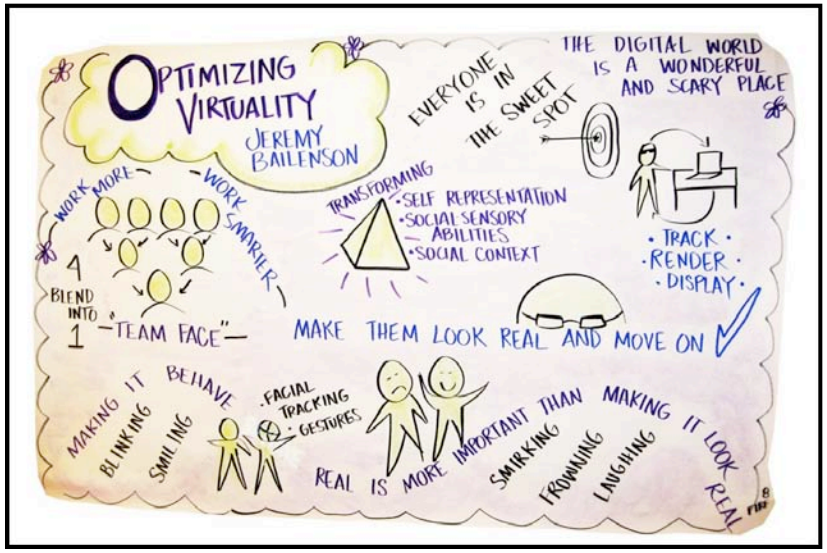
To me the issues around the design of the physical and the virtual environment are the same. Every time you move from one kind of work to another, from one team to another, you have an interface issue. Virtual environments are low resolution environments – at this time – compared to physical environments, which are high resolutions. Over the next decades, the virtual environments will be come higher resolution, becoming relatively indistinguishable from physical environments. And that will produce a whole set of metaphysical issues about the nature of reality and physicality.

Place is important. An environment you can manipulate to fit your epistemology, psychology, your mood is important. The ability to translate to other people the knowledge of your place and what's going on is important and has to be in the process, the software and the technology. The ability to work with space in real time is absolutely critical. And art is extraordinarily important. There is no such thing as a neutral technology. There's no such thing as a neutral tool. They all have limits, downsides and upsides. They all have an embedded thought process in them.

Mac and Windows, for example, represent different world views. It's about culture. The issue of culture is incredibly important. In the end that's all we're talking about. What happens is the technology translates easily and begins to take over. Recalling Stewart Brand and the clock of the Long Now; there are some things that change rapidly and some things that change very slowly. There is something of value in things that remain. There's something of value in the things that change.

Optimizing Virtuality – The Unique Affordances of Digital Teams

Jeremy Bailenson, Department of Communication, Stanford University



What is it that can happen with a virtual team than can never happen when you're interacting with a physical team? Ninety percent of what happens in a virtual space is the same as what happens when you're face-to-face. Leadership skills emerge. We treat people as if they're real – especially when we know they're people.

But what about the other ten percent? What is it that can happen in a virtual space that can never happen in a physical space – to make a virtual team interaction better than any physical team interaction can be? If we can understand this, we can better understand what it means to have a virtual representation and what it means to be inside virtual reality.

The theory of transformed social interaction offers some insights. When someone is portrayed digitally and has the ability to transform their behavior, appearance and identity at will, how does the world of social interaction and team work and collaboration change? To understand this question, we'll examine the punch line of about twenty studies and talk about how powerful the ability to transform ones identity in virtual space can be on a person's ability to persuade, collaborate, and teach – and how that changes how one thinks about themselves and other people.

All types of digital identity conform to the social phenomenon of digital representation, whether they are on the very high end – having an avatar – or simply an image or a voice. In all of them, the ones and zeros are sent electronically, then the digits are rendered on the other end. The process of tracking position, sending it over the network and rendering on a computer is repeated continually in digital immersive virtual environments – tracking, sending, and re-rendering. That's the basic technology.

We make avatars using photographs and a process called photogrometric software. It uses 2D photographs and instantiates three dimensions of an object using certain types of physics. We take a couple of photos of a person, thirty minutes later you're sitting inside a virtual reality environment that captures about 95% of your facial variance. The crucial thing is that the virtual representation can be animated. Its behavior can be dissociated from mine, using a wire frame model textured with a picture, changing its emotions, or other more serious transformations. One thing we're working on is using various physiological measures as tracking cues – heart beat, sweat, etc.

We can also track a person's gestures. With no markers, only using 22 feature points, we use sophisticated software to track facial gestures. A real-time digital model can be built, and then animated. We're testing how making the avatar actually look like and behave like you influences

your interaction and participation in the game or on the team. Our research shows that making the avatar behave realistically is more important than making it look real.

What's fascinating is putting version of people together in a virtual environment such that they interact with each other – an immersive system in the lab or Something like Second Life. The key difference between the way two or three people network in virtual environments are different from a video conference is that in virtual reality the images are continually redrawn; they are high level, smart images. Everyone is sending each other about their own behaviors and everyone redraws each other locally on their individual machines. In a video conference, an analog image is sent back and forth.

The critical idea in transformed social interaction is that a strategic filter can be applied to the real-time data, so that the real-time data is transformed as it is sent – and is transformed as it is redrawn on the computers of the other people. In this way, it would be possible for me to send each one of you a different version of myself. For strategic reasons, I can, therefore, present transformed version of myself or my behavior – various versions of myself – to different people, tailored to every person in the crowd, based on tracking algorithms and optimal interaction strategies.

There are three dimensions of transformed self representation. The first is transforming myself – look better, be more intelligent, be more attuned to the behavior of other people. The second is transforming my social-sensory abilities – having the ability to do things that I couldn't in real life. Third is transforming social context. There's no reason the virtual world has to look the same for all of us; the physics of space and time can get changed.

One example of transforming self representation is augmented gaze. Gaze is the most powerful nonverbal cue. For example, when I look at you, your heart beats faster, you're more persuaded, you learn more from me. In physical space I can only maintain eye contact with one of you at a time. In virtual space I can maintain eye contact with many people at the same time. I'm sending you information about where my haze is directed. Everyone can get a separate version of where my eyes are directed; it would appear that I'm looking at you all the time – the "super gaze." When this is applied, three things emerge. Not a single person has figured out that it's not a real gaze. People are very uncomfortable with this. In normal human interaction, we don't stare at each other for more than seven seconds at a time; and there are important cultural differences. Thirdly, in the augmented gaze condition, people return the gaze more consistently. Fourth, in the "super gaze" condition, persuasion is more effective.

Another example of transforming the self is what we call the digital chameleon – mimicry. There's a lot of research that shows that when you mimic someone, it is a powerful tool toward gaining an advantage. In virtual reality, someone can steal the behavior of the other and render back a version that is transformed to be more like the other person. In our study, with a 4 second mimicry, less than 5% of the people detected the mimicry, people pay more attention (never look away), and the person mimicking becomes much more persuasive.

The other side of this is the real time collection of information about you. A nonverbal profile of you can be collected – hand shake, eye gaze, identity capture, etc. When someone is more similar to you, you are much more likely to like them, do what they want, for example, vote for them. Using facial identity capture and morphing technologies, we've tested this. Not a single person in our study (in 1200 subjects) has ever detected a 60:40 blend of their image in another.

The same concept can be applied to "team face." Can the face become a "uniform" on the avatar? When people interact with an avatar with a team face, people spend more time working, they work smarter (they're more likely to reject bad ideas and accept good ones) when everyone's wearing the team face than when they're wearing their own face.

