14.0 Collaborative Computation

Introduction and Definition

"Groupware" is the label for the notion that computers and information can be used to support business teams, rather than mere individuals (the dominant personal computing paradigm in the last decade). Groupware thus encompasses both the creation of entirely new systems, as well as the pressing into group service of systems designed for individual use.

PC-based groupware products are proliferating today, yet the term remains more a concept than a product category in its own right. In the long run "groupware" as a discrete category will disappear entirely, as group-oriented features are incorporated into virtually every product offered in the PC sector.

Groupware as a product category is growing solidly but modestly. The single largest groupware product is Lotus Notes, which is enjoying considerable popularity among corporations, but still has an installed base which is minuscule compared to the total installed base of networked PCs in corporations. The features that make it popular will find their way into more generalized environments such as operating systems, advanced data repositories and even Internet browsers and servers.

Groupware will have its largest impact on organizational structures. Even the most casual glance at business history makes it clear that each time a new infrastructure becomes available (e.g., railroad, telegraph, telephone) the entities which are ultimately most successful are also the first to reshape their structures in order to gain maximum advantage of the new information conduits. The new networks emerging today are "geodesic" (a term first noted by Peter Huber in the mid-80s in the context of telephone deregulation), that is, global, non-hierarchical and without any central node. It is a safe bet that our organizations will follow suit.

Ultimately, the term "groupware" will disappear sometime within the forecast period, for the simple reason that everything in computers and networking is becoming group-oriented. A decade ago, the term was a novelty in a world where "personal computing" was synonymous with stand-along systems. In 1995, personal computers are anything but standalone, running with operating systems designed for network and Internet connections. In a decade or so, group functionality will be the norm and stand-alone anything will be the exception—perhaps it will be called "soloware" to distinguish it from the new majority group-oriented applications.

This group-oriented future will be relatively slow to arrive, but the Air Force can gain much by aggressively pushing group-oriented systems. In a sense the Air Force is already on the bleeding edge of groupware by virtue of distributed simulation operations on the Defense Simulation Internet.

14.1 The Laser: Groupware's Key Driving Force, and Its Consequence for Communications

As mentioned earlier in the Personal Computer section, the advent of cheap lasers is the defining technological force in this decade. In turn, it is triggering a profound shift in the nature of communications as a medium, and it is this shift that groupware is riding into everyday reality. Decades worth of cherished telecommunications dreams may finally be realized, but

they are likely to come to pass in utterly unexpected ways. Communication isn't just coming into its own; it is becoming an entirely new medium. Three profound shifts can already be seen:

14.1.1 Communications: No Longer People Talking to People

For most of this century communications has been synonymous with people talking to people. However, the future growth in communications lies not in people talking to people, but in machines talking to machines on behalf of their human owners. Hints of this trend already abound. For example, voice conversations account for less than half the traffic on AT&T long lines between the United States and Japan the balance is generated by fax machines sending documents back and forth on behalf of their owners. The sales of fax machines are growing explosively.

The explosive growth of Internet use is another example of this shift towards a world of machines talking to machines on people's behalf. Email is the most widely used groupware application today. And this growth of communicating machines has already had unexpected impacts—the collapse of the North American Numbering Plan into a mess of new area codes was occasioned by the unexpected need to give machines their own phone numbers.

But so far, the devices communicating on our behalf have been helplessly stupid. Who trusts their fax machine enough to ignore the status printout? Add processing power, however, and things get interesting. This on-board intelligence will allow our communications devices to become more reliable and more autonomous, eventually becoming powerful "infobots" managing a growing list of more sophisticated tasks on our behalf, from managing calls and mail, to coordinating our calendars to purchasing information and conducting simple transactions. Ever more autonomous systems will of course create special challenges on the battlefield of the future. (See Intelligent Software Agents, Chapter 5.)

