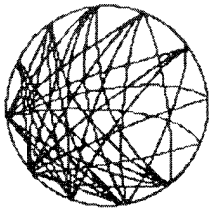
CHAPTER 7



VIRTUAL PLACES

Home Is Where the Site Is

In the last decade of the millennium, the transition to the Information Age is in its tumultuous "storming/norming" phase. Communism crumbled and market forces reign. A new economic world order prevails as nations scramble to stabilize political patterns. The proliferation of computers and networks approaches critical mass as electronic technology shifts from analog devices that reproduce information to digital designs that enable infinite mutations. Electronic bits now drive the great transforming processes of an increasingly ascendant information-based civilization.

Virtual teams are little glimpses of the future, experimental triads of people, organization, and technology. Living a vital part of the future today, virtual team members are imprinting a bit of themselves on the shape of things to come. Their failures and victories inform successive teams and networks. Of considerable consequence is how virtual teams use digital technology. One stop on this journey is a company that lives by the technology it makes and that launched 70 virtual teams all at once.

SunTeams: Increasing Customer Loyalty

In 1993, Sun Microsystems, the Silicon Valley maker of network computing solutions whose motto is "The network is the computer," began to focus on quality in a unique way. "We asked ourselves how we could embed quality into our corporate DNA," says Jim Lynch, Sun's director of Corporate Quality. To address the question, Scott McNealy, the company's CEO and one of its four 1982 founders,[1] convened a series of annual meetings for his senior staff. Chief executives of other leading companies were featured speakers. In 1993, Federal Express' CEO Fred Smith addressed the group, followed by Motorola's CEO Gary Tooker in 1994 and Xerox's Paul Alaire in 1995.

Two major themes surfaced from these yearly meetings: Each CEO stressed the importance of teamwork and recommended getting employees directly involved in customer satisfaction.

Tooker's address particularly resonated with McNealy. Pointing to the significant impact of teamwork on Motorola, Tooker provided McNealy with the outlines of a model that Sun would follow. If Sun could apply its extraordinary technology strength to resolving its quality issues, it would be ready for the 21st century.

The classic "lean-and-mean" company, Sun had always celebrated the independence and initiative of its individual engineers. Lynch describes them as "bright engineers walking to their own drum beat and reinventing the ground rules of computing." Curt Crosby, who coordinates the team effort for Sun Microsystems Computer Company (SMCC), the company's largest operating division, which designs and manufactures its products, describes the culture as "the basic hero mentality." Thus the move to encourage teams required ingenuity and a particular spin that would appeal to Sun's free-wheeling culture.

There had been teams before at Sun. "We have always had a lot of teams self-forming in the natural course of doing their work," says Lin Brown, SMCC's quality director. What was about to happen at Sun, however, was something new—the intentional use of cross-boundary teams to tackle the company's most challenging issues.

"When you're tampering constructively with a company's DNA, you have to be very careful," says Lynch, who was the architect of what

would become SunTeams, a new companywide initiative launched in 1995. Sun's strength is technology innovation. This meant that the company had to execute its team-based drive toward customer and process improvement with great delicacy. Lynch points to Java, Sun's paradigm-shattering innovation that delivers chunks of software over the Internet as needed. "It was not a technology idea that came about because we were improving processes." Sun's consequent challenge was "to keep the best of what we've got and improve what needs improvement. It's extraordinarily complex."

Jump-Starting Virtual Sun Teams

Once McNealy and his staff decided to launch SunTeams, they moved quickly. In September 1994, just a few months after Tooker's visit, McNealy and his staff met with leaders of Motorola's team effort. With more than 5000 teams operating throughout its company, Motorola is widely respected as a model for teams in large firms. Because it is in a related industry, its experience seemed a particularly apt model for Sun to follow. Five months later in February 1995, Lynch got the go-ahead from McNealy and his staff to implement "A SunTeams Architecture."

"The basic idea was a 'lightweight, one-size fits all' approach that was nonbureaucratic," Lynch recalls. To keep things simple, they developed a seven-word definition that would be immediately understandable by Sun's 17,000 employees:

Process improvement through teamwork for customer satisfaction.

This purpose statement provides a high-level goal (customer satisfaction), the means (teamwork), and the result (process improvement).

A consistent definition is one point of Lynch's 10-point architecture for SunTeams that covered the basics of high quality and good teamwork. The other points are:

? A customer, either external or internal;
? A common methodology;
? Continuous and sustained process improvement;
? Education in SunTeams-specific courses at Sun University;
? Management support (which was required);
? A one-page start-a-team process;
? Annual team recognition;
? Team rewards throughout the year; and
? A consistent set of criteria for measuring team effectiveness.

To kick things off, McNealy took to The SWAN (Sun Wide Area Network) in April 1995. The company's vast computer network includes "WSUN Radio," not literally a radio station, but rather an internal Web site that transmits text, graphics, audio, and video. McNealy's kick-off broadcast was the first of three. He took to the airwaves again during the summer of 1995, then reinforced the message for a third time in October 1995.

McNealy encouraged people to become involved in SunTeams—and proffered an appealing incentive: The first annual celebration would take place in San Francisco the following March. The 16 finalist teams from across the company, selected from the major divisions, would attend "SunTeams Celebration 1996." Members of the teams that advanced to the companywide competition would enjoy an all-expenses paid weekend—with their significant others—at San Francisco's posh Ritz-Carlton.