We can also give avatars powers people don't have in real life, transforming social-sensory perception. We built an algorithm that would reinforce certain behavior; we ran it in a learning environment. For example, when you were out of my field of vision for more than 10 seconds, your avatar would start to disappear and you became translucent, producing a disability. We found that people paid attention more and learned more when they were given the extra sense. We've tested the ability for a student to step inside the teacher's body.

Transforming social context is another opportunity. We can change space; we can change time. We can speed up, go slower. We can transform space. In any given room there's a sweet spot; when you sit there, you learn better. In physical space only one person can sit there. In a virtual world, everyone can sit in that ideal space (front and center, rather than on the side), thinking that everyone else is in the other spots. The test scores are better when people sit in the sweet spot. We've also shown this effect with distance – being closer rather than farther away.

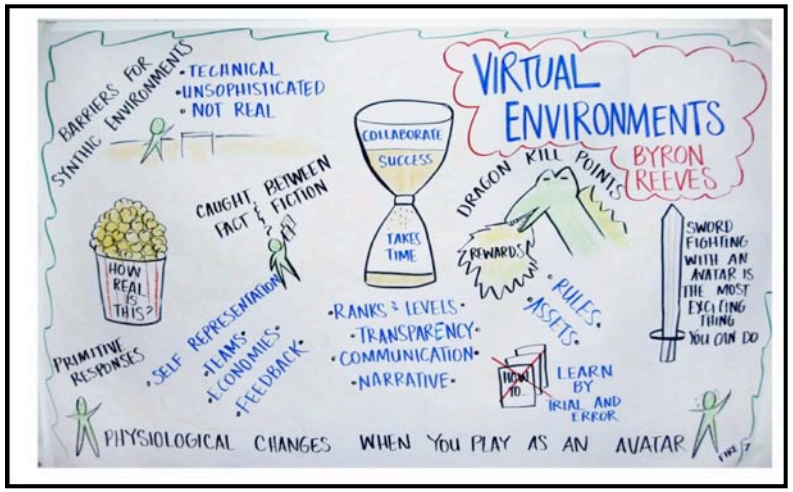
Transforming conformity is another effect we've studied by overriding the behaviors of participants and making them appear to be different;. In a class of ten devils, the eleventh person will become a devil because of conformity. However, if the behaviors of the ten students is overridden to portray them as angels, the eleventh person conforms to the angel behavior.

In conclusion, let me say that the digital world is a really wonderful land a really scary place. It's really important to talk about these effects and to expose them. When actors or participants are transformed, it's really hard to detect – even when it's done poorly.

If you want to have an amazing team or better collaboration, it's really important to think about this stuff.

Serious Games

Byron Reeves



For the cost of maintaining a laptop computer with a recent graphics chip, you can have your meeting in a virtual environment. I show a group at IBM that is experimenting.

I'll show some research about participating in meetings in a virtual environment, sitting behind a computer at a desktop and navigating a self representation using a mouse. I'll talk about research on what you can do in these environments, especially related to serious work.

There are three categories of barriers to using synthetic environments in the workplace or other serious environments (and I include a 3rd grade classroom as a serious environment.) It is important when you think about the advantages of these environments to think about logging in behind a firewall with a five-year old graphics card, when you can't download on image with out permissions. This is the most important limitation on being able to use virtual environments tomorrow.

Another constraint in using virtual environments is the feeling of many people that it is play – unsophisticated narrative that doesn't have a serious context. One can talk about how important play is to the work environment. But aside from that, many people think that people's response to virtual worlds, since they are not real, and made of only picture, text and media, should not be taken seriously.

A lot of this hinges on whether media are "real enough" to engender social responses.. Media is catching us between fact and fiction. These virtual things are representations of people, places, money, and behavior. How real are they? How real do they need to be?

Twenty five years ago, I tested young children's perception of what would happen if I turned upside down a picture of a carton of popcorn on a TV screen. The results were surprising. There were children who were verbal and understood the question who believed that if the TV image were turned upside down, the popcorn would fall out of the carton.

When virtual and real lives are confused, people think it's rare, it's correctable, it's inconsequential, or that the viewer has engaged a willing suspension of disbelief. It is the perception of many that when you make your avatar and go into the IBM meeting in Second Life, you willingly and thoughtfully suspend disbelief and give over the calculation about what's real and not real in media because it allows you to participate more fully.

We've been studying whether this is true or not. We have found that there's a lot of the young child's response to the media perceptions of all of us, including adults. When you equate mediated representations with real life, there is an unconscious and automatic process that is common, applies to everyone, and doesn't always depend on fancy equipment.

The human brain is not specialized for the technology we're building today. This is the last nanosecond of evolution. Humans are specialized in taking ANY bit of information as real first, believing them to be true before considering whether they may be false. If media have faces, voices, gesture, a human look and feel, stories or competition, or interactivity, people's first response is to interpret it as true. Close counts. Things are true before they're false. New media engage old brains. From an evolutionary basis, we're advantaged if we take it as real before we consider whether it may not be true.

For example, if you play World of Warcraft, you're at your desktop, on a good computer with a good graphics chip, you've downloaded a piece of software and you pay a monthly fee to participate. You're in a game that has 9 million players segmented into about 10,000 servers. You have an avatar, you're part of a narrative, you're part of a guild, you have a team, a particular role on that team, and "you" can't succeed in this game unless "we" succeed.

This is about collaboration. This is perhaps one of the most sophisticated collaboration environments one can study at this point in time. There is tons of information about the game that visible on the screen to every player. You have logistics information, chat information, information about players, color-coded roles in the group. I can press a button and get to the people I want to talk to. I've got numbers flying at me and all kinds of information about my group – a dashboard that's very, very sophisticated.

We've used this World of Warcraft environment to identify the types of information in this world that have parallel in the business world, and study them. There are guilds and levels that are established by display of collaborative success. The narrative, the goals and the collaboration in this world are different from environments such as Second Life. In World of Warcraft, the environment itself is dictate; the game you play has been established.

In our research we've identified twelve things that make virtual environments word. First, you have a self representation – an avatar you've created and are maintaining. You are now "in the picture." There're some interesting psychological implications. Teams are a very important ingredient. To keep a guild going, team have activities, make their own website, have performance reviews, develop DKP systems (Drag and Kill Points – the algorithm by which "I" know, before the game starts, what "I" get if "we" do well.) The computer keeps track of how often I participate, how well I do. There's a lot of transparency – it's the ultimate meritocracy. And it has an interesting implication when you think about transferring this to serious environments..

The economies are hugely important. You've got to have a currency – a virtual currency – to keep track quantitatively, empirically – by which we can keep score. Auctions, trading – they're all taken very seriously.

Feedback in virtual worlds does not mean quarterly reviews. The numbers are changing moment by moment. Everyone knows how everyone else is doing. Trial and error is a valid learning approach in serious games. Because everything happens really fast. A manual is like nails on a blackboard. Some people will looks things up, but most rely on trial and error. In a virtual world, I know everything about you very quickly because ranks and levels are transparent.

Communications systems can be changed on the fly in virtual worlds. Everything is done in the context of a narrative, which increases motivation. The rules are all out front, and we know what the rules are, as well as the consequences of breaking a rule. The members of a team are held to standards. The assets are defined. The time is defined, and there's serious time pressure. Lastly, virtual worlds give us places to explore.

This has important implications for how serious virtual environments will evolve, but it also gives us questions about what it means to be literate in the 21st century. You can easily play too much. Studies on virtual collaboration in the workplace indicate that when teams don't work

together it's usually because they don't know how they'll benefit from the stuff they contribute.