Simple examples of this emerging world already exist today. "Program trading" on Wall Street has been commonplace for years. The Internet universe is inhabited by a menagerie of simple software agents performing routine tasks like mail handling and information gathering for their human owners, and the first telephone agent, a system called "Wildfire", is available for purchase. We will see a dramatic increase in machine-mediated communications in the groupware arena over the next decade. Look in particular for intelligent group schedulers, communications coordinators, group-oriented project and mission planning aids, and of course, ever more autonomous network-based agents toing and froing in the service of team-oriented masters.

Of course, new worries will replace old as communications become more machine mediated. We will wish for the simplicity of jammed paper as we worry whether errant software agents have misdelivered our electronic documents or are off making mischief somewhere on the global network. Larger-scale snafus will also be a certainty: recall that unsupervised software trading programs were what sent the stock market into a nose-dive in 1987. The key challenge for knowledge workers in this new regime will be one of intervention keeping up with the inter-machine conversation sufficiently to catch and correct glitches. Defining the limits of infobot autonomy and teaching our new infobot companions when to call for help will be a hot issue early in the next century. Groupware in the decades ahead will involve more than human-to-human conversations—"participants" will include machine intelligences as well.

14.1.2 Communications: No Longer a Conduit

A second shift goes even more directly to the nature of communications as a medium. For most of this century, communications have been a conduit, a pipe between distant physical locations. A decade or two from now, our communications medium will seem less a pipe than a location in its own right. It will become a place, a destination where we will conduct more of our business and personal interactions.

This future has been richly anticipated by today's' cyberpunk authors like William Gibson, who describe a future "cyberspace" where we will spend ever more of our lives, and reality is quickly catching up. The popularity of MUDs, multiple-user dimensions, on the Internet hints at the shape that communications-as-destination will take. Despite the limitations of the text-only environment imposed by today's networks, the current crop of MUDs has matured into social virtual realities offering a richness of interaction unmatched by anything short of face-to-face encounters. The first video-based MUDs have been developed in several laboratories, and seem to be clear harbingers of the form that net-based systems will take over the next two decades.

Cyberspace today is largely monochrome and text-based, but it will evolve into something that is steadily more vivid, thanks to growing communications bandwidth. The first multimedia MUDs already exist. MUDs employing two-way video are unremarkable fixtures in a handful of research labs, and consumers will shortly be able to subscribe to a next generation of MUDs that substitute cartoon-like multimedia worlds for ASCII environments used today. In the long run, MUDs will mutate into more generalized environments where participants will be able to do the sorts of things people do in the real world today: socialize, hang-out and conduct business. Cyberspace will thus become a powerful adjunct to today's real-world business environment.

14.1.3 Communications: From Scarcity to Abundance, and Ultimately, Ubiquity

Finally, the communications medium is experiencing a third shift, from scarcity to abundance, and ultimately, ubiquity. This shift has already profoundly affected the regulatory environment which, since 1970 has been shaped above all by the consequences of communications abundance. Deregulation got a push from politics, but it was also inevitable, for the old regulatory order was preoccupied with the fair use and allocation of a scarce resource communications bandwidth or monopoly over wire connections to the home or business.

It is the final dimension of this shift, from abundance that ubiquity that will deliver the greatest surprises for planners. No matter how quickly communications reality advances, user expectations will advance more rapidly yet. Policymakers and soldiers alike will expect communications to be instantaneous.

14.2 Groupware: How Soon, How Fast

Groupware is growing slowly in terms of general business acceptance, but the Air Force has an important opportunity to take advantage of this technology. The combination of the domain-specificity of the Air Force mission, combined with its unique management structure positions the Air Force to take early advantage of emerging groupware system options, at a rate more rapid than is possible for business at large. With this in mind, this section offers a rough

forecast of which areas are likely to advance most rapidly to a point where they can be effectively exploited.

14.2.1 Videoconferencing

Videoconferencing systems are slowly emerging from a long gestation period that dates back at least to AT&T's PicturePhone service of the early 1960s. Videoconferencing rooms have given way to videoconferencing carts and most recently, to "desktop videoconferencing" built into workstations. The price of systems continues to plummet, both for terminal equipment, as well as communications links. In addition to the evolution of traditional commercial products, such as Intel's ProShare, two-way video is burgeoning over the Internet with the diffusion of Cu-C-me and M-bone. At the moment these Internet solutions deliver images little better than that of TV in 1952, but they are evolving rapidly, and are likely to deliver satisfactory video for ordinary users by or before 2000.