While the SunTeam architects expected positive reaction to the idea, they were amazed at the response. The first year saw 70 teams—about twice the number they had anticipated—spring up across the corporation's six operating companies. Called "OpCos" in SunSpeak, they include SMCC, SunExpress, the aftermarketing company, SunService, the company's service arm, SunSoft, Sun Microelectronics, and JavaSoft, the newest OpCo.

All of the teams were virtual in sonic respect. Typically team members were in different locations and time zones—at minimum American East and West Coasts. They were specialists in different areas, such

as operating systems and networking experts. Not infrequently, they came from outside the company altogether: Suppliers and customers were members of numerous teams.

Shrinking the Dissatisfiers

Through its research on quality, the company had identified 32 "customer dissatisfiers," such as late delivery of products and slow response to customer problems. "SunTeams are working on things that are important to us, not redesigning the lunchroom," Lynch explains. By aligning the Sun-Team effort to initiatives that addressed its customer satisfaction drive, the company virtually guaranteed that the teams would have an immediate impact on company performance.

SunExpress' Customer Order Cycle Team (see Chapter 1) developed an entirely new EDI-based (Electronic Data Interchange) system. It allows major customers to place their orders online and receive them within three days with minimal human intervention. The 15-member team was cross-functional (operations, marketing, sales, information resources, and finance), cross-geographic (Massachusetts, Illinois, Texas, California, Japan, and The Netherlands), and cross-company (including both a customer, Motorola, and a supplier, Caterpillar Logistics Systems).

Amazingly, the team successfully completed its work within seven months without ever meeting face-to-face. "We never had the entire team in the room at the same time," says Bill Crowley, operations manager-North America for SunExpress, one of the team's two co-leaders. Instead, the group held two-hour weekly conference calls with as many people as possible gathered together around speaker phones in their locations.

SunService's Live Call Transfer Team, based in England, significantly reduced its customer response time by entirely overhauling its call answering process. The redesign involved everything from creating new office space to installing new telephone technology to crafting new job descriptions. While most of the team members were collocated, they came from separate functions and worked locally on a 24-hour clock responding to customers in all time zones. Because they could never take everyone off the phones for a meeting (after all this was the

group responding to customer problems), most of their communication was by e-mail.

As with many of the SunTeam efforts, the Live Call Transfer Team's success has led to a new initiative, the "7 x 24" project. "We can't have specialists in every country," notes David Gibson, who managed the Live Call Transfer Team. "We're designing a system that will allow us to offer 24-hour global support independent of where the engineers are located."

In less than a year, SunService's Two-Day Customer Quality Index (CQI) Team radically improved the rate at which they resolved customer problems. Before the team's work, it settled 54 percent of the problems within two days. After the team did its work, the number jumped to 70 percent. At the same time, they cut the backlog of open customer problems (what the Sun folks call "train wrecks") by 49 percent in just nine months. By July 1996, the backlog had decreased to barely 25 percent of the problem at its zenith.

"It was a grassroots team of about 16 people who interviewed all 340 people in our service center to find out the sources of the problems," says Tom Young, SunService's Customer Service manager who led the effort. "Every technology that we touched on had someone working on the project." Team members came from five different engineering groups located on the U.S. east and west coasts.

The Reliability Management System Team comprised 25 members from SunService and SMCC, 12 functional units, and three continents (Asia, Europe, and North America). It tackled a problem of such proportions that it has re-upped for the next year of SunTeams. "We started from scratch on something that is huge for the company," explains Sun-Service's Worldwide Quality Program manager Celestine Lee who leads the team.

The problem that the RMS team is working on is how to provide integrated processes, metrics, and tools for detecting and resolving product incompatibilities once they are in the field. In this case, the field is global because Sun sells its products worldwide. "Our systems go down to the lowest component—major subassemblies such as [logic] boards, power supplies, and monitors—and we need to know how they operate

across a number of different platforms. A [disk] drive may work fine in one platform and not as well in another. We need to be readily aware of the problem, get to the bottom of it, and resolve it as quickly as possible," she explains. Among the team's first "products" was a metric for detecting subassembly incompatibilities that people could understand readily worldwide.

"Now we have the additional challenge of existing beyond the 'normal' life span of a SunTeam," Lee observes. "We have to continue to evolve the team, ensure that it sustains trust, and find ways to maintain momentum."

The impressive results of these teams' work are typical of most of the efforts. Though a few of the teams foundered, none was a categorical disaster. With such positive results, the company is expanding the effort. "From a SunTeams perspective, we're on a roll. We're all fired up hut check in with us in three or four years," Lynch cautions. "After the first celebration in San Francisco, no one doubted that it was the beginning of a new era, but everyone also understands how complex this is."

"We've Done Away with Paper"

Three aspects of Sun's virtual team program merit study by other companies because they are beacons of virtual team success: sponsorship, preparation, and infrastructure.

First, Sun insisted that every team have an executive sponsor.

Sun did this right from the start using their peers to introduce the idea to the senior executives. "We took a lot of our ideas from Motorola and Xerox," observes Lin Brown, SMCC's quality director, "which laid the groundwork for top level buy-in. The executives were committed from the beginning."

To ensure ongoing executive involvement, each team had to recruit an executive sponsor. "The executive sponsor is important even for simple things such as approving travel budgets," says SMCC's Crosby. "The teams could just decide to get themselves together and do it, overcoming the first-line manager resistance to spending money on travel."