Businesses that are able to design work in which people are reinforced in different time domains that currently exist may do better, because the human brain is built to work very well in situations in which there is lots of information about what's going on. If you're a call center operator doing your work in a system that looks like World of Warcraft, would you stay at the job longer? Perhaps because it's more engaging.

Our research has investigated how engagement – a heightened sense of involvement – changes if users perceive that an avatar (a representation controlled by an individual) vs. an agent (the character on the screen controlled on by the computer.) We've studies various tasks – combat looting, mail exchange, building – and have found that heart rate accelerates when you think you're interacting with an avatar. This primitive, physiological response indicates the perception of a sense of presence. Skin conductance show similar autonomic responses in the body. We are also studying this with FMRI, looking at activity in different parts of the brain. We have found that when people think they're interacting with real players (avatars) there is activation in the right inferior parietal region of the brain, the region involved in self-other connectedness and social activity.

Competing with an avatar is more arousing than competing with an agent, and it's more arousing than cooperating with an avatar. When people believe they are interacting with an avatar, they have more real empathy for other players, despite the game context. This cascades into responses we would all agree are important. You're most likely to remember information in moments when you're aroused than when you're not aroused.

The Gartner group, by the way, says that by the year 2010, 70-80% people who have jobs in large enterprises will have an avatar at work. This week, IBM released a serious protocol statement about dress and conduct for avatars in reflecting IBM. We have found that if a person is able to choose their own character, they have a greater investment in the character.

These primitive responses are critical for serious outcomes such as learning. Increased realism makes things easier to learn. Our studies have shown that there is better conceptual learning in virtual environments when learners perceive that they are interacting with an avatar (rather than an agent.)

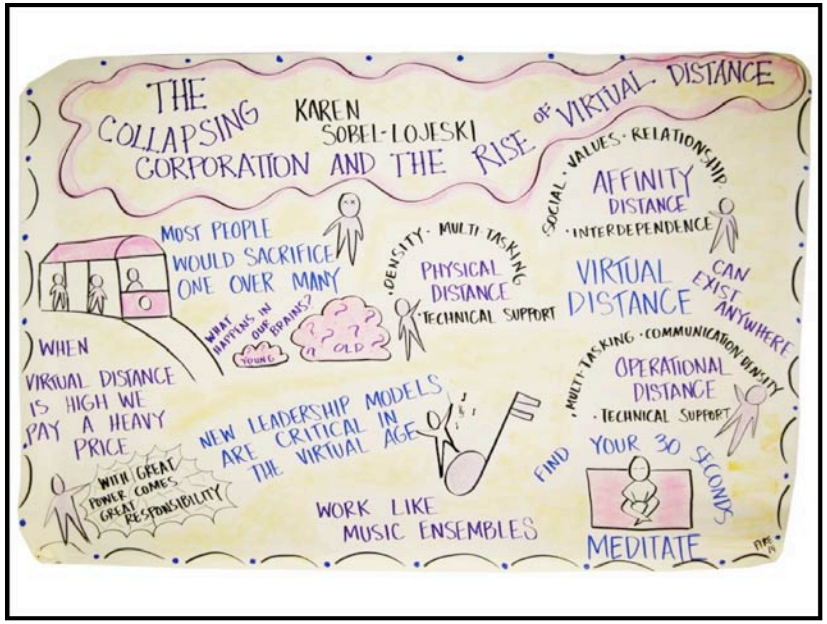
In a study we've recently completed with IBM (collaborating with Tom Malone at MIT), we've studied how virtual environments change how leadership develops. Using video recording to study activity in virtual world and compare it to what we know about leadership in the world in companies.

In the real world, leadership is considered to be a discovery exercise – a property of an individual. Companies seek to find the "right" leaders, train them, and nurture them. In complex guilds in virtual environments, leadership is far more an attribute of the environment in which people play and work than it is in the individuals that do the leading. In virtual environments, information is everywhere. There's reinforcement in all the time domains. Artifacts, currency and rewards are considered as real. Multi-modal communication channels exist. Practiced leadership in these environments happens very fast, roles are often temporary, and risk-taking is encouraged.

We believe these findings have important implications for leaders who will emerge from the gamer generation. In the complex games, emergent leaders have an attitude of "You lead today, I'll lead tomorrow." As a leader or as a player, you're as good as your last time out, because all information is transparent. The findings imply a transformation in the model of leadership, collaboration, even innovation.

The Collapsing Corporation and the Rise of Virtual Distance

Karen Sobel-Lojewski



Virtual distance is the perceived distance between two or more individuals, groups or organizations, when their primary method of communication and coordination is electronic. It occurs at the intersection of multiple and competing challenges to individual, team and organizational collaboration. Virtual distance can be prevalent in work groups that are co-located as well as those that are distributed. When it exists, virtual distance can impact every aspect of a corporation.

Recall a person who is very far away but to whom you feel very close, when you think of them. Recall someone who works near you, from whom you feel very far away and distant.

Distance does matter. It matters psychologically. Perceived distance influences the risks you'll take; it influences trust. In the corporate world, the perceptual construct of virtual distance matters because they are organized in traditional hierarchical structures. However, managers expect us to behave as though we are in a dynamic, peer-to-peer network. The expectation is that we can reach many people. The gap in between the reality and the expectation is the noise in which virtual distance lives.

Virtual distance is made up of real, physical distance (physical and temporal), operational distance (the day-today operational and organizational factors), and affinity distance (the way you relate to other people.) Of these, affinity distance is the most important. If you minimize operational distance, especially for time-sensitive projects, you can improve the way people work. But to create a truly competitive company with a collaborative work force, you have to reduce affinity distance.

The most important elements of affinity distance are cultural value system and communication style. Value systems are multi-layered; they include personal, work, cultural, and moral dimensions. Value differences are very important in the perception of virtual distance. To decrease virtual distance, social distance matters a lot – especially power and status. Informal status is the more important.

Relationship distance has to do with the social network stuff –strong ties and weak ties, the people you know in common, and the weak ties are more significant in minimizing virtual distance. This is true because through strong ties establish barriers that are not existent in weak tie relationships.

Interdependence distance is the internalized sense that people are dependent on each other for their individual and joint success.

In environments with high virtual distance, innovative behavior, freedom of thought with each other, trust, job satisfaction, role and goal clarity, performance, and helping behaviors, and leader effectiveness all decrease significantly. We pay a heavy human price when virtual distance is high.

My research, conducted through survey research, has established an index for virtual distance. The index includes all the aspects of virtual distance I've mentioned. An organizational map is used to describe the social network for individuals in an organization.