Diffusion of videoconferencing systems has been modest to date. Even low-cost desktop video systems are moving slowly. However, the situation is akin to that of fax machines in the last decade; the industry seems poised for a take-off sometime within the next decade. All that is missing is some stability in standards and more coordination among manufacturers. This will happen, though the moment of take-off of course cannot be predicted with certainty.

Plain-vanilla videoconferencing can be an effective business tool, but it is likely that the "phone call" model of setting up conferences will erode in favor of more socially rich and interactive modes of communications over the latter half of the forecast period. This represents a convergence of videoconferencing with novel groupware notions. Look for "video hallways"—permanently established links between informal spaces in physical sites separated by distance. Also, we will see the emergence of video MUDS that offer greater opportunities for informal interaction than formal video conferences.

This is an area where the Air Force can take early advantage of emerging systems. Businesses on the outside will have to wait for costs to drop further and for systems to be acquired by their client communities. The Air Force however can accelerate deployment of emergent systems into mission-critical areas as needed.

One footnote: beware of the "travel substitution" mirage. The simple fact is that rich electronic communications lead to the desire for more face-to-face meetings, and more face-to-face meetings inevitably lead to more electronic interaction between meetings. Instead of travel substitution, the Air Force should pursue "travel shifting"—the use of electronic communications in order to be able to cluster and rearrange physical meetings for greater convenience and effectiveness. Pursuit of mere travel substitution will amount to the sacrifice of effectiveness in favor of simple efficiency.

14.2.2 Shared Databases/Group Memory Systems

Lotus Notes is the current leading product in this area, but it is likely that we will see the emergence of competitive systems built around more open Internet-based models early in the Forecast period. Notes is likely to have a long life, and be upgraded by its new owner, IBM, and it will find a solid home in a small and slowly growing number of large corporations. But the more open systems are much more likely than Notes to capture large audiences outside of these

corporations, and ultimately will eclipse Notes in much the way Internet-based mail and the World-Wide Web eclipsed proprietary on-line systems.

One can forecast this broad trend with a high degree of certainty, but the details defy prediction. That said, the trajectory of surprise is likely to match that of the Internet over the last three years, and the requisite innovations are likely to come from the same quarter—university researchers establishing start-ups to exploit new markets.

14.3 MUDs

Multiple User Dimensions—MUDs—represent the fastest growing sector of the Internet today. MUDs are in effect social virtual realities that for the moment are largely text-based, employing a simple Pascal-like language to manage the details of the social interaction occurring. The majority of MUDs are recreationally oriented, but the number of research MUDs is increasing, and the first business MUDs are likely to appear in the near future as well. As already mentioned, multimedia and video MUDs exist in research laboratories today, and will begin to find their way out into the real world soon after 2000.

The main event on MUDs is human-to-human interaction, for the moment at least in the virtual MUD space, the humans "meet" in social, business, or gaming context. However MUDs are natural environments for the deployment of agents and near-agents. As agenting technology advances, human-agent interaction could become even more important than pure human interaction.

14.3.1 New Operating Systems

Operating systems have become steadily more network-oriented and group-oriented. For example, two major operation systems of today, Windows and the Mac OS, both include network access and file sharing as standard elements. As operating systems advance, look for the incorporation of email and other group functions as essential features.

One wild card is the disappearance of operating systems, replaced by network environments. In effect, the environment becomes so group-oriented that the very notion of an operating system begins to evaporate.

14.4 Implications

The growing diffusion of groupware presents a large number of implications for the USAF. A few of the most important include:

- Continued change in organizational structures. Our organizations have long been shaped by the communications infrastructures they use, and the 1990s will be no exception. As new communications media proliferate, look for new organizational forms to emerge as well. Hierarchies have already yielded to team-based forms; new web-like organizational structures appear to be the logical next stage. By the end of the 1990s, we may discover that laser-driven access has blurred organizational structures and boundaries to the point where the corporate model as we know it becomes all but obsolete.