SunService's director of the East Coast Solutions Center Scott Woods, who served as executive sponsor of the Two-Day CQI Improvement Team, agrees. Executive support is needed because the team leaders don't control all the resources and budgets. The sponsor has to make sure the people who do control the resources understand."

McNealy's staff stayed involved; they were the judges for the final San Francisco competition, which proved to be highly significant for the attendees. "A lot of them had never seen these executives before," Brown recalls. "They were people that you hear about but never see. It was a really big deal to present to the Executive Management Group and get to socialize with them."

Second, Sun prepared carefully for the Sun Team launch while leaving room for a great deal of flexibility and creativity.

Unfortunately, many companies decide to move to teams without a great deal of forethought. Often an edict comes down to "form teams, with no supporting guidelines. Equally frequently, a company launches its team initiative with so much bureaucratic baggage that the effort is stillborn before it begins.

"One of our themes in SMCC is to have a very skeletal foundation so that the teams can go off and run with it in each of their organizations," says Crosby. "While we have to put some fundamental processes in place, organizations can creatively add to the process." This means that each team is free to develop its own agenda and schedule while holding administrative overhead to a minimum. Virtually every team that applies to be a SunTeam is accepted. When teams experience

unanticipated conflicts, they quickly resolve them themselves with guidance from the team sponsors.

Third, Sun had the technology infrastructure to support a large number of virtual teams.

Sun has been a boundary-crossing e-mail culture since it began in the early 1980s. "The Internet has always been the backbone to Sun's approach to computing," Brown points out. "We use e-mail for everything that people in a lot of other companies use the phone for."

Possibly connecting the world's largest intranet in terms of Web servers, SunWEB did not even exist in 1994, but by 1996 it had 3000 servers connected to it.[2] "We started using the [World Wide] Web to support cross-boundary work the moment Mosaic [the first graphical browser] was discovered," Brown says. "It was a real natural for us. Now we handle an incredible number of things over the Web: internal employee handbooks, manager handbooks, benefits information, quality data, and all kinds of tools. It's become our method of choice for internal communication. It's so easy and effortless. You can take any piece of information and put it on the Web in about 10 seconds. We've done away with paper and moved to the Web."

At Sun, the Web is the place.

Moving from Place to Place

"If you want to change an organization, the best lever is to change how it communicates," says W.R. "Bert" Sutherland, director of SunLabs, Sun's research and development group. "The big change of our time is what engineers call the 'time constant.' You can go around the globe in a matter of a few seconds in e-mail; the postal service takes days or weeks; in the windjammer days, it took months. A phone call is instantaneous if I can get through. E-mail is fast but not instantaneous and you don't need the recipient's attention. Different communication styles lead to different organizations."

While organizations can enormously increase their effectiveness with the smart use of technology, heed what we have heard repeatedly from our on-the-ground virtual team experts: "It's 90 percent people and 10 percent technology." Social factors above all derail the development of many virtual teams. Understanding the new "social geography" of media, as Sun is doing, provides a powerful advantage in constructing productive virtual work places.

Increased access to information is a primary driver of change from hierarchy-bureaucracy to networks. Virtual teams depend upon the open exchange of information, both internally and externally. Still there is a danger here.

Absolute openness will absolutely kill virtual teams.

As more information becomes more public, privacy becomes more precious. If all of its information and communications are public to everyone all the time, a virtual team will:

? Have more difficulty coalescing its identity;
? By-pass socialization rituals; and
? Remove essential supports for authority.

Issues of what is public, what is private, what is open, and what needs to be secure are central to virtual teams. In particular, these issues impact the design and development of cyber places, the true homes of fully realized virtual teams.

The Play Is the Thing

No Sense of Place[3] is the title of Joshua Meyrowitz's ground-breaking book exploring "the impact of electronic media on social behavior." The essential message of the book is that electronic media are dissolving the historic connection between physical place and social place.

Meyrowitz brings together Erving Goffman's concepts of how social settings influence roles with the mind-popping work of Marshall McLuhan who described media as extensions of the senses (see Chapter 4). Communications technology sets the stage for a whole new roster of roles as place expands into the ether.

Goffman said each role has two sides. Using the metaphor of a play, he described the role as presenting its public face to the audience and its private face "backstage" where the actors and director develop, rehearse, and discuss performances. Historically, belonging to a group has meant being able to go backstage. New people socialize into the group through their gradual introduction to the backstage. There they gain "inside" information. Promotion in a hierarchy means moving to ever newer, more exclusive stages.

Since time and place have historically been coincident, Goffman simply assumed the obvious, that groups communicated primarily face-to-face. Until now the more subtle relationship between physical space and social effect has been obscured.

"It is not the physical setting itself that determines the nature of the interaction, but the patterns of information flow," Meyrowitz writes. If the social setting is an information system, then new media dramatically change the roles that people play. He places roles in three categories essential to virtual teams: identity, socialization, and rank.

Identity

For the group to have its own unique sense of *identity,* its physical location matters less than the "shared but secret information."[4] Members have access to this privileged information where and when the group gathers, providing them with a core sense of belonging. Shared but secret information separates members ("us") from others ("them") who do not have the same access. Backstage the team discusses options, resolves conflicts, and makes decisions.

Suddenly, in the electronic era, people no longer must gather in physical places to "belong." Virtual teams tend to have very porous boundaries and may have little or no backstage. As private group places

become public ones, group identity, an elusive quality hard enough to establish in the virtual world, blurs.