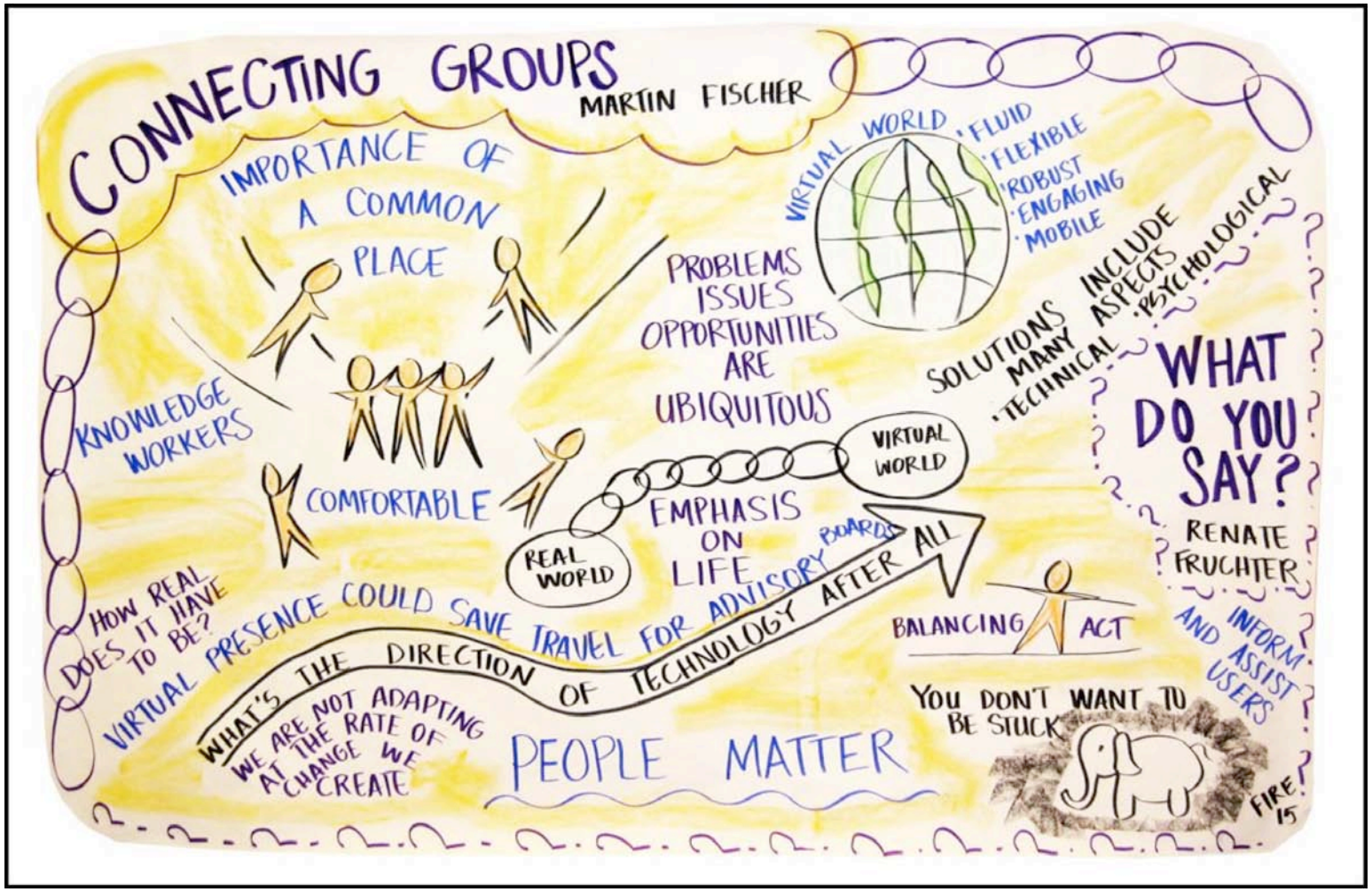
When virtual distance is high, a team's initial innovative activity drops off with time. The same is true of success. When virtual distance is low, the effect is the opposite, with innovation and success increasing over time. As multitasking and competing priorities increase, virtual distance plays an increasingly important role.

New leadership models are needed because traditional leader characteristics do not translate easily for virtual teams, and sometimes not at all. Charismatic leadership, transactional leadership, and transformational leadership models all fall short.

It is the ambassadorial leadership model that is most relevant for the virtual world. Ambassadorial leaders are context sensitive, they are excellent communicators and have great cultural skills. They develop relationships and adapt socially, building cohesion and balancing work demands with diplomacy.

In short, the team issue is handcuffing us. When we think of teams, we usually think of sports, of cohesive, long-standing unit. This is not how we usually work. We work like music ensembles in which we are specialists that come together.

FUTURE THINKING



Connecting Groups: Summarizing Wednesday

Martin Fischer

The challenge with [using collaborating tools for] buildings and infrastructure is that you have to be able to build a model faster than you can build the real thing.

Up until recently that has only been the case for truly complicated and complex projects. But lately, and of course thanks to research in the CIFE [Center for Integrated Facilities Engineering] Lab, we have had hardware and software tools that are starting to make it possible to build meaningful models fast enough to convince project teams that playing in a virtual world or working in a virtual world will save money and time in the real world.

I'll share a couple impressions and a several surprises. One thing that impresses me is that the problems, issues and opportunities are ubiquitous. We saw presentations from many different industries, and the problems, issues, and opportunities seem to be very similar across all of them. That's good news for Media X, I believe.

I was struck by the wide range – and yet the fluid blend – of tools and concepts we saw. Some clearly are already in use, and others seemed far – hard to know how far – perhaps in line with Paul Saffo's 20 year horizon. It seems quite clear that solutions need to incorporate technical, psychological, social, and business aspects in others to become accepted solutions.

No single presentation addressed all of these aspects. Yet, we know that when you actually want to make something work for everyday use, you have to consider and integrate all aspects. That is a very strong argument for the kind of partnership and interaction that we have here in terms of the industry academia interrelationship. It is difficult to bring together all of these different groups and people together in a fruitful collaboration.

As humans, we are all very much rooted in time and space; this is part of who we are. It's interesting to me that many of the presentations gave examples from buildings, which in academia isn't usually regarded as the prime place to do scientific and academic research.

I was also struck by how product model abstractions and virtual worlds are used across several different disciplines. There are similarities in the product model of a skull used in the medical school, for example, and the building models we use, as well as the models used by manufacturing and many, many other industries.

I was also struck by the range of applications – from mobile to global distributed. And by the importance of having a common place, in order to associate what we do and how we behave with that place.

In the coming months, I will integrate several new ideas from these presentations into my teaching and research. Some will be implemented in the new iRoom, an interactive workspace lab that is in the final stages of being designed and built to support fluid interaction among local and remote participants and [within both] physical and digital environments. An I-Room is a space that has multiple displays and allows the movement of information among different information devices as fluidly as possible to support face-to-face remote interaction collaboration.

As I think of WHY, in Cindy's terms, it can be better to "be there" virtually, I offer this preliminary list (in addition to keeping my United mileage under two million miles) of hypotheses [about collaboration in virtual spaces] to study:

1. You can compress and expand time and space very easily; this is very important to gaining insights that you cannot gain otherwise through simulation and other tools.

2. You can explicitly consider process and organization issues. Today when we go into a virtual world and work together, we reflect more on how we work together. This is perhaps a temporary benefit, but good to harness while we have it.

3. Role models can have a larger influence more quickly because you can model a behavior for a very wide group of people.

4. [Virtual] sandboxes, of course, can be useful in trying stuff out. In a virtual sandbox you can overlay things to gain insights that otherwise are difficult to visualize. Shi-Ping's Touch Table video showed that nicely.

5. Try, practice, fail. The[risks and] consequences are low.

6. You can make access to information and insights more democratic, more widespread - like anatomy models, for example.

7. You can change scales easily.

8. You can take things apart in ways that you could otherwise never take apart.

9. You can engage participants more, and they can become more objective. The conversation becomes more about the things that we are discussing than about it being your idea or my idea.

10. You can see connections, relationships and dependencies that otherwise were not easily observable.

[We need to understand the requirements] regarding virtual worlds:

a. Fluidity of interactions – flexibility – is important for individuals and for the team.

b. Intuitive is important – like plug and play.

c. Robust and transparent are important – considering the product organization process issues and engaging mobility.

What would actually be good metrics to measure team performance in virtual spaces? I was struck for example by Pete's surprises in how his two different groups used virtual environments. We have only modest research on how teams actually perform face-to-face, much less virtually. What conclusions would you draw from that? We need to know this, because if virtual teams are indeed a "big deal," then we need to figure out how we deal with them. And if not, we can forget about it and go on to other high priority questions.

