

Designing in the Global Room: Empirical Studies of Distributed Work

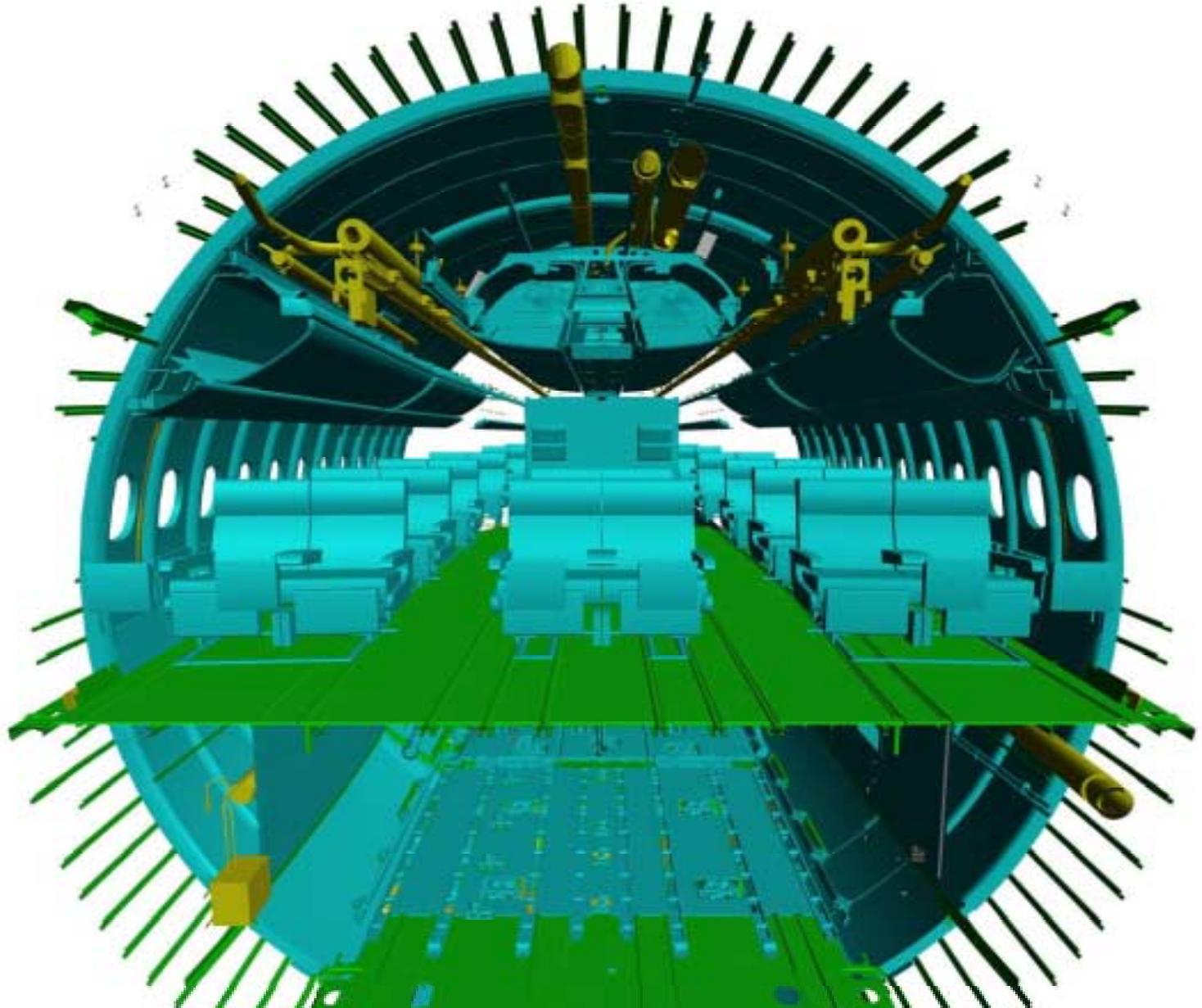


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Distributed CAD: TeleFly



Virtual Collocation and Design

- **Virtual collocation** - using technology to enable teams to collaborate as if they were physically collocated
- Technology can support formal interaction
 - design sessions
 - status reviews
 - staff meetings
 - task forces
 - best practice teams
- Also informal interaction
 - ad-hoc collaborations
 - expertise seeking
 - social exchange

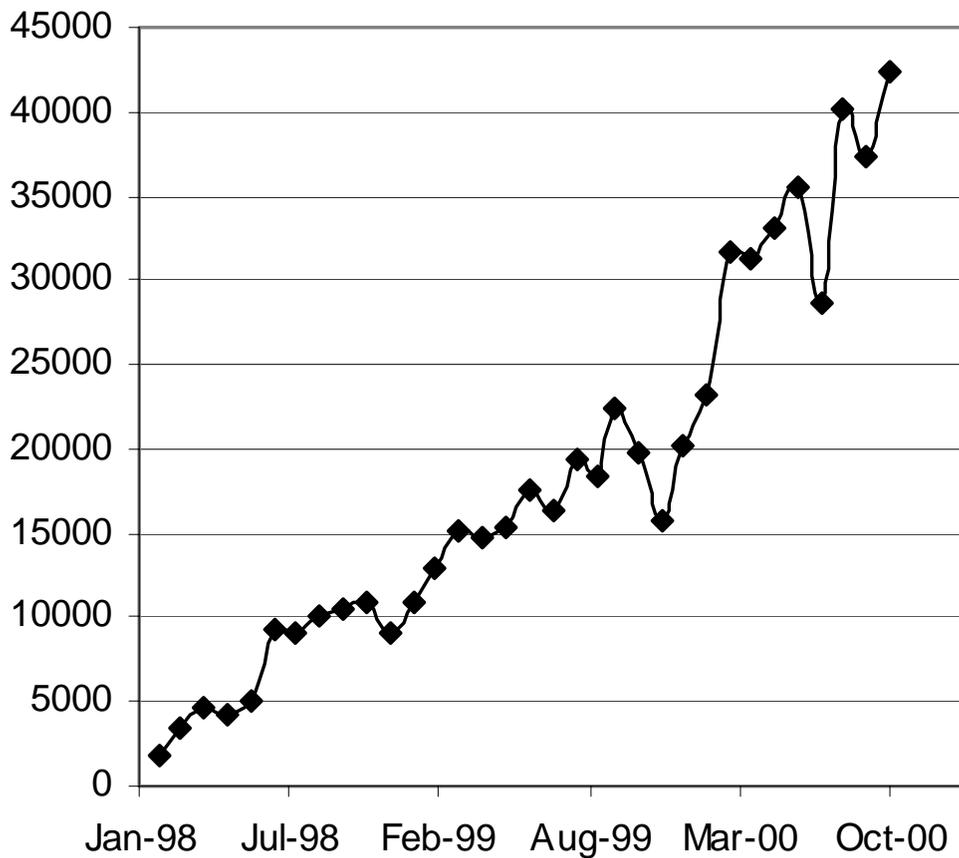
Motivation

- How can we design better systems to support collaboration?
- This means moving beyond information exchange
- Predicting system success is hard: there exist many “failures”
 - non-adoption: users, system, interaction of context, users, system
 - system constrains how we interact, e.g. we are constrained in how we organize information
- Rethinking of how behavior and systems can together be considered