Socialization

New people become members of a group through "controlled access to group information," the formal and informal processes of *socialization*. Orientation and training are formal processes of socialization, while hints, tips, and suggestions convey crucial knowledge informally. People grow into groups over time. When access to a physical place governs availability of information, the whole group can watch as new members transition into full participants through their rites of passage.

Since it is physically impossible to be in two places at once in the face-to-face wo~4d, access to new places also used to mean that you had to leave old places behind. The electronic era suspends the Newtonian laws of motion. Here people do not have to desert old places in order to access new ones. You can simultaneously attend numerous online places, acculturating yourself to new groups while weaning yourself from old ones. You even can multiply synchronous interactions: One European member of a major U.S. corporation's executive committee attended one of the group's meetings by video conference. At the same time, he took phone calls and talked to frequent office visitors. Where exactly was he during the meeting—or was he attending multiple meetings simultaneously?

As physical places give way to virtual ones, new members can instantly gain access to all of the group's information. Not surprisingly, traditional patterns of socialization are collapsing as transition stages become more difficult to discern.

Rank

According to tradition, *authority* is highly dependent on access to exclusive places that house special knowledge. Elite clubs are obvious locales that demonstrate the power that comes with place. University libraries are another; if you belong to that particular academic "club," you have access to its special knowledge which can literally make you an *authority* on a subject.

Indeed, the higher the group is in the hierarchy, the more these socially remote places convey a sense of "mystery and mystification."[5]

Inaccessibility is a measure of status (or lack thereof). Members jealously guard backstage areas and carefully script performances.

Since the Nomadic era, new media have increased the ability of leaders to segregate and isolate information systems. The consequence is the extension of control. Here again, the electronic era is chipping away at these bastions of privilege. While it still may cost many thousands of dollars to join the country club, you need only pay your monthly Internet provider fee to enter into conversation with countless numbers of experts everywhere in the world.

Likewise, anyone with a modem and a World Wide Web browser now can visit thousands of university library home pages without ever registering for a single university course. Yet if that same person showed up at one of these libraries without an official identification card, access would likely be denied.

Another irony of the electronic era is that an anti-status symbol of the past is now an important tool to sustain authority in the future. Typing, once considered the province of the hired help, is a key skill in the electronic world. The effect of broader access to once-exclusive information has been felt nowhere more profoundly than in the upper ranks of hierarchy.

The "Construction" of Virtual Places

The need for some degree of privacy is one of those archaic features of groups that remains essential for virtual teams.

Privacy complements openness as individuality complements group cooperation.

In general, virtual teams face more hurdles in establishing their identities than do collocated ones. Shared, exclusive information is one way that a team develops a strong identity. For many groups, privacy is essential. Such is the case with Buckman Laboratories' (see Chapter 2) online Research and Development discussion area where patentable

products are under development. “Inviting someone into that forum is asking someone to look at your research notebook,” says Victor Baillargeon, Buckman’s former vice president of Knowledge Transfer.

Corporate borders secure the absolute need for some information exclusivity in the competitive private enterprise system. Membership and privacy are invariably established at the enterprise level. There an account on the corporate information system accompanies the badge with a picture for access to the physical facilities. At Buckman Labs, “membership” as an employee in practice means an account on CompuServe and passwords to Buckman’s online discussion areas. Some of the discussions are open to the entire company and others are restricted.

For decision-making and negotiating tasks, team privacy is essential. Openness to disagreements and an ability to tolerate yet manage conflict are at a premium in healthy boundary-crossing groups. Yet these qualities are even harder to foster in a fish bowl. The 10-minute video of Sun-Teams preparing for their final presentations for the competition in San Francisco contains several amusing scenes poking fun at their need for privacy. Teams rehearse in private and present in public.

It is easy to design digital places that combine public and private areas, most simply through passwords and access lists. We have already noted that virtual team boundaries tend to be multilayered. Often they comprise a small core group, an extended team of less-directly responsible members, and an even larger network of external partners and tangential people. Companies regularly configure multi-level virtual spaces. Internet sites allow public access to published information, such as press releases and annual reports. Internal intranet areas require authorization with access to plans and interim results. Completely private places are where teams discuss their most sensitive issues, such as budgets and personnel matters.

By creating information places with graduated levels of access, virtual teams more easily and naturally stage the socialization of their members. At Buckman, for example, new employees begin by perusing the generally available information as a way to get to know the group’s public persona. Soon, they receive passwords that offer access to the

"regular" inside information of the company's work. Later they are invited to join certain discussions with information that is proprietary to the group.

Virtual Ladders and Competency Networks

The social effect of increased access to information is most dramatic in the shrinkage of hierarchy—which is flattening but not going away. For the most part, middle and supervisory management ranks are dwindling. Executive management is, if anything, becoming more exclusive and remote, a trend symbolized by the steep increase in CEO salaries. For all the personal aversion of many senior managers to computers (a dying generational artifact), the best and most powerful tools of digital technology have always been put at the service of executive information systems. This is not likely to change in virtual organizations.

Executives face the greatest challenge in making virtuality work for themselves. They above all must balance two apparently conflicting needs. On one hand, they must follow a general admonition to share information cooperatively and broadly throughout the organization. On the other hand, they have the strong requirement to protect the privacy of their own deliberations and "below the waterline" information (the disclosure of which might "sink the corporate ship"). The behavior of protecting exclusive information from subordinates is all too easily carried into executive team relationships. One unfortunate consequence is a corresponding diminution of cooperative pursuit of overall corporate goals.