In our lab, we have observed a number of construction project teams that are coordinating how aspects of building design make buildings more buildable. Typically this happens with 2-D drawings and the interaction of physical artifacts. Lately teams have started to use digital models, virtual worlds, to support this process.

To study this, we videotaped these interactions and then do very careful analyses of the interactions that take place in a meeting. We derive objective measures of performance. Then we are also measuring people's perceptions. Was this a great meeting? Were you happy with it? The outcome? The process, etc.?

We are analyzing the meeting outcomes, participants' satisfaction, meeting productivity, team interactions; participation and workflow, emotional interactions, and the interaction with artifacts and models. Looking at a model, sharing a drawing, sharing a chart: which of those are [best done] with virtual models and which of those are [best done] with physical interactions. We are trying to see whether working with virtual worlds and models makes a difference versus working with only physical artifacts.

We have found that throughput is much, much higher – easily doubled – when a meeting is supported with virtual models and artifacts. The

typical [problem] resolution rate in our industry is zero, so typically in a meeting nothing is resolved. Everything is: "Chuck, look into that, come back to us tomorrow or in two weeks, etc." That is the typical result of a meeting; the big action list. And then in two weeks things have slightly only changed – you all know the issues, right. We found that [problem] resolution rate climbs to about 75% in meetings that are supported virtually, meaning issues are actually resolved right there and then [at the meeting.]

We found that the project focus [in virtually supported meetings] was hovering around 90%, where typically it is 50% [in meetings with no virtual support.] Fifty-percent [of the team's time] is typically spent on other stuff – the football game and all that kind of stuff.

The early results are interesting and we would like to understand how [the results from the construction industry] relate to other sectors of the world, whether the processes we are using makes sense, and [if] the metrics we are using make sense.

Other issues we want to study include how to design virtual environments and artifacts for the user experience. In Wednesday's conversations, there was a lot of talk about the technology. Then we said it is about the user. But then we immediately jumped [back] to talk about the technology!

We want to study how to move between virtual sandboxes, virtual world work and real work. These boundaries are blurred, but each has some importance, and it helps to know when you are playing in a sandbox, really exploring things, and when you actually doing the work. Along these lines, how do we link real worlds and virtual worlds? Sometimes the real world is most important; sometimes we need to go back and forth.

We want to better understand the audio dimensions of virtual spaces and how automation figures into virtual worlds. As we make things more virtual, we can think about automating things that [to date they have been] done manually and [improve how all the individual parts] play together.

And we want to study how to support value-adding activities without squelching spontaneity and creativity? I see this tension in corporations. I see a lot emphasis on predictability, reliability and productivity, which of course is important. But that in itself doesn't lead to a great wonderful world. We have to find a way to protect the spontaneity and creativity that exists and bring it into [the work and the work environment] if it's not there.

The biggest question is how we best blend physical and virtual worlds. I think it is crazy how, for example, in 2007 we still design buildings. Generally, the physical structure is designed from the outside in and then the digital world is overlaid onto the physical environment. Yet for almost everything we do, we depend critically on the appropriate support of both the physical and digital virtual environments. We still design one building after the other, separately. There are opportunities to be much more creative in integrating the physical and digital environments in much more imaginative ways than we are currently doing.

Who Uses Tools for What: Summarizing Thursday

Renate Fruchter

It is interesting to see how critical mass is developing around the need, the interest and the awareness of the importance of teaching and preparing a new workforce for the global market. At the Project Based Learning Lab, we build software applications that support all these activities, bridging the analog and digital worlds together. We deploy them in a network of international courses on the global workforce.

Key questions that we are addressing look at knowledge capture, sharing and reuse, [for situations in which] knowledge in context is more important than document management. In our studies, we observe how people go through behavioral transformations; we examine factors that are critical to business processes, such as trust, such as communication channel preferences, and how global teams mine the data that these tools capture.

In a nutshell, people matter. Four presentations dealt with this by looking at virtual worlds, education challenges, collaboration spaces, and personalization. In emphasizing that people treat technology and media as [they treat] people and by differentiating participation versus navigation, Byron raised several questions:

- "How real are these virtual worlds?"
- "How seriously should we take them?"
- “Can we do real work with them?”

The environments and players of virtual games offer several insights. Very sophisticated team tools in gaming environments provide great collaboration dashboards, suggesting that kids who play virtual games will be ready for virtual collaboration. The flip side of that opportunity is that games in virtual worlds can perhaps be used to build leadership competencies.

Virtual game players’ experience in taking risks for leadership represents a major shift in attitude towards leadership. Byron’s observations that virtual game players understand the temporary nature of leadership roles complements my observations in the organic emergence of team structure in my global teamwork course, where by design, I do not assign a team leader or a project manager.

New research frontiers include the relationship between body and brain, comparisons between avatars and agents, engagement that crosses and balances the duality of competition and cooperation.

Jeremy’s application of transformed social interaction theories [to virtual worlds] emphasized that behavioral modeling and mimicry are very important and powerful influences on non-verbal behavior and communication. The implications of these findings in cross-cultural, cross-disciplinary collaboration, [for situations in which] you don't see each other in person on a daily basis or even weekly basis, are profound with respect to frictions and misunderstandings in virtual teams.

In the virtual world, high impact teams build trust and community. Neerja emphasized that although we do love technology and we build technology, the ultimate goal of technology is to mediate communication between people.

People matter, and the focus on personal and cultural relevance is essential. The balance between stress and comfort is human. In stress situations, people prefer similarly; in unstressed scenarios people prefer diversity. Harnessing technology and collaboration spaces to leverage this balance may enhance collaboration.

Sun Microsystems has been a forward-thinking company, asking questions about alternative work environments for the past 15 to 20

years. Not only [have they been] asking the question, but [they have also been] proactively creating and reinventing work spaces as new knowledge and technology are available. Ann showed us the SUN ID card, which recognizes each individual and permits plug-and-play flexibility from any connection, anywhere. I these cards, because I think [using them] could release a lot of stress and increase our appetite for diversity.

Ann and Eleanor each reinforced the organizational obstacles to change, which are referenced in the literature and observed in our studies. Eleanor linked this to behavior at the individual level, at the team level, at the organizational level.

Dierdre showed a compelling example of an engaging, collaborative space that integrates visualization, stimulation and collaboration. She shared with us questions about maintaining and sustaining new environments such as the Decision Theater.

Technology changes rapidly, and obsolescence is an issue. Matt' approach to designing spaces and collaboration emphasized the value of ongoing participatory engagements in very rapid prototyping efforts.

The challenge of adapting to the accelerated rate of change is important in setting expectations for the deployment of new technologies. Change is hard, risky; and it takes time. Technologies that are multi-user applications, that bring people together, are even harder. Unless you have a tango partner who dances at your same level of competency, it is inevitable that you are going to step on each others toes and occasionally miss the beat.

A critical set of research questions concerns the transformation of processes. How long does it take for people to adopt or abandon a new tool? What are the metrics that individuals, teams or organizations can use for self-assessing these transformations?

We have begun to study these in my lab, but we want to expand our studies to a larger scale, to evaluate these new virtual spaces and [understand] how people actually engage in these environments. One of the grand challenges would be to identify the community and build a framework to analyze, characterize and identify metrics and then collect data to quantitatively and qualitatively define what is happening in the different collaboration environments so we can then inform and assist users.

As Eleanor reminded us, people need to learn to connect at all levels, both social and technical, not trivial. In knowledge work, the technical is much easier than the social, and innovation tends to come from knowledge workers that communicate and interact rather than from the lonely genius. Even in our AEC [architecture, engineering, construction] industry, we are requiring people in the field to become knowledge workers. They are learning how to build models.