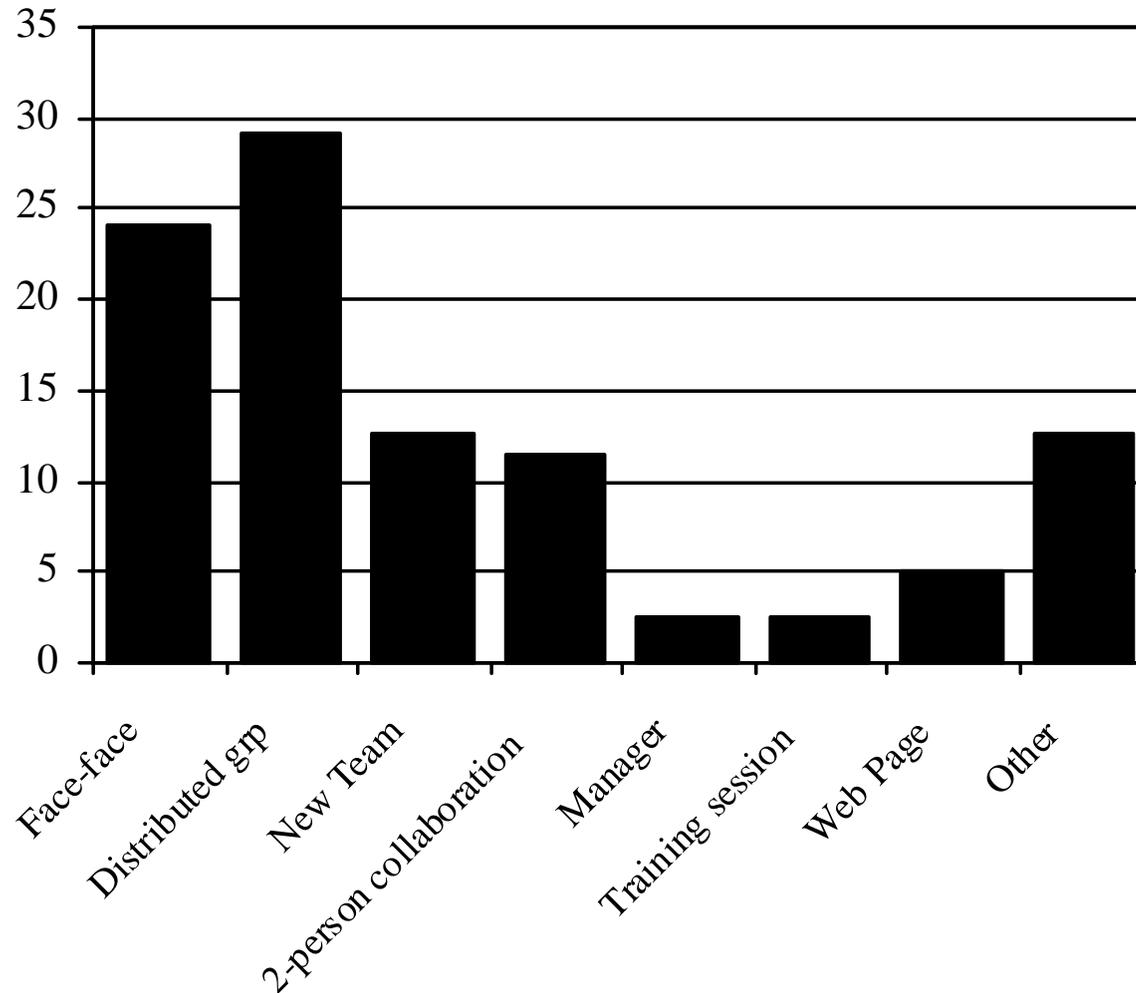
A Taxonomy of Collaborative Technologies: Some examples

•Synchronous, same place	Electronic Meeting Rooms
•Synchronous, different place	CVEs Shared CAD systems Video, audio Data-conferencing
•Asynchronous, different place	Shared workspaces Email
•Asynchronous, same place	Shiftwork: voice messages

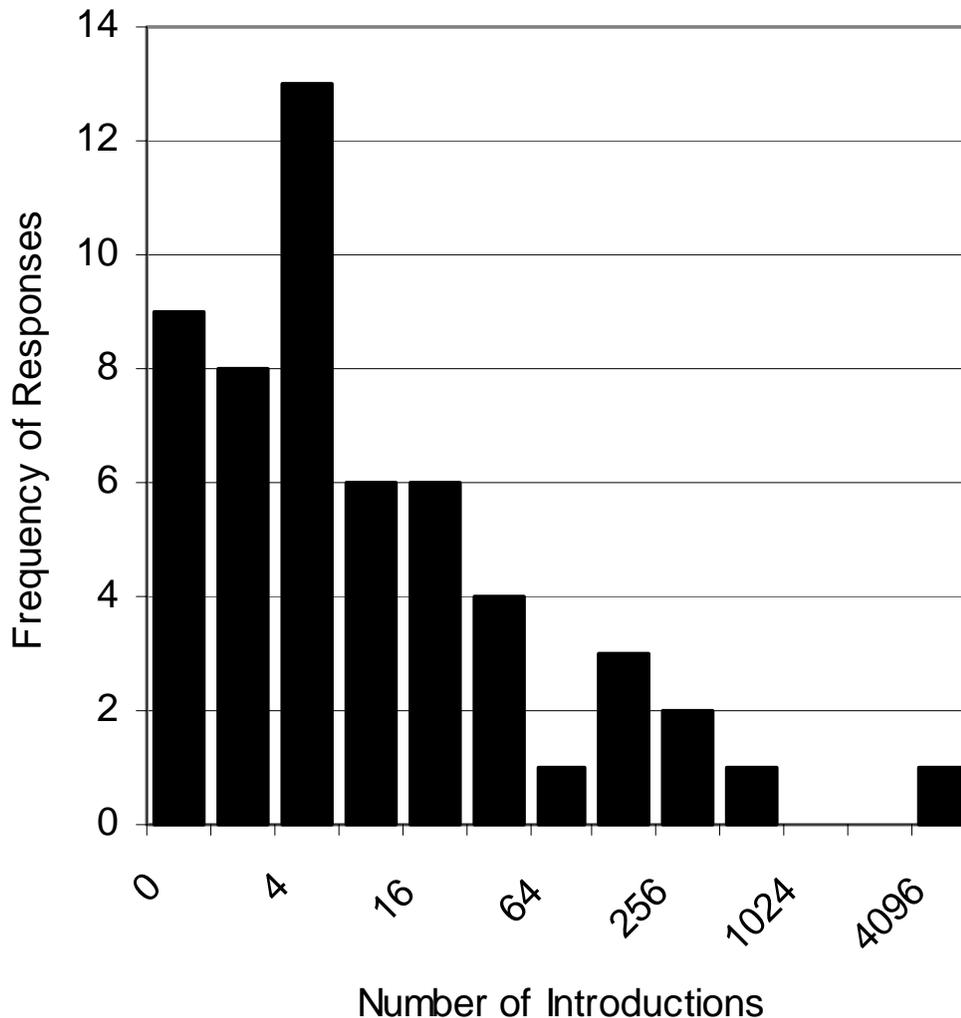
The Rise of Data-Conferencing Usage (Boeing)