Paradoxically, while hierarchical boss-ship contracts, virtual teams and networks demand more *leader-ship* not less. Many leadership roles are changing. Virtual team leaders often act more as coaches than bosses. They are more likely to lead through influence than coercion, and are much more diverse in their sources of power.

Like vertical leaders, horizontally linked leaders need their private places. They too exchange peer-related information, debate standards, criticize rules, challenge orthodoxy, and otherwise prepare to meet their public leadership tasks. Membership in competency groups is usually "by invitation only" based on expertise and/or position.

Competency networks that link people with common expertise (such as technical) or similar roles (such as project managers) address the need for horizontal leadership in virtual teams.

Where Place Is Going

Metaphors from the physical world regularly tag the online one. People sitting at computers work on their own desktops while accessing group information on servers at sites. Desktops may be a metaphor that in time will seem as quaint as horseless carriages. Regardless, some sense of place—like a site—will persist in the human online experience.

Site is a cross-over term. It simultaneously stands for a building (or group of them), a computer or a cluster of machines, and an ephemeral place of bits in cyberspace, as in a World Wide Web site. Physical and online sites alike range in size from small to gigantic. At the small end of the scale are physical and online "rooms." At the other end of the scale are corporate campuses like Microsoft's in Redmond, Washington and vast cyber facilities like America Online.

As teams and organizations expand their presence online, they will continue to create online places that are analogous to the information resources in their physical places. Each organization that goes online invariably creates its own digital place, stocking it with information and products previously available only in physical places.

The United Nations Development Programme (UNDP) is perhaps the most electronically sophisticated group at the global organization. It uses electronic networking both to carry out its mission—to build more sustainable livelihoods for all—and to encourage more direct individual and community participation worldwide in the UN. For the 1995 Fourth World Congress on Women in Beijing, John Lawrence, principal technical adviser at UNDP, and his colleagues "worked from behind the scenes," he says (echoing Goffman's language). Supported by the Education Development Center of Newton, Massachusetts,[6] the group "rented an electronic virtual room where anyone could come in to

discuss issues that were related directly to agendas raised." During the summit itself, they scanned relevant documentation on to the Internet as it became available. Annotated summaries of sessions were available during or just moments after events took place so that anyone anywhere in the world with Internet access could view them.

People create online places from the ground up. To do so, they use virtual analogs of desktops, rooms, offices, factories, malls, and communities. These and other familiar "place" metaphors serve as the building blocks for local cyberspace. We anticipate these metaphors will rapidly evolve from cartoonlike storefronts and graphical menus to increasingly sophisticated three-dimensional virtual realities that members will "walk into and fly around." As the early generations of kids growing up with computers mature, they will incorporate the representational features of game technology into virtual team interfaces.

Product Places

Insofar as they could be developed in digital form, Information Age technology products always have occupied a privileged position in the world of virtual work. They benefit from a basic axiom of "going virtual":[7]

> *Digitize early and often. Start your results in digital form and keep them digital as long as possible.*

The development of products in digital form offers one significant way that virtual teams can go beyond physical place metaphors. This capability has been slowly developing for the past two decades.

The Result Is Where We're *At*

One early case of an astonishingly successful global virtual team was Digital Equipment Corporation's Calypso Project in the mid-1980s.[8] This team created a revolutionary new minicomputer design. It was so

robust that it served as the basis for a major product line, the VAX 6000 series. At the same time, the Calypso team built a production capacity that saw the first machines roll out simultaneously from three plants separated by an ocean. Everything was done in record time, and the project generated $2 billion in revenues the first year, and many billions in the years to follow.

From the beginning, Calypso put its whole product design online. Thus it closed the loop on what had been a gradual transition through the 1970s in engineering and manufacturing design from analog to digital processes. The project's most intriguing technology innovation was its product database that contained everything from chip design to the metal "skins" of the machines. The product design was the team's "place." Everyone on the team had access to the whole product database. At the same time, the communications system was designed to notify people only when changes were made in areas that they had previously specified as important to them. Thus, the product itself in its digital form became a highly specialized primary communications medium.

While a computer design eventually must go from bits to atoms as a machine is made, software is a pure product of the digital age. Software is a truly ephemeral "thing" that naturally lives in virtual space. Software teams have always been at the leading edge of virtual work. Two key factors genetically code them for success. First, they have a commonly accessible online product focal point for their interdependent tasks. Second, they tend to have the necessary computer technology for communicating easily across boundaries. In our experience, the weakness of distributed software teams usually lies in their people and organizational issues, not access to their common product or the availability of technology.

One early very successful global software project was the team that developed the Ada language. Military and other applications that require very fast real-time data processing for systems such as the Boeing 747 use Ada. Beginning in the mid-1970s, a core group of a half-dozen people engaged with a larger set of 100 key contributors in 20 countries. Together, they carried on a complex set of technical conversations over the DARPA network, the military forerunner to the Internet. Over the

multi-year course of the project's development, the conversation volume grew to 10,000 comments.

As with Calypso, the Ada product was both online and shaped the team's (online) conversation about it. Jean Ichbiah, the Ada project manager and now CEO of Textware, credits the early establishment of a coherent architecture (that is, strategy) as the key to organizing the talents and time of the larger team of teams. The architecture and the creative issues it posed provided the classification system of topics that structured conversations among team members. As conversations came to resolution, results would accumulate in the language product. Ichbiah believes that "distributed product development is very positive because it requires the process to be more structured and formal, with well-defined interfaces between relatively independent components."