Studies from our lab that have mined archives of communication between teams have given us insights on influence leadership in global teams. Often the project leader or the project manager assigned to the team is not the influence leader. Influence leaders change over time, depending on the topic and depending on phase of project. By identifying influence leaders and [studying the] ways they influence teamwork, we can help teams self-assess design interventions that will improve performance and produce better products. Eleanor's concept of the virtuality index an be applied in education as well as corporate settings.

Our presumption has been that physical distance is important, but the message from Karen was that affinity distance is the most critical type of distance. There is a high price on the human side when you look at the virtual distance. Karen's findings show that people in the virtual world assume, make monumental assumptions, that people are all the same. Yet, people are not all the same. My question is: How can we teach people not only to walk a mile in somebody else's shoes, but take off their shoes before they put on the shoes of someone else?

Imagine the Futures We Could Create Together

Neil Jacobstein

I like to ask people, when they visualize the world of 2050, what do they think about? Will the world look better? Will our quality of life be higher or we will be facing a train wreck? What does it look like to you?

For most of the world's people, there is no future. They don't have the luxury of thinking about the future. For many of the world's people, poverty and thinking about their next meal is what it is all about. If you have gone to places around the world that have real poverty and you have smelled it and experienced it firsthand, you know what I am talking about. If you haven't done it, I encourage you to do so. It is worth doing. And if you don't think it's a travesty that we have the kind of technology and systems that we could put in place today, and we have people living in squalor, then I think that you should think again.

We also have another set of travesties simultaneously going on with the way we have been managing the planet. Think about humans' space time perspective. Consider common events like birthdays, quarterly profits, and mortgages mapped on a graph of space and time. Most of the world's people are thinking about themselves and their immediate families. Maybe they think about their neighborhoods or their communities. They also tend to think short term, like about lunch or the next meal. They might think about saving for their kids' educations. If they are really thinking far out, they might consider the horizon of their mortgage plan 30 years from now, but most of the big systemic consequences in the world will take place further out on the space time curve – at the planet level and beyond, and 25 to 50 years or more into the future. Unfortunately, almost all of the personal rewards for CEOs managing businesses, academics worrying about tenure track, or people thinking about their jobs, push people towards short term, local thinking. So, it is not an accident that we see the world that we see today.

Environmental, energy, health infrastructure problems, security problems, and educational problems are chronic, and they have been neglected for a long time. They are now both critical and urgent. The first Earth Day was 37 years ago! Actually, these problems were urgent then. Our window for dealing with urgent problems is shrinking rapidly. These problems won't wait. And as we have discussed in the last couple of days, our biology, our biases and our habits make it very hard to put together the critical mass of people and technology necessary to solve these problems as opposed to sit around and talk about them.

We have a number of powerful new technologies emerging today, including AI and nanotechnology. They are about precise manipulation of bits and molecules. They can provide some solutions – not all the solutions – to many of our critical problems. Yet these technologies

come with their own set of problems, and they need to be managed. All powerful technologies are multi-edged swords, so I think that our challenge and opportunity in this group is to utilize the Media X suite of tools as it evolves over time to put together a virtual collaboration environment that can be used for problem solving, and bring together academics, industry, and community partners into real world problem-solving teams.

You can see that these neglected critical infrastructure problems are omnipresent. This week we saw a bridge collapse in Minnesota; it collapsed right into the Mississippi River. The officials responsible for this were warned in 1990 that the bridge was structurally deficient. In fact there were 18 workers doing surface repair on the bridge at the time it collapsed. They were just doing patchwork as usual, no deep repair, and no attention to the underlying systemic problems.

Our critical infrastructure for energy, public health, bridges, and transportation has been starved for maintenance. Each of these infrastructure areas is a problem with potential for disaster. When you get a storm, for example like Katrina in New Orleans, the storm presents its own set of challenges. But when the storm is combined with a neglected levee system, you get a real disaster. There is a great book by Stephen Flynn called "Edge of Disaster." If you haven't read it, it is worth reading. It is about building resilient systems that prevent problems from becoming disasters.

We have a long tradition of tool use, but even though our tools have changed radically, we still have a large number of hardwired biases in our cognition. Tversky and Kahneman, Byron Reeves, and others have done great work in this area. We really need to deal with these biases as we approach our next generation of powerful technologies.

The list of future threats is long, and I remain optimistic that we are up to the challenge of addressing them. But make no mistake, these really are tough problems. Let me just pick a couple of them as examples.

Our energy supply lines, particularly for liquid fuels, are unbelievably brittle. We will probably experience the consequences of that problem again soon in the transportation sector. These problems can be avoided by redesigning our energy systems.

There was a recent New York Times' Op-Ed by a former Secretary of Defense, Bill Perry, and Ashton Carter at Harvard. These are two people who have spent their time for the last 25 years trying to prevent nuclear proliferation; and they basically said in this Op-Ed, "the cat is out of the bag" and "we have lots of people around the world that are interested in doing harm to us", so we better think seriously about how to deal with the consequences of an attack. Simulation and VR would be helpful here on many levels.

There is always the possibility of terror attacks with advanced technology. That may or may not happen in your locale, but we know that natural disasters happen and we can ameliorate their effects if we deal with the critical infrastructure problems proactively.

We know that the issue of pandemic flu threat (like the H5N1 virus) is a question of 'when, not if.' The key here again is to build up the resilience of our health infrastructure, to prevent cascading problems. Immersive VR is already used as a training environment.

We also have future opportunities that we are not fully taking advantage of. We could have truly high-quality, global, computer-based education. Adele Goldberg and I were working on this at Xerox PARC in the late 70s, and we still don't have it today, mostly due to inconsistent R&D funding. We could have fast and adaptive emergency response instead of the kind of chaos that we saw around Katrina. We could eventually use the excess C02 in the atmosphere for building high tensile strength building material. We could actually get major health improvement through biotechnology and nanotechnology. We could have ubiquitous intelligent devices and systems in our world. We could use molecular manufacturing for generating abundance for the developing world, as well as ourselves. We could open the space frontier for industrialization.

All of these things are possible, but they require leadership and long R&D lead times.

I think George Orwell had it right when he said, "life is a race between education and catastrophe." Buckminster Fuller had a big influence on me. He said in 1962 that he could envision a worldwide, high quality, interactive education system. The one he envisioned was very much like the one we still don't have today.

Most of you are familiar with Ray Kurzweil's research on the accelerating exponential growth of technology. A child holding a PDA has more computing power in her hands than the typical 1960s command and control system war room. On the information system side, Moore's' Law has in fact turned the people with web access (and that is certainly not everyone) into information billionaires, but there has been little comparable improvement in the world of manipulating matter and energy. And that, I claim, is primarily a function of knowledge deployment, not just thermodynamics. We will eventually learn how to program matter inexpensively and with precision. It may take 15 or 20 years to be able to pull off the challenging R&D, but no real theoretical breakthroughs are required to make that happen, just a lot of hard engineering work.

Molecular manufacturing will transform humanity's relationship with molecules and matter, like computing changed our relationship with bits and information. We will need to exercise considerable foresight to ensure that we implement it thoughtfully.

Richard Feynman gave a famous talk in the cafeteria at Cal Tech in 1959. He pointed to the possibility of molecular nanotechnology and basically said, that this would not violate any laws of chemistry and physics. And yet I was one of the presenters at a National Academy of Sciences meeting in 2005, where we had a bunch of technical people sitting around a table still grappling with the question of whether molecular manufacturing was possible or not. They decided that it would be technically feasible, and requested a nanotechnology roadmap, which is forthcoming this year from the Foresight Institute.