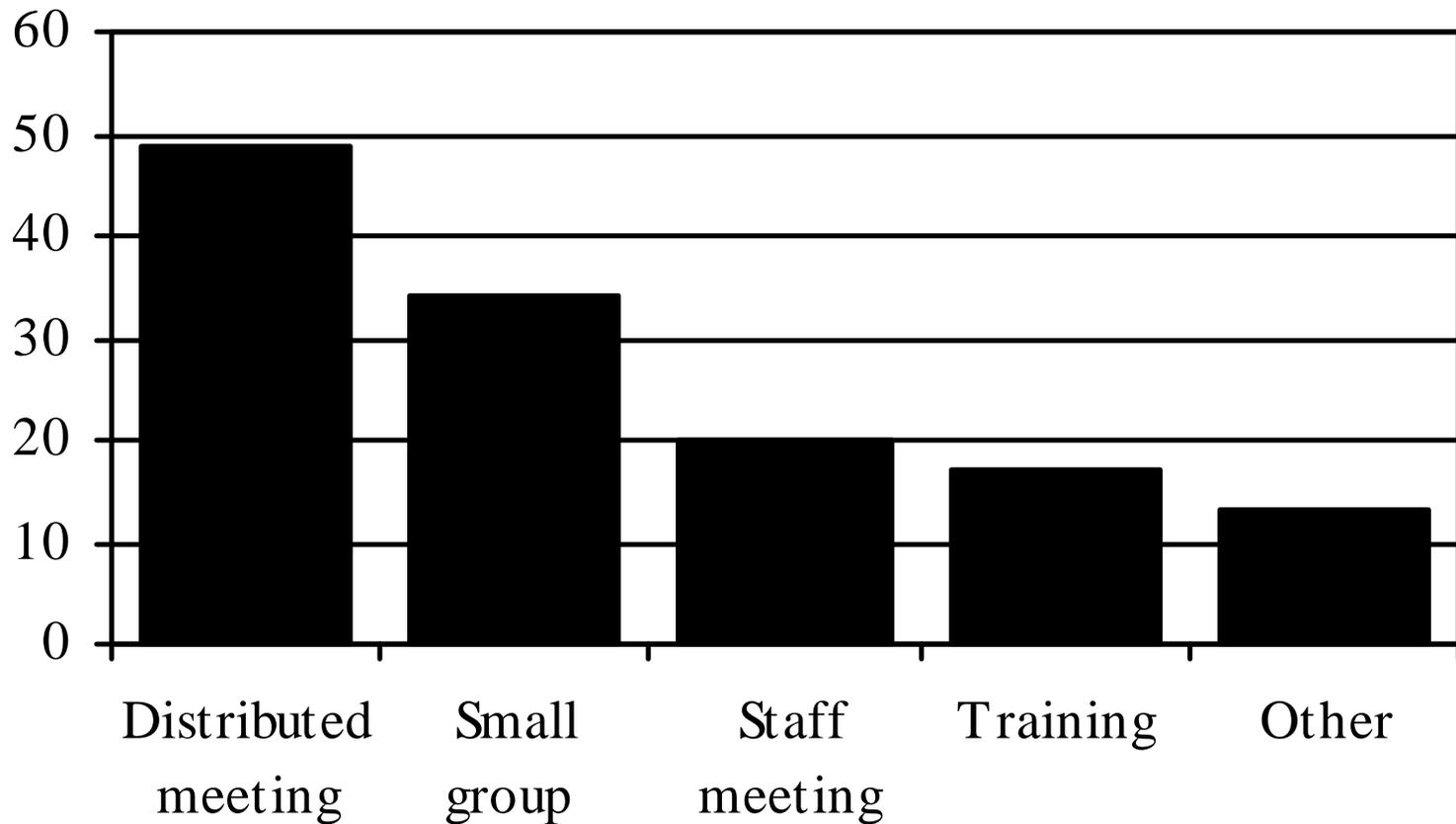
54% learned about the technology from remote colleagues



Most contributed to diffusing the technology



Why they introduced technology to others



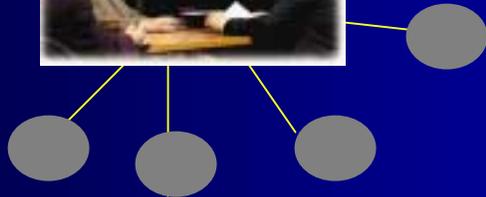
Technology Diffusion Across Distance

- Unlike how other technologies are diffused, collaborative technologies are being introduced remotely
- Desire to collaborate may be the driver for the diffusion of virtual collocation technologies
- Technology diffusion process is changing

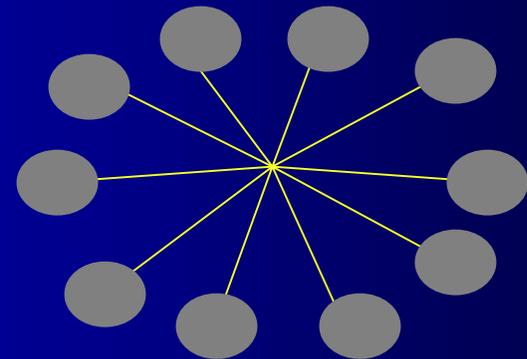
Supporting Virtually Collocated Teams: Desktop Conferencing



- MS NetMeeting: client software
- Shared application: all can display and interact w/info
- Teleconferencing
- Two meeting configurations:



Conference room with remote



All at remote sites

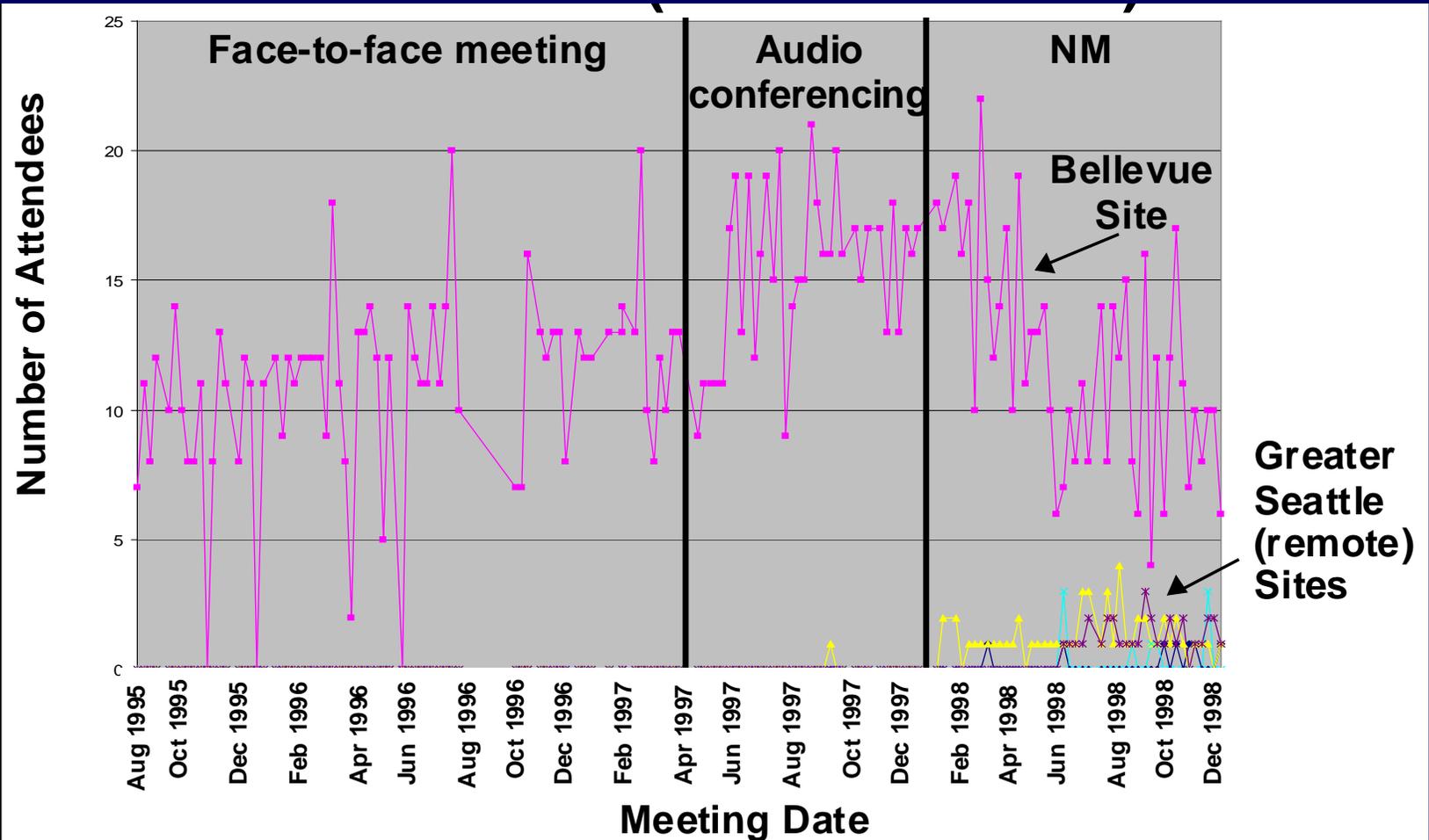
Problems with Virtual Teamwork

- Inexperience with technology use impeded whole group
- Problems with turn-taking, identifying speaker, who is present
 - strong turn-taking disadvantage for remote people
- Members reported lacking knowledge to make sense of others' on-line behaviors:
 - *“reflective looks means they are thinking, silence on the line doesn't”*
 - *“are they pausing for a comma, or for a period?”*
- Low involvement due to multi-tasking
 - low group commitment and meeting disruption

Developing New Roles and Means for Virtually Collocated Teams

- Technology facilitator: leads to effective meetings
- Meeting facilitator: integrates remote members into meeting
- Chat window: additional communication channel
 - enables parallel work without disrupting meeting
 - advice for technology problems
 - attendance check
 - social communication

Attendance over Technology Phases: Greater Seattle

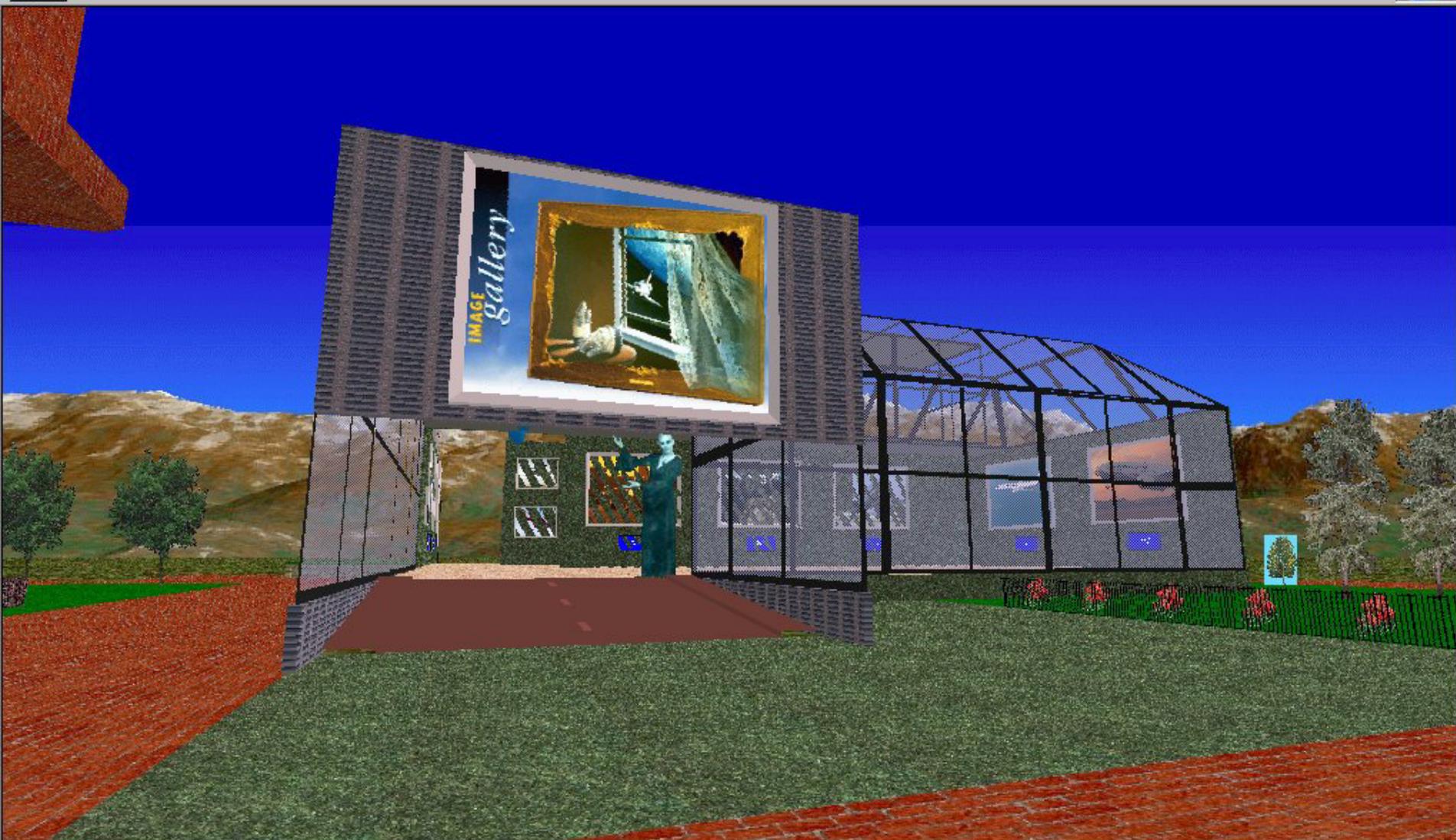


Supporting Informal Communication: Collaborative Virtual Environments

- Goal: After mergers in which a company becomes more globally distributed, can a virtual environment provide connections among people, company-wide?
- What value does a 3D graphical interface have for supporting informal interaction?