"The story was very interesting from a networking standpoint," says former Apple senior vice president Ike Nassi, who was originally a reviewer of the Ada over a five-year period. "Remember: this was DARPANET in the very, very early days. The reviewers worked with the language design team that was drawn from groups in many countries. We had a series of very official language design notes that were issued by the language design team with extensive commentary. It was a very formal process. We'd download the notes and then send lots of e-mail back and forth. It was almost Talmudic in nature. Visualize scholars sitting around a virtual table pouring over scrolls and arguing over Judaic interpretation. A lot of thought went into a lot of issues and in the end Ada popped out."

All Virtual Presence

Although they were pioneers in complex virtual team collaboration, Ichbiah and the Calypso team managers also attest to the importance of face-to-face meetings as a necessary part of the communications mix. In "extreme virtual teams," however, face-to-face plays little or no role.

Lynx is an example of a very large-scale, completely voluntary distributed software project community that operates with very little face-to-face contact. This is the Internet-based global group of over 500 engineers and other professionals who develop, maintain, and evolve Lynx, the Netscape of text-only Web browsers.

The Lynx network is organized into a teamnet of specialized working groups that use the simplest form of digital interaction, an e-mail list. "The mailing list serves to collect code patches and to return glory to those who contribute them," says Al Gilman, who keeps a FAQ (frequently asked questions) for the list. "It also collects trouble reports and carries discussion among the participants that are generally related to Lynx. The list participants function as a self-managed team to repair and improve the Lynx product.

Using your result as the lodestone for place does not have to be big and complicated. It can be as simple as a memo or report. At the University of Texas, Kathleen Knoll and Sirkka Jarvenppa conducted studies of virtual teams who never meet yet who must produce common products. They analyzed data from 19 teams numbering from three to seven graduate students each at 13 different universities in nine countries who only used e-mail to communicate.[10]

The best predictor of success for these extreme teams seemed to be a decision "during or soon after brainstorming, to work from a common document summarized from everyone s comments. This process seemed to help the teams collaborate." Teams with a common document early in the process generally communicated more frequently. They also had more consistent and even participation, showed less conflict, and evinced more satisfaction in the project. Finally, they demonstrated a greater sense of team," meaning that they communicated "feelings, context, sensory information, roles, and identity."

Virtual Technology Principles

As place becomes ephemeral and moves online, it also has a physical existence in technology. Network technologies and organizations are coevolving, each influencing the other. The principles of distributed organizations complement the principles of distributed technology. Virtual teams are small group networks coming to life in the age of computer networks, and vice versa.

A severe organizational dissonance arises when a company installs new network technologies without changing its traditional hierarchical-

bureaucratic management. The then-dominant form of mechanistic organization shaped early computing with its massive mainframes and "slave" machines, totally dependent "dumb" terminals. Nowhere is this more clear than in traditional MIS (Management Information System) departments. Such centralized facilities sprang up to manage mainframes. Today the decentralized network paradigm drives computing. Virtual teams and network organizations at all levels leverage this technology best.

A network of computers and a network of people share some common conceptual elements:

- People are nodes;
- Links are links; and
- Purposes are applications.

The people/links/purpose model of virtual teams fits the features of the digital workspace that network technologies create. A schematic of a technology network often uses circles and lines. Circles stand for nodes that are individual machines, sites, or networks. Lines are the technologies that connect the nodes. A picture of people networks looks similar. Typically it consists of circles that stand for people or organizations with connecting lines indicating relationships. Often missing in both types of these circle-line diagrams is the third critical element: the purposes—the applications of the network.

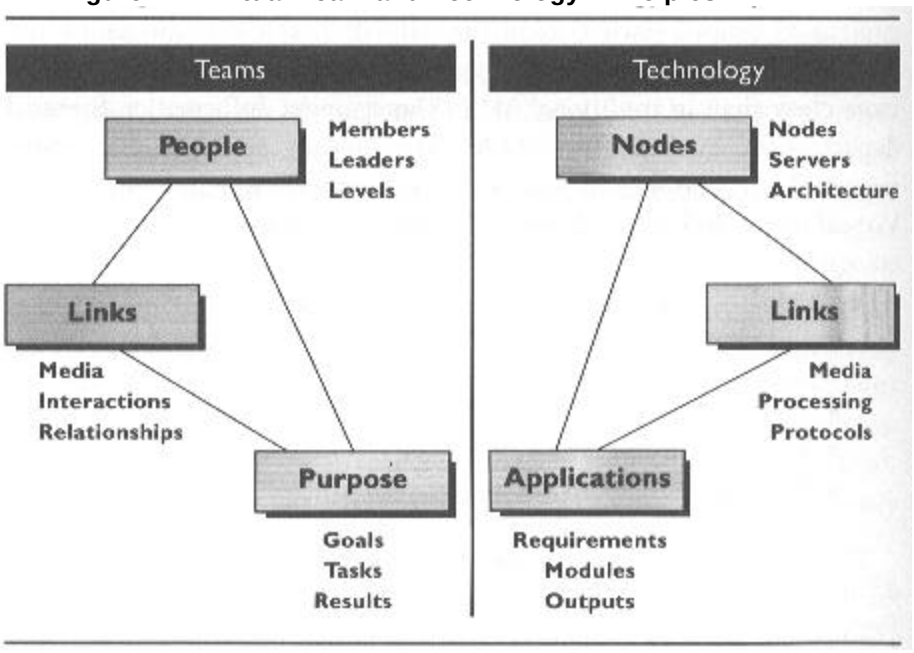
The virtual team principles can help you shape networking technology to support your boundary-crossing groups (Figure 7.1).