Alan Kay said that "The best way to predict the future is to invent it". That is certainly true. Humans have been inventing the future of manufacturing for a very long time starting with chipping flint and bones, and moving through all the processes involved in manufacturing. Today we can use different configurations of carbon atoms to get wildly different physical and electronic properties. Carbon can be used in graphite, a very low tensile strength lubricant; or it can be in the configuration of a diamond crystal, with a tensile strength on the order of 50 times the titanium that we build rockets with. Carbon nanotubes can be electrical insulators, superconductors, or semiconductors, depending on the configuration of carbon, and some doping compounds.

There are two classes of nanotechnology. One is the kind that you read about in the New York Times, which is mostly material science warmed over. The old departments of materials science are now often renamed the Department of Nanotechnology in one form or another. That has to do with being able to get funding for dealing with phenomenon less than 100 nanometers or billionths of a meter. But the molecular manufacturing that we'll see in 15 or 20 years has to do with building devices and systems, not just materials. Much of the early work in this area is in design and simulation. Some work that we have been doing at the Institute for Molecular Manufacturing deals with guidelines, embedded safeguards, and the long term design of molecular factories that could build not just tiny things, but large things, like buildings.

If you look at the maturity of early nanoscience and engineering, it is a whole family of technologies. Some early materials related products are actually in the market.

Solar photovoltaic systems that use nano materials are just now emerging. Molecular manufacturing, on the other hand, is still at the

applied science foundation level, with the frontier being lab scale demonstrations.

But make no mistake, you can build really big things with molecular manufacturing, and the feasibility study has already been done by nature: huge redwood trees are the product of solar driven molecular manufacturing. They grab carbon dioxide from the atmosphere, and photosynthesis splits the carbon from the oxygen. We breathe the O2 waste gas to live, and the carbon is synthesized into glucose. The glucose is polymerized into cellulose, a low tensile strength building material. Termites use enzymes to convert cellulose back to sugar, so we currently build houses of candy. We can do much better than this. We will eventually make extraordinary high tensile strength building materials out of carbon dioxide, and sequester carbon dioxide out of the atmosphere.

I believe that we can use the technology that we have been talking about for the last couple of days to help us build an entirely new technology base. The world's population is 6.7 billion and growing. The expectations for affluence are rising throughout the world. The world's poorest people have the dirtiest technologies. If you have been to Mumbai, Beijing, Jakarta, or Bangkok, the air in those cities is really hard to breathe. If the developing world with its increasing affluence adopts our current technology base, the environmental impact is going to be quite severe. We need more and different technology, not just less of the same. Our low tech products are not good enough for them. We need high quality green products for them, and for us.

Many of the problems that we see today and we read about in the papers have a common root cause. Poor control of matter and energy is not the only root cause of these problems, but it is an important one. There is still very low literacy for thinking about problems this way, and for creating a systems framework around precise control of matter and energy. One of the things that universities are great for is to get people to think in terms of systems and root causes, and real world problems qualify for study.

Some future benefits of molecular manufacturing include: low-cost, high efficiency solar power; carbon from excess CO2 used to make super strong building materials, and improved living standards around the world. There are lots of people in the United States that live in relative poverty, and even rich people often live in poorly designed cities, with obsolete, energy squandering infrastructure that could be replaced.

There is no “free lunch” here. Molecular manufacturing is going to require a lot of R&D, and long-term thinking – something that is in short supply - especially in Washington today. And, it will require new safeguards, guidelines, and controls. Technology, particularly advanced technology, requires foresight, based on probabilistic estimates of long-term systemic consequences, not crystal ball gazing. Foresight is extended by actually having sensors in the environment about what we are doing. It is corrected by closed-loop feedback from those sensors, and it is enhanced by invention and innovation.

A group of people that I have worked with at the Institute for Molecular Manufacturing and the Foresight Institute have put together guidelines for nanotechnology development that are similar to the biosafety guidelines for biotech development that were developed in the 1970s. VR environments for collaboration can help us to examine and refine these guidelines, extend our foresight, and develop new technologies in a responsible way.

So, let me be specific about some of the things that I think are needed in the energy community, in the environmental community, the nanotech community, and even in the AI community. For example, sometimes as “shoemaker's children”, AI researchers don’t actually use in everyday life all of the technologies that they enable. The AI community is actively collaborating, often using Wikis and simple web tools. State-of-the-art augmented VR environments for real world interdisciplinary problem-solving could be really useful. Martha is going to talk about the Media X tool kit or suite, and that is a good place to start.

Many of you have additional tools that could be used for this kind of work. Global partners could contribute modular tools, data to populate research environments, and testing systems for other tool vendors. We need continuous evaluation at the technology, culture, and user levels. We need plug and play standards for seamless component integration. And we can build scaleable systems from mobile PDAs to desktops to augmented environments to global networks of heterogeneous environments like Decision Theater, with some interoperability between them.

If we can have a $100 laptop – currently $175 laptop, but soon to be a $100 laptop – how much would it cost for us to have a distributed virtual reality environment that is truly geared for problem solving, and what kind of scalable infrastructure will we need to put in place to make that happen?

I think that is a question worthy of this community.

What I am after is being able to put together communities of interest rapidly across industry, university, and government – and to integrate real world design, problem-solving, planning, and emergency response.

The challenge is to not just have this meeting be about yapping and yammering about problems, but to actually put our technology to use. Let's get started! Thank you.

Tackling the Intractable

Byron Reeves

When Chuck showed me the agenda for this workshop, that he and Martha and others put together, I said, this really sounds great. Is the audience going to be up to this?

And I discovered in the last couple of days that it is certainly the case. In fact, the audience is the program in many ways. I have been very impressed. This is, in my view, wonderful and atypical. I think it is a couple standard deviations above the mean in terms of a small group exploring a problem with great speakers.

The attraction of many people to being a faculty member is that you get to help others figure out what to think about, and you hope they figure out what to do. The "think-do" coefficients are both in the equation for anything successful.

[At this meeting,] Stanford University has been the "think" component. A lot of you folks and the companies that are Media X partners have been the "do" component. What I see happening right now is that both of these groups are having to think about the entire equation.

I can speak mostly for the University. If you look at any of the development fund-raising material for our University, or if you listen to our President's last speech, it had something about the fact that there are significant problems in the world.

We need to get out of the Ivory Tower. We need to be in the world. We need to be interacting, collaborating, helping to solve these problems. And if you are going to do that, you have to talk to the people that are creating problems; you have to talk to the people building the things that (inadvertently) cause the problems. You've got to be engaged in a dialogue that you haven't been in previously.

I think I have spent enough time in companies to know that is the case there as well. The notion of coordinating expertise maybe one of the best things that companies do. Coordinating expertise may be the true resource that companies really need to protect, even more than exactly how to stuff, to address the new questions that are coming up.

This think-do equation is really something that all of us have to deal with, so my self-disclosure is that when I experience this enthusiasm, when I hear these great ideas, I have to say that I am probably the newest to the do-half of the equation and consider that to be the biggest constraint to making my intellectual world here relevant in the world.

This is an invitation for the doers to help the thinkers, or as we breakdown these walls in this bifurcation of these worlds, is to really start to think about exactly what we can do.

I want to give you a little bit more self-disclosure about exactly what I think about and what I think about doing. I am not necessarily thinking just about we need to create a virtual world where we can all meet or that there is some middle level of abstraction. I actually get stumped more by what to do this afternoon!