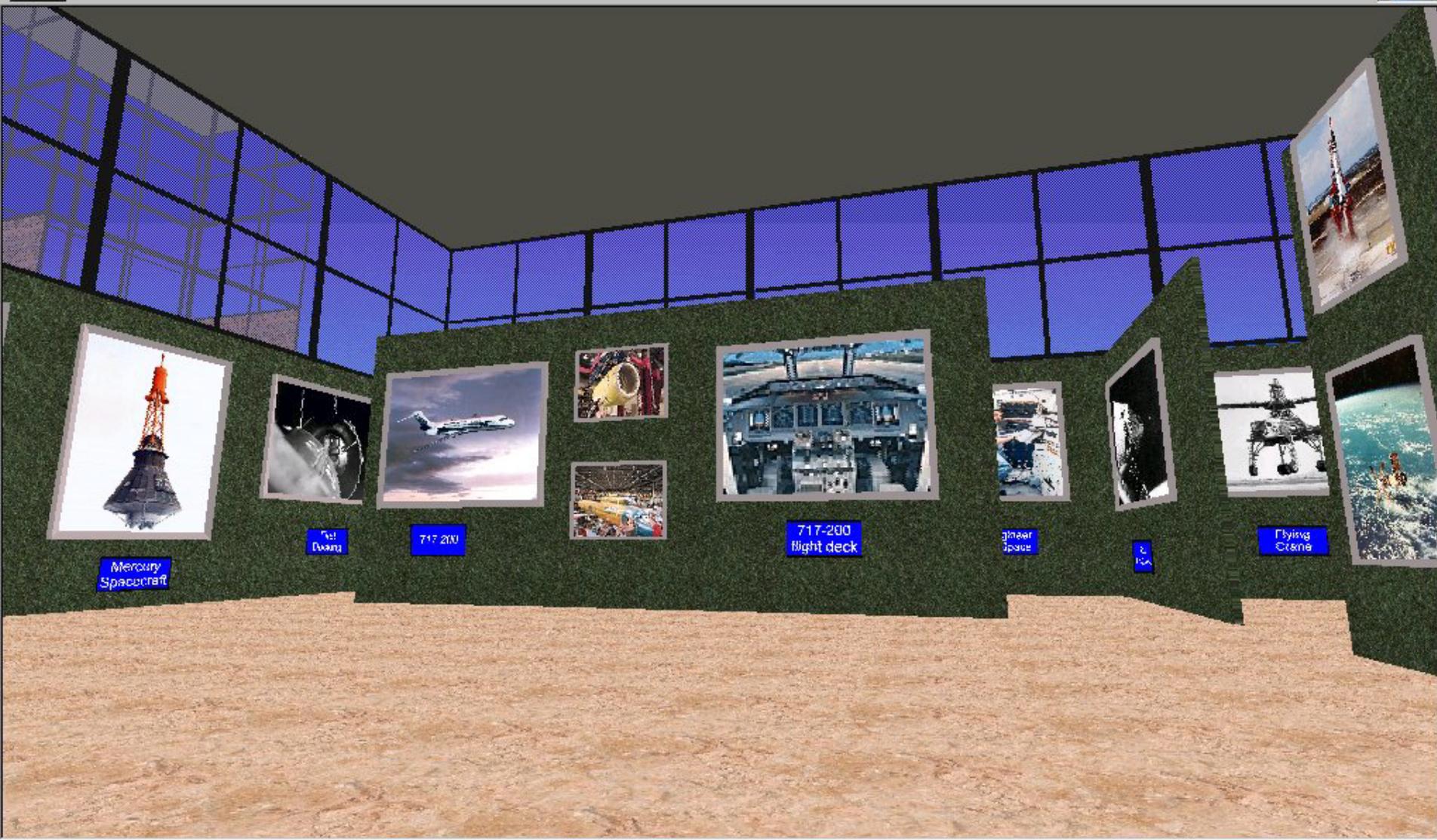
ACT1



Rick Wojcik:
Rick Wojcik:
Building Inspector Application to acquire privileges of crystal accepted



ACT1



Mercury Spacecraft



Jet Engine



717-200



717-200 flight deck



Space Shuttle



Space Shuttle



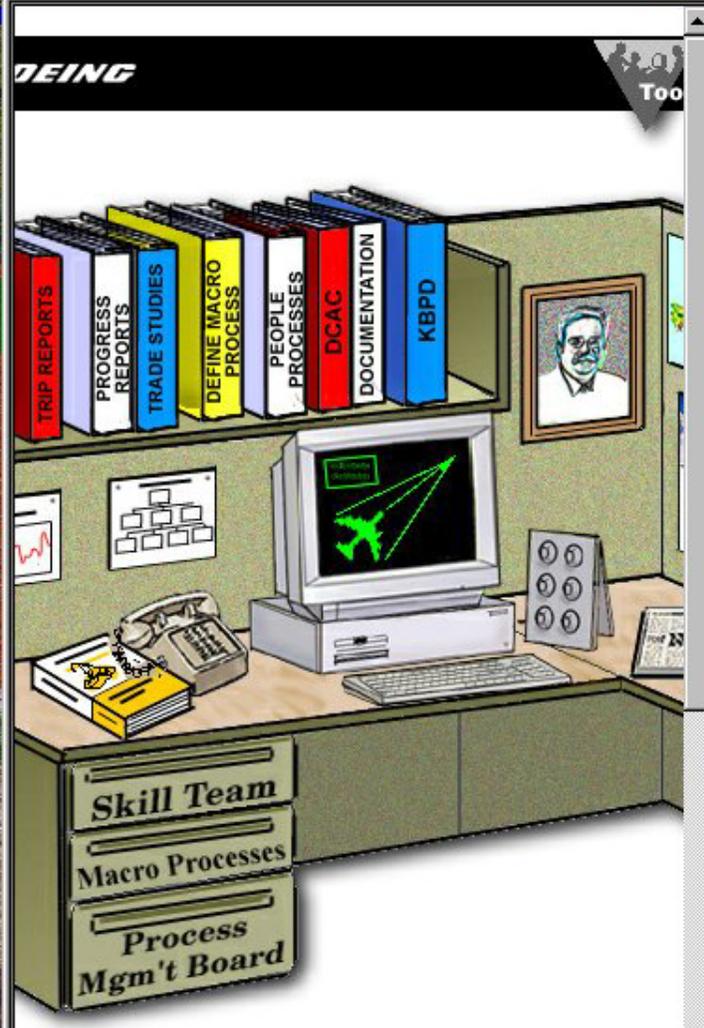
Flying Crane



Rick Wojcik: Building Inspector Application to acquire privileges of crystal accepted



ACT1

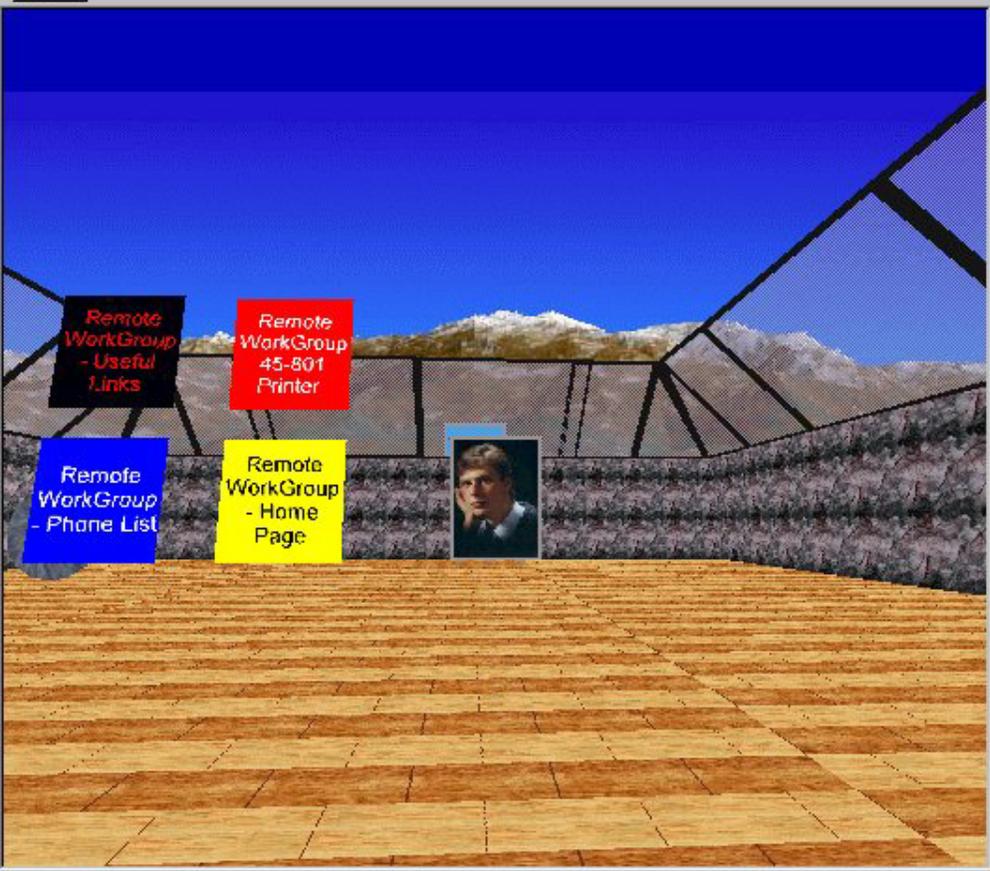


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Rick Wojcik:
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ACT1



Immigration Officer: Welcome to Boeing World. Check out the interactive signs at 1N 1W.