Network Nodes

Just as the word "people" in virtual teams comprises three principles, so does its correlate in technology networks, "nodes." A virtual team's technology network has:

- Independent nodes;
- Shared servers; and
- Integrated levels.

Figure 7.1 Virtual Team and Technology Principles



The power of the team relates strongly to the adequacy of technology tools available to the people to do their work. For virtual team members, this usually means personal computer power—a node. "Independent nodes" on the computer network enable every virtual team member to have the ability to work independently *and* interdependently. Ever since the earliest configurations of terminals and mainframes were eclipsed (which is not to say they have disappeared), computer networks have depended upon some minimal level of intelligence, or independence, in their nodes. When your LAN or Internet connection goes down, your PC, your independent node, continues to function. Ideally, all virtual team members have their own PCs.

Computer network servers reflect the shared leadership of virtual teams. Servers house information that is common to virtual teams—their databases, applications, documents, and other files that belong to the group as a whole. In the client-server computing paradigm, typically each organizational unit has its own server, for example, a departmental server.

Virtual team leaders often have responsibility for the information on the server and for who has access to it. Servers suggest *service*, an important metaphor for the emerging mode of leadership in virtual teams, what Robert Greenleaf calls "servant leadership."'[1]

Just as virtual teams, teamnets, and other people networks are structured in levels, so are technology networks. From the ever-shrinking gates on chips to processors and peripherals to the awesome reach of networks of networks, complex computer and communications systems follow an inclusive sets-within-sets-within-sets design. A multilevel architecture is a *sine qua non* of good digital technology. For virtual teams, integration is a practical matter. It arises both in the technologies the team chooses to support its functioning and in the technologies it uses to generate its work product. Will our applications work together? Can we link to the corporate networks? Can we connect remotely? These are key pragmatic issues that virtual teams must resolve.

Connecting through Links

Organizational links are the great differentiators of virtual teams—supported by their corresponding technology links:

? Multiple media;
? Boundary-crossing processing; and
? Trusted protocols.

Nodes alone do not a network make. Both technology and people networks need physical links. Virtual teams access multiple media drawn from the array of communication forms developed over the ages. For interactions other than face-to-face ones, technology links are the physical connections that virtual teams live by. In the digital era, the computer-based medium includes all previous media. It is increasingly easy and commonplace to mix print, audio, and video into multimedia. Even handwriting plays a role in virtual teams: People share virtual whiteboards through their Web browsers while working synchronously with audio and sometimes video links. (Still nothing has quite the feel

of a handwritten personal note, increasingly cherished in the digital era.) The best virtual teams use multiple media.

Virtual teams need to be able to move their work across complex and diverse technology boundaries. For virtual teams, processing leaps across space, time, and organization boundaries. Data flows to and from and among many different locations. More than one virtual team member has lamented, "I couldn't read your file. It came across as gibberish." If a team cannot move its work from node to node, it clearly impairs its ability to function effectively at a distance. To develop distributed work processing, you need to be concerned with the computer processing capability of your teammates as well as your own.

Trust has its correlate in technology networks in protocols. Processing across boundaries requires more than physical connections. Protocols, permissions, and open formats are based on agreements and decisions of people who manage systems. It requires people's agreements to make it possible for cross-boundary computing systems to work together. Trust in this arena is vital. In most computer systems, people do not give out permissions lightly. Establishing and agreeing to protocols are areas of cooperation that enable the development of technologies to work together. A large-scale example of this is the TCP/IP[12] Internet standard. Without thousands of people committing to use the same technical standards, the Internet simply could not function.

Purposeful Applications

The third analogy is between organizational and technology purposes. For a virtual team, goals first surface at the beginning of the group process. In a similar way, original requirements and specifications are necessary early on for technology development. Vision sparks the need for new technology together with perceptions and anticipations of user needs. Purpose grows from the seed of vision and clarifies into a system design with:

- ? Cooperative requirements;
- ? Interdependent programs; and
- ? Concrete outputs.

People develop requirements for certain applications. Ideally, a group's goals, which it arrives at cooperatively, drive the development of technology to support them. Remember that for a virtual team, users include the group-as-a-whole as well as the individuals in it. The cooperative work of the interdependent virtual team members determines requirements for groupware. E-mail, for example, makes no sense in the singular. We are still in the early stages of learning how to design interfaces for groups-as-users.

Tasks, the definitional heart of teams, represent the work that unfolds from the goals. Interdependent applications need to support interdependent work. Modular software programs (for example, application "suites" such as Microsoft Office) are the design equivalent of "independence with interdependence" in virtual teams. As the interdependence of work accelerates, systems of access to programs will change. They may migrate to Java applications modules delivered by the World Wide Web, which provides a virtually universal computing platform. For the interdependent virtual team, interdependent software is key.

A virtual team's decisions about the results that it will deliver inform, if not drive, their selection of technology for creating an online product place and delivering the output. For task-oriented teams, concrete results are the bottom line, so output matters. However ephemeral or fantastic the means by which the miracle of computing is achieved, screens, printers, and other output devices finally deliver meaningful and concrete results to people. Thus, virtual teams need to think through what technology supports the results of their efforts.