I have had the great pleasure along with a lot of others, and I am certainly not the only faculty member here who has started a company, (called Seriosity – an attempt to try to bring some of the stuff we are working on in games to the enterprise) of working at Microsoft Research and other big companies. But I have never been impressed with this think-do distinction more than when you get in your little car and head down to Sand Hill Road to make your presentation and you have got the slide about the intellectual foundations of this idea. And I have all my MIT buddies – we are the board and the cofounders – and then there is this next slide which at my cofounder's insistence is the "do" part of this. And it is the enterprise software executives who are going to participate in this and who are really going to get into the details of this. And the question they ask is: When can we meet with Frank to write this paragraph to get him to say, yes, to this first thing we can do? It is an executional drill that is wonderful to experience.

The question here, as a faculty member, is an invitation, even now I know we are close to closure but as we go here, what are the small steps?

Chuck was talking about that journey of a thousand miles. It starts with just one message, one additional meeting, one thing we can do, and this is really important to the faculty, I think. If we take Neil's presentation, which I just loved, and it is the one that I aspire as a faculty member to always being reminded of those challenges. What is the first step on that journey and how specifically can Media X, can Chuck and myself and Martha and others here, what can we do to help bring this to fruition?

What is the first step? We are always asking should it be another meeting. We need support. We need participants. We need your time. The other part of the "do" part in the university is that I think it is often – and I am not sure how people see this from the outside – but Stanford for example is an extremely entrepreneurial place with plenty of our faculty – there are 1200 individual entrepreneurs who are collecting support for their work who had no infrastructure support. They have a nine-month salary and an office, but they are well-funded and have a lot of needs to actually create infrastructure to actually do these things, so in that context, how can we turn heads among the faculty?

How can we get you folks that have both of these pieces of the equation involved in actually helping to solve some of these problems?

That is my invitation to you to help the faculty here on the "do" side of this. I see marvelous convergence on the "think" side. This notion of collaboration, be assured that this word has a commercial value right now with respect to technology, that you talked about the last couple of days, but We had an off-site meeting with about 35 faculty in the Institute that Media X is part of, and many of them – even the majority of them – have no industry connections. They are linguists and psychologists and philosophers and people that are interested in the notion of technology kind of broadly. The one word that we all honed in on, which was the interdisciplinary glue that was really making this work, was collaboration.

In the university this is a very significant concept as well, so that is by way of saying that the topic that has been outlined here and that you have taken a start at, and brought all your work to, actually is shared even by those that are not necessarily interested in the next company or the next piece of intellectual property.

I would love to hear your ideas, and if you accept the nudge to tilt toward near-term things that could be done now, I'd certainly appreciate that.

APPENDICES

Meeting Agenda

Summer Institute @ Wallenberg Hall
BUILDING EFFECTIVE VIRTUAL TEAMS
August 1-3, 2007

Wednesday, August 1 CONNECTING GROUPS

8:30 AM	Registration, Continental Breakfast	
9:00 AM	Introductions	
	Expectations, Overview	Chuck House, *Executive Director, Media X at Stanford University*
9:20 AM	Backbone Conferencing	
	Marratech	Dr. Magnus Lofstrand, *Lulea Tekniska Universitet*
	Lecture Capture, Room Control, and Collaboration	Dr. Larry Rowe, *President, FX PAL*
10:15 AM	Wallenberg Hall Walk-Around and Break	Eric Grant, *Wallenberg Hall* and Daniel Gilbert, *Wallenberg Hall*
10:45 AM	“War-Room” Visualization for Decision Support	Dr. Shui-Ping Hsu, *Director, Futures Lab, Northrup Grumman*
11:30 AM	Let's make micro-mobile teams (net)work	Dr. Patrick A. J. Punte, MSc, *TNO Defence, Security, and Safety*
12:15 PM	Lunch and SUMMIT Tour	

12:30 PM	Tour of the facilities and programs developed by SUMMIT at Stanford, and in collaboration with other groups inside and outside of Stanford.	Dr. W. Paul Brown, *Stanford University School of Medicine* Dr. Dev Parvati, *Director, SUMMIT, Stanford University School of Medicine*
2:00 AM	VR for Personal Expression and Enterprise Teams	
	Animating the Archive Using Second Life	Henrik Bennetsen, *Dir. Research, Humanities Research Center*
	A Room of Your Own	Greg Nuyens, *CEO, Qwaq Forums*
	Media X Works	Dr. Martha Russell, *Researcher, Media X at Stanford University, and President, Clickin Research*
	3D Virtual Environments in the Enterprise	Cindy Pickering, *Principal Engineer, Intel IT Innovation and Research, Collaboratory*
	From Facilitating to Creating Collaborations	Dr. Piet Hut, *Professor of Astrophysics and Interdisciplinary Studies, Institute for Advanced Study, Princeton, NJ*
4:30 AM	Bus Departs for Tour and Demonstration	
	Tele-immersion HP Halo	Dr. Rick McGeer, *Scientific Liaison, Hewlett-Packard Company* Dr. Harlyn Baker, *Senior Scientist, HP Labs*
6:30 AM	Dinner at McArthur Park	Dr. Paul Saffo, *Institute of the Future*

Thursday, August 2 **WHAT DO YOU SAY WHEN YOU'RE CONNECTED?**

8:30 AM	Continental Breakfast	
8:45 AM	Overview	Chuck House
9:00 AM	Studies of Virtual Environments	Dr. Byron Reeves, *Stanford University, H-STAR, SCIL, Media X*
9:45 AM	Personalization in Virtual Reality	Dr. Jeremy Bailenson, *Stanford University, Dir. Virtual Human Interaction Lab*
10:30 AM	Break	
10:45 AM	Education and Training	
	Virtual Law Scholars	Luis Perez-Hurtado, *JSD Candidate, Stanford Law School*
	Virtual Life	Neerja Raman, *Stanford University, Senior Research Fellow, Digital Vision Program and Fellow, Media X at Stanford University*
	Creating Regional Wealth	Jeff Saperstein, *Jeff Saperstein & Associates*
12:15 PM	Lunch and Tours of Bailenson's Lab	
1:15 AM	Decision Theater—Sustainability Solutions	Dr. Deirdre Hahn, *Associate Director, Decision Theater, Affiliated Faculty, Department of Information Systems, W.P. Carey School of Business, Arizona State University*
2:30 AM	Spaces and Collaboration	Matt Taylor, *Principal, Taylor Architecture*
3:00 AM	Break	
3:15 AM	Virtuality Indices	Dr. Eleanor Wynn, *Enterprise Architect, Social Computing, Intel Corporation*
4:00 AM	The Collapsing Corporation and The Rise of Virtual Distance – What Executive Leadership Needs to Know About the Other Side of Technology	Dr. Karen Sobel-Lojeski, *Chief Evangelist Officer, Virtual Distance International, Inc. and Research Director, Institute for Innovation & Information Productivity*

5:30 AM	Leave for Dinner	
6:00 AM	Dinner at California Café	Howard Rheingold, *Author*

Friday, August 3 TACKLING THE INTRACTABLE

8:30 AM	Continental Breakfast	
8:40 AM	Overview and Rapporteur Recaps	Chuck House
	Connecting Groups	Dr. Martin Fischer, *Stanford University, Computer Science*
	What do you say?	Dr. Renate Fruchter, *Stanford University, Center for Integrated Facility Engineering*
9:10 AM	Catalytic Processes for Prioritizing/Acting	Dr. Neil Jacobstein, *Chairman & CEO, Teknowledge Corporation and Henry Crown Fellow, Aspen Institute; Fellow, Media X at Stanford University*
10:15 AM	Break	
10:30 AM	VR Next Steps	Dr. Patrick Hanrahan, *Stanford University, Computer Science*
11:00 AM	Tackling the Intractable	Byron Reeves
11:45 AM	Trinket Exchange and Wrap-Up	
12:00 PM	Adjourn	Chuck House

ATTENDEES

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Paul Saffo, Visionary

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