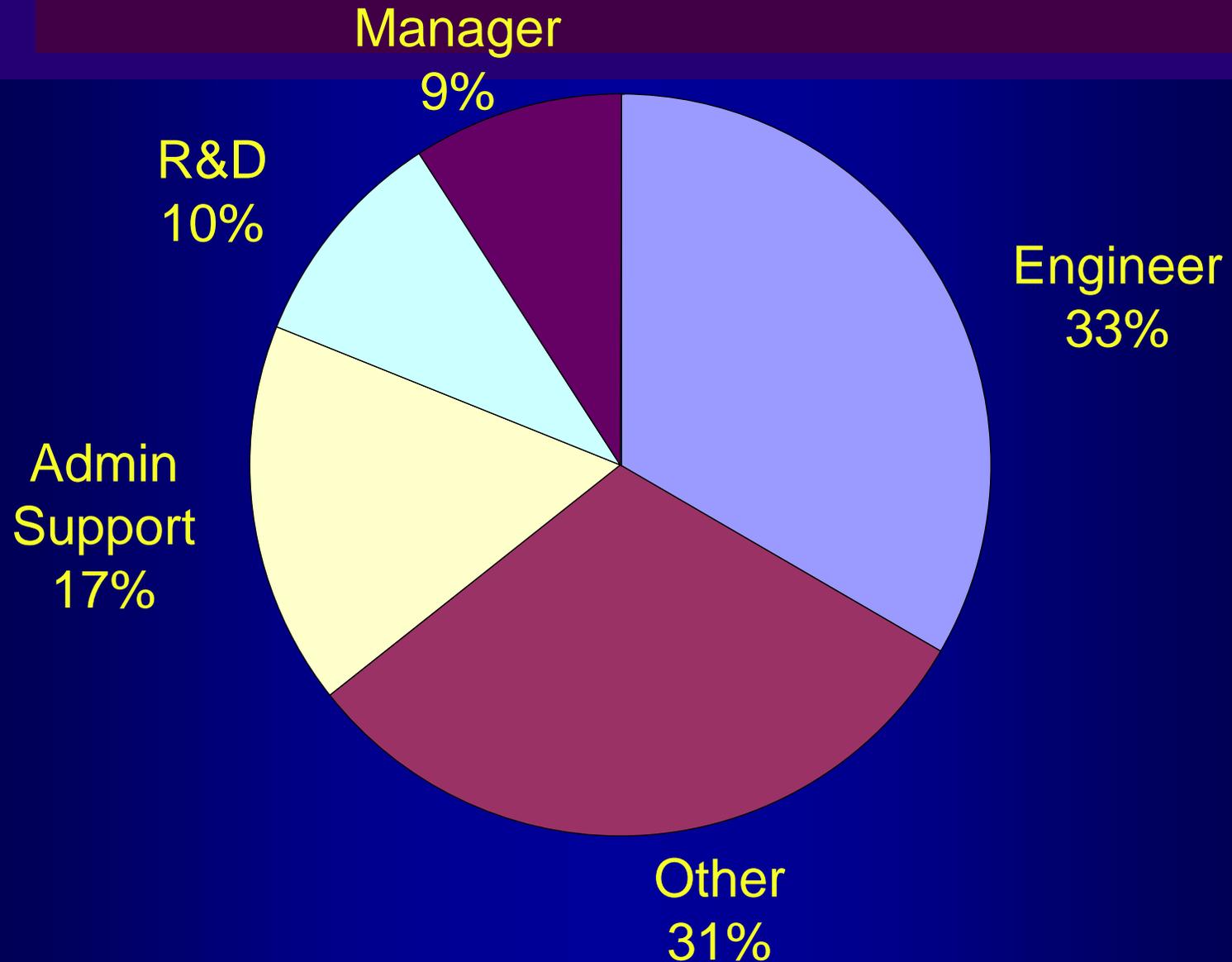
Everett Site Co

Remote Workgroup's Phone List

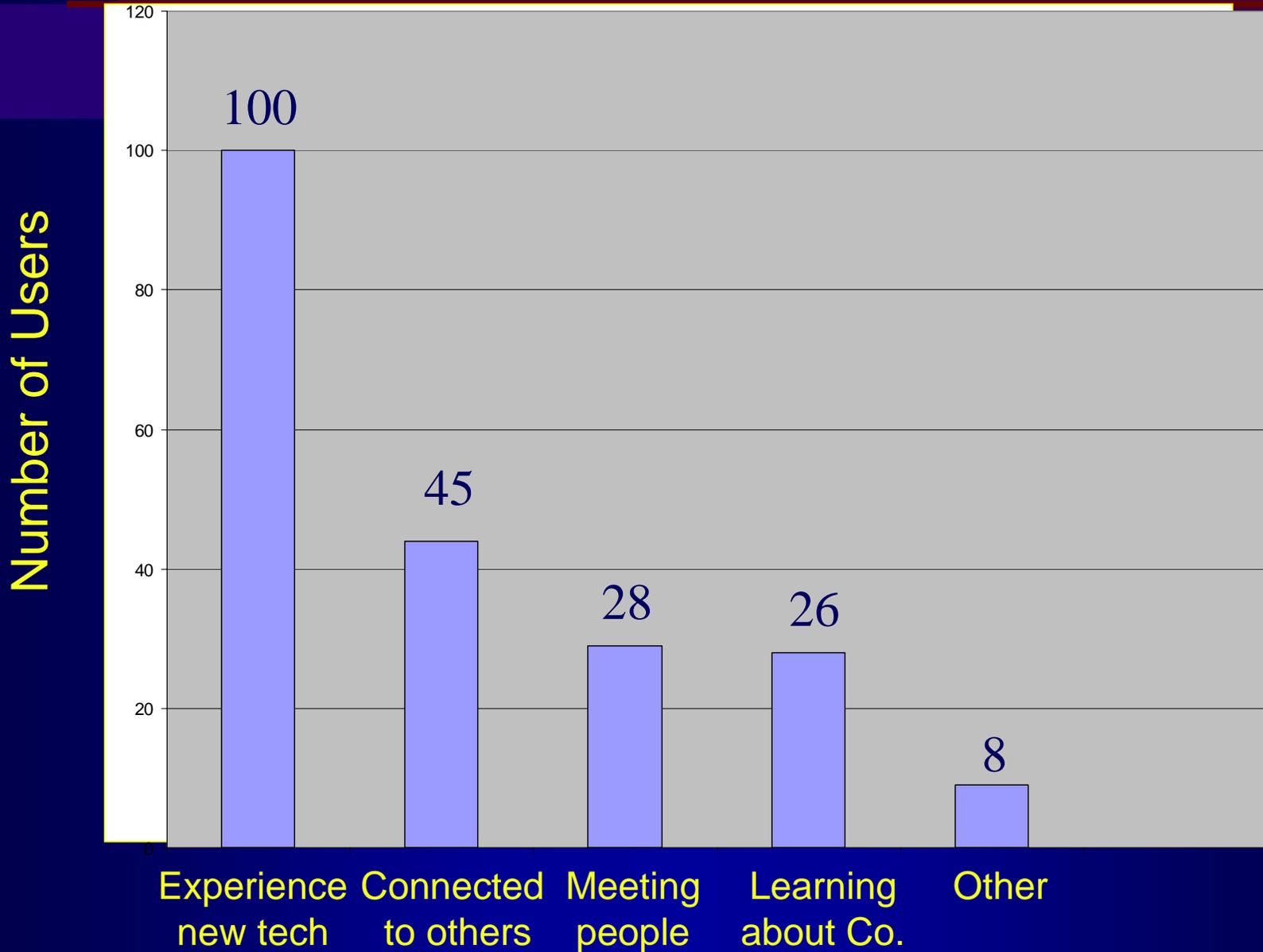
[Netscape News & Mail](#): *How to set up Netscape's news reader and e-mail features.*