Using the digital representation of the product as a virtual working space is one way a team makes its shared models explicit and extends the intelligence of the group.

Thinking Technology

Creating virtual places is initially about making adequate substitutes for physical places. This is a necessary but preliminary step in the evolution of virtual teams and networks.

New technologies are innovations that diffuse through society in a well-recognized pattern. First, the new technology develops slowly

against resistance, gaining a foothold by replicating and replacing functions of older technologies. Only after an innovation establishes itself as a substitute will its truly innovative features and revolutionary effects come to full expression. Then it rapidly expands through society.

> *The cognitive characteristics of groups will blossom in the fertile soil of shared digital environments.*

Members gain more than social and task information with their access to physical places. They also use them to take possession of shared "mental" or "cognitive" models. In a direct visceral sense, people acquire a mental image of the collocated team. You can easily visualize such an image as a set of unique individuals assembled in their special place. Equally important is the model of the group's work. This is traditionally evident in the space where people do the work. Materials, tools, partial products, and people identified relative to their roles all contribute to a concrete understanding of the group's purpose and how it pursues it. All of this together becomes the shared cognitive model.

As people construct new virtual places, they embed in them their shared cognitive models—consciously or unconsciously. A virtual team does not just replicate an old physical place. It also generates a new conceptual space that has never existed before.

When virtual teams explicitly share their models, their ideas go beyond the members themselves. The Calypso product database reflected the integrated result of many people's thinking, both in its overall architecture and in the countless choices people made about their communications. Thus, a significant portion of the group's shared intelligence and ongoing thinking was expressed and retained in bits online.

Cognitive Webs

In the idiom of the Industrial Era, organizations are likened to machines. In the Information Age, both organization and computer networks are

feeding off the same metaphor, the human brain/mind. Where once the extension of limbs and senses occupied center stage in the human development of tools, today digital technology amplifies mental capabilities.

The abundance and variety of the links of virtual teams are their most distinctive feature—even more so than their people or purpose elements. During the initial analog phase of computer development, physical brain analogies between corporate networks and human nervous systems seemed apt. As we rocket into Web worlds interrelated through hypertext links, mind metaphors will come to dominate future descriptions of virtual organizations.

After 10 years online, Buckman Labs is still in the early stages of building its companywide online repository. The more it puts online, the more explicit the company is able to make its cognitive models. We expect that this will be the new norm for virtual teams. As they develop their shared virtual reality with more of their information online, they become increasingly explicit about their models.

The roots of these emerging models reach back into traditional hierarchy and bureaucracy as well as cast forward into the new elements of networks.

Navigating with Mental Models

Traditional Models

- **CORPORATE identity is an executive responsibility for the public face of the whole organization. It is often the starting point for the development of external sites on the World Wide Web.**
- **HIERARCHY is most visibly represented by an organization chart. Hierarchy is a valuable navigation tool, particularly internally and for customers. Often, however, organizations treat it as a trade secret.**

(Continued)

Navigating *(Continued)*

- **BUREAUCRATIC** rules and regulations, policies and procedures, guidelines, and protocols are the recently modern models of the traditional organization. Formalities and organizationwide information collections are very transferable to the online medium, usually by converting existing processes and analog media into digital forms.

Network Models

- **PEOPLE** and organizations are identified online in directories, "yellow pages' Web home pages, and other collections of individualized information. Leaders offer their own key views of the team and its work through online announcements and pronouncements. The hierarchical design of sites and their component parts—represented in some variation of an outline or a table of contents—attests to the level structure of information.
- **PURPOSE** appears as online mental models in statements of vision, mission, and goals along with the strategies and plans used to achieve them. Hyperlinked plans are a largely unexplored but potentially very powerful form of group interface.'[3] Results that use the product as an analog for place offer a final destination that makes the work worthwhile. The virtual team's output provides a very valuable and practical mental model for the work of the group.
- **LINKS** generate shared images that flow from the group's communications as well as the pattern of the ongoing conversation and information exchange. A communications model accumulates through various modes of memory that store, recall, modify, and reprocess the group's stream of consciousness. Shared calendars and information associated with meetings, events, and deadlines also help people build a common model of the group's movement through time.

Some organizations already are incorporating some of these features. The first three selections (buttons) on Sun Microsystems' internal home page offer access to information through organizational, functional, and geographic models of itself.'[4] Such models serve as a group interface to its common information, whether through text, outlines, diagrams, pictures, animations, or any other representational form.

> *On the Web, people can express links and relationships in context.*

In intranets, a dynamic distributed human intelligence comes together in a context that grows with the group. With hypertext links—more of a concept than a technology—the team's ability to create and use shared cognitive models crosses a fundamental threshold. The nature of the online space is no longer primarily an artifact of the hardware/software structure of the technology. It is a matter of choice, the human intellect creating a shared cognitive space.

SunLabs like all of Sun, its larger host company, uses intranets extensively. "We're witnessing the next change in communication style," says Bert Sutherland, SunLabs' director. "E-mail is a push model; I want to broadcast to someone. The Web is a pull model; the information sits there until someone who wants it can pull it."

For millennia, new media have improved the ability to *push* information. With digital media, the historic trend is suddenly reversed. People are becoming increasingly oriented to information pull—seeking and finding the information they need when they need it. In a "pull model" of information access, particularly where users are both readers and writers, it is vital that everyone share common views of what information goes where when.