- Electronic marketplaces and electronic commerce. Electronic commerce is merely a specialized form of groupware. The electronic trading systems of the 1980s amount to primitive predecessors to new venues for electronic commerce. Already, less than 25% of the US money supply is represented by paper currency. Now business *people* are joining their transaction flows in this new environment. Look for future hybrids of trading, conferencing, and e-mail systems to mature into the cyberspace version of the medieval marketplace, a transactional venue for the conduct of everyday business. The long-term consequence may be the emergence of "electronic commerce" the creation of forms of transaction as different from today's modes of interaction as today's business interactions are from those of half a century ago.
- Access tools will deliver on early 1980's visions. For example, powerful workstations could finally make telecommuting a reality for more than a determined few enthusiasts willing to put up with the complexity and aggravation of PCs. Elsewhere, the diffusion of connectivity-rich information appliances is likely to support a whole new class of nomadic executives relying on a global network to work not at home, but everywhere.
- New generations of office tools will appear. Tasks, once performed by discrete devices like fax machines and copiers, will be combined and performed by a new generation of office tools. For example, companies are already beginning to offer inexpen-sive desktop "I/O utilities" that combine laser printer, scanner, fax, and low-volume copier in one printer-sized box. Workers will still go to the copy room to make large numbers of copies on the now-digital copiers, but these new boxes will save shoe leather when making one or two duplicates in the local office area.

14.5 Thinking the Unthinkable: The Virtual Pentagon

Imagine that groupware technologies become so effective that the Pentagon is replaced by a "virtual Pentagon" a destination in cyberspace accessible by Air Force personnel from wherever they happen to be on the planet. It would be premature to seriously propose such an outcome based on currently available technology, but it is likely that such an eventuality will seem a non-controversial option well before the end of the forecast period. In the meantime, we recommend using the notion as an organizational artificial horizon against which to measure the potential benefits of groupware advances. One extreme-case scenario follows.

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The last USAF officer has departed the Pentagon—and Washington. By now everyone in the Air Force is working much closer to USAF's actual operations, dispersed at bases around the US and the globe. The Pentagon's population has shrunk to that accounted for by the office of Secretary of Defense, and its staff, plus a small population of staff whose role it is to support visitors to the Pentagon. Military officers still visit the Pentagon, but they now "hotel" for brief periods when on-site for various meetings. Overall, the daily population of the Pentagon present on military business is one-tenth of the population in 1995.

The Pentagon's warren of offices has been radically revamped. Gone are the acres of office suites, replaced by a large number of flexible meeting spaces, and visitor offices. With slight variations for each service, everyone follows a similar pattern: an arriving officer stops first at a "concierge" desk, is handed a secure wireless phone and is assigned a visiting office. The art of the concierge is to cluster visitors together according to the reasons for their visit. For example, a team of 15 individuals has converged to meet around the development of a new weapons system. All are assigned offices near the conference room in which they will meet, which itself is a team room dedicated to the group not merely for the duration of their meeting, but the entire length of the current phase of their project. A project coordinator is the only permanent inhabitant of the area, responsible for various group tasks on-site. Upon reaching the entrance to the area, each participant pulls out their "rolling office"—in effect a small file tabouret on wheels containing personal files and personal effects—and tugs it into their assigned office. In the office is a desktop workstation and a docking station for the visitor's laptop PC.

The meeting room is similarly equipped with rich communications links in order to accommodate other participants who were not able to adjust their schedules to be physically present at the meeting. One wall is a "video wall", a large-size screen capable of being used for videoconferencing or displaying computer-mediated information. At the group's option, it can be used to display a remote colleague, display CAD information or display any of several feeds from remote sources.

Of course only a fraction of the Pentagon is now used by military personnel. The Secretary of the Air Force and her Secretariat remain at the Pentagon to conduct the business of the Air Force. Senior military leaders of the Air Force spend more time then perhaps they might like handling interactions with Congress, OSD, the Joint Staff, and occasional non-electronic meetings with the leadership of the other services.