Name	Phone		45-56/IRC	FAX	342-
Bomarc					
Cordt, Rex					
Walcott, Wayne					
Shands, Cecile					
Arthur, Brenda					
Clavel, Leo					
Coons, Laura					
Edain, Hasan					
Fitch, Kjrstin					
Higdon, Steve					
Layerno					

Work Roles of Users



Biggest Benefits



Enhancing Work

I am able to confer with counterparts in other company groups... I can show off websites that I have developed for ISDS and he can then show them to others in his group by taking them to AW.

I met a CAU who is helping to develop and maintain our virtual world site, and now is adding to our web site, providing tools for his group.

Not so much one particular person, but the “connectedness” one experiences by dealing with people who are widely separated geographically in the real world. This technology, at least temporarily, removes that separation.... The contacts in Boeing World have made those distant places “feel like immediate parts of a whole.

Boeing World: Lessons Learned

- No organizational support
 - non-work hours, disapproval of managers
- User reports: CVE's have potential, but technology not there yet
- Needed external structure (e.g. Town Hall meetings)
- Need functionality to better “connect” people of similar interests

Supporting Formal Interaction: Shared workspaces



- Development and introduction of a groupware system for ministries between Bonn and Berlin (4 year project)
- Asynchronous workteam cooperation support by:
 - shared workspaces
 - simple workflows
 - awareness services



The Paradox of Flexibility:

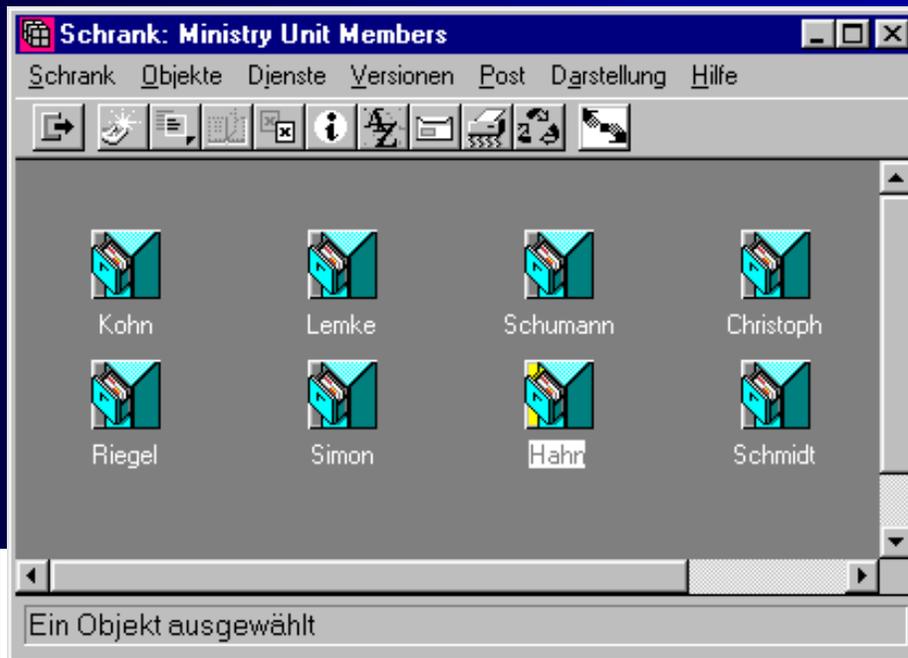
“There must be ground rules established for working together and dealing with the groupware. The culture is lacking to be able to handle this problem with the new technical possibilities. The stronger the technical flexibility, the more rules must exist for how we can handle this.”

-translated from German

Incongruent Conventions

The Writing Office View:

Structure by document owner
Filenames: member, date



The Ministry Unit View:

Structure by work-process
Filenames: task



Heterogeneous User Groups

Characterized by differences in jobs, tasks, education, technology experience, etc.

The Writing Office: type electronic versions of documents

The Ministry Unit: Speech-writing, citizen queries, info exchange

Shared objects subject to different perspectives and handling

Writing Office' View: content is irrelevant; unit member information is important

Ministry Unit View: documents associated by task; names and dates can be confusing in parallel work

The Requirements: Conventions for Shared Tasks

- Wide range of conventions needed for:
 - document changes
 - access rights
 - storage (e.g. aging information)
 - creating documents: shares vs. copy
 - borders between public and private work
 - substitution rules
- People's actions on shared objects affect the whole group
- Congruent procedures: cooperating partners must develop same assumptions, goals, conventions with system usage

Convention Violations

- Social methods not adequate
 - Documents removed from the shared workspace
 - Incongruent uses of a shared address list
- Technical methods: users found a way around it
 - Provided incorrect file codes
 - *“If I know the file code I give it. Otherwise I use a fantasy number”*

Usage Phases

				Trying solutions	
				Discovering problems with interdependencies	
			Refining functionality		
		Refining functionality			
	Setting up group functionality				
Understanding system use					
Transferring individual practices					
Setting up group functionality					
6 months	12 months	18 months	24 months	30 months	36 months

Supporting virtual teams: HDTV (with Paul DeFlorio)



An Exploratory Study Using Life-size HDTV with Team X

- NASA is interested in virtual collocation for these types of teams, to share expertise
- Currently audio-conferencing used
- Can another technology improve communication?
- What impact does using high telepresence (using life-size HDTV) in virtual collocation have on team performance?

Sidebars in the design process

- Important way for engineers to process information
- Networked spreadsheets provide results, engaging in sidebars
- Team X: Avg. number coded during three-hour session: 98 (large variability)
- Avg. engineer speaks 20 minutes in sidebar, range is 7-110 minutes in a three-hour session.
- Sidebars used to process information from spreadsheet: question assumptions, negotiate, find other options, etc.
- Collaborative technology support needs to consider informal processes as well as formal

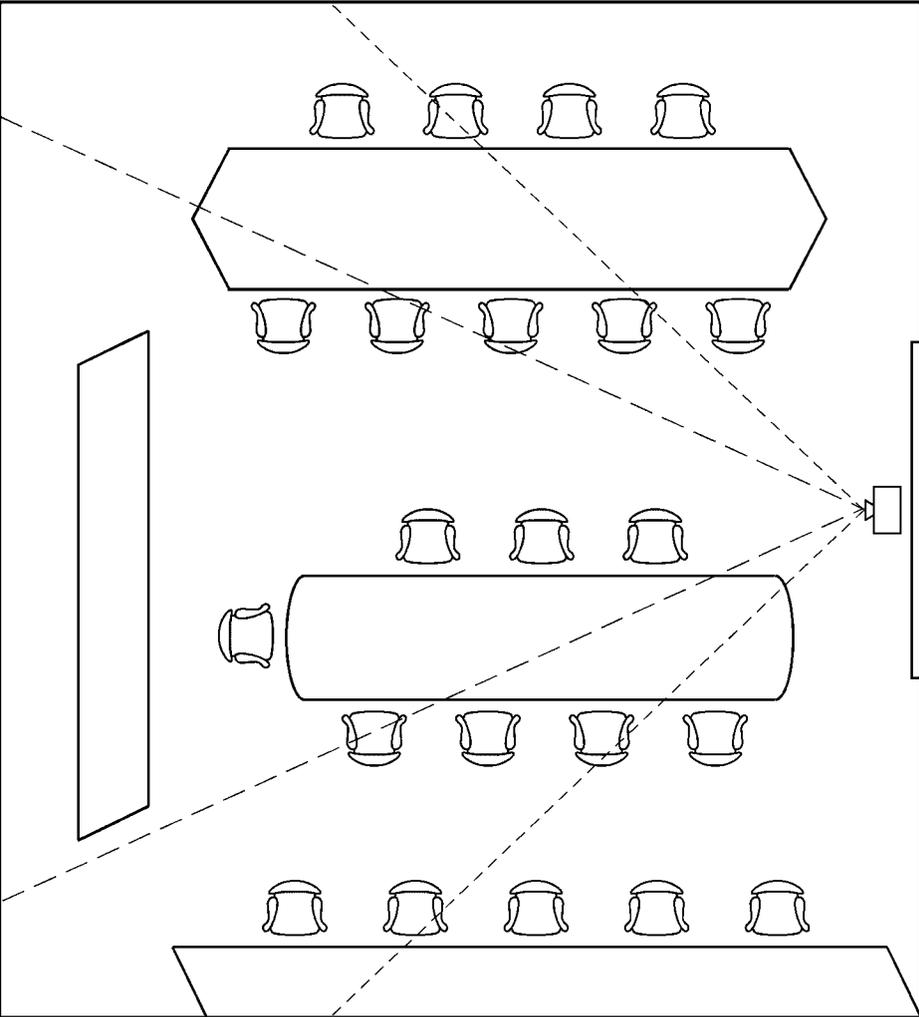
Experiment

- Large 128" x 72" screen showing HDTV as a "window" to show activity between rooms + audio
- Team X split into two rooms
- Real space shuttle mission proposal
- Telephones, with phone numbers, to support sidebars
- Day 1: audio directly sent in, video sent through Gigabit Ethernet (.8 second lag)
- Day 2: both audio and video sent through Gigabit Ethernet (degraded audio)

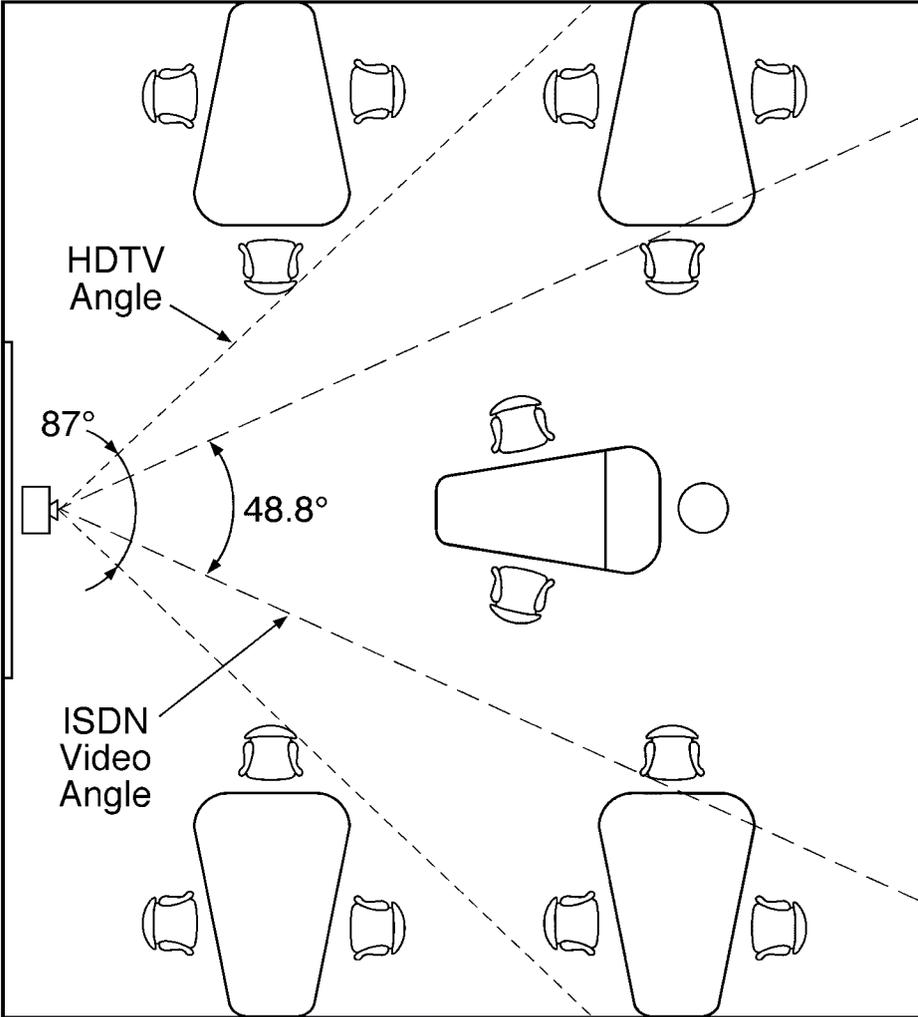




Room A



Room B



The Effect of High Telepresence

- High-quality audio is essential
- Video wall was used as means for observing activity in remote room: who is in sidebar conversation
- Compared to ISDN video, HDTV quality was rated nearly twice as good
 - *“The video was great, you could make out facial features of people at the back of the room.”*
- Life-size HDTV appears promising as a way to connect remote design teams

Challenges in designing for distributed work

- How can we leverage people's ability to monitor others' work, contributing expertise, checking errors, etc.?
- Security issues
- Privacy
- Bandwidth, network limitations
- Technology use as a comprehensive framework:
 - organizational influences, barriers, culture
 - local vs. remote rewards
 - team processes
 - social processes: e.g. trust, coordination

Supporting Design Work in All Phases

- Design work shifts between formal and informal interaction
- Technology support for both types
- Considering new roles on team when distributed
- Flexible systems that do not prescribe work
- Integrating remote people into continuity of work, design
- System analyst / designer as *workteam facilitator*

D to main site: Does anyone in this room understand what he's saying?

D to main site: Does anyone in this room understand what he's saying?

Remote site: I do

D to main site: Does anyone in this room understand what he's saying?

Remote site: I do

D: You're not in this room

D to main site: Does anyone in this room understand what he's saying?

Remote site: I do

D: You're not in this room

Remote site: I'm in the global room

The Workteam in the “Global Room”

D to main site: Does anyone in this room understand what he’s saying?

Remote site: I do

D: You’re not in this room

Remote site: I’m in the global room

