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Virtual teams: Technology and the workplace of the future

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Executive Overview

Managers are challenged to develop strategically flexible organizations in response to increasingly competitive marketplaces. Fortunately, a new generation of information and telecommunications technology provides the foundation for resilient new organizational forms that would have not been feasible only a decade ago. One of the most exciting of these new forms, the virtual team, will enable organizations to become more flexible by providing the impressive productivity of team-based designs in environments where teamwork would have once been impossible.

Virtual teams, which are linked primarily through advanced computer and telecommunications technologies, provide a potent response to the challenges associated with today's downsized and lean organizations, and to the resulting geographical dispersion of essential employees. Virtual teams also address new workforce demographics, where the best employees may be located anywhere the world, and where workers demand increasing technological sophistication and personal flexibility. With virtual teams, organizations can build teams with optimum membership while retaining the advantages of flat organizational structure. Additionally, firms benefit from virtual teams through access to previously unavailable expertise, enhanced cross-functional interaction, and the use of systems that improve the quality of the virtual team's work.

> You have no choice but to operate in a world shaped by globalization and the information revolution. There are two options: Adapt or die.... You need to plan the way a fire department plans. It cannot anticipate fires, so it has to shape a flexible organization that is capable of responding to unpredictable events.
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> –Andrew S. Grove, Intel Corporation

Just as the personal computer revolutionized the workplace throughout the 1980s and 1990s, recent developments in information and communication technology are on the verge of creating a new revolution in the coming decade. A group of technologies, including desktop video conferencing, collaborative software, and Internet/Intranet systems, converge to forge the foundation of a new workplace. This new workplace will be unrestrained by geography, time, and organizational boundaries; it will be a virtual workplace, where productivity, flexibility, and collaboration will reach unprecedented new levels.

This exciting new potential comes at a time when increasing global competition and recent advancements in information technologies have forced organizations to reevaluate their structure and work processes. Many organizations have downsized and there are continuing pressures to implement increasingly flat (or horizontal) organizational structures. While these new organizational structures may achieve gains in efficiency, flat organizational structures, of necessity, disperse employees both geographically and organizationally, which makes it more difficult for those members to collaborate in an effective manner.

One popular response to this challenging new environment has been to outsource a number of organizational functions, replacing traditional structure with an interorganizational network or virtual organization. Virtual organizations have received substantial attention in both popular and academic literature.[2] While the interorganizational challenges presented by virtual organizations are important, this leaner new competitive

landscape presents important intraorganizational challenges as well.

During the past several years, one of the most dominant intraorganizational initiatives has been the development of team-based work systems. Many organizations have recognized that team-based structures have the potential to create a more productive, creative, and individually fulfilling working environment. A majority of U.S. corporations use some form of team structures in their organizations, and many report that teams enhance their ability to meet organizational goals.[3] In general, teams have provided firms with significant gains in productivity, and as such, have become a fixture among contemporary organizations. But what happens to the team advantage when fundamental organizational structures begin to change? Can teams survive amidst radical transitions in the greater organization? Perhaps more importantly, can radically transformed organizations recapture the productive potential of team-based work?

A majority of U.S. corporations use some form of team structures in their organizations, and many report that teams enhance their ability to meet organizational goals.

Recapturing the benefits of team systems will require flat organizations to create teams whose members may no longer be located together, or may even include members from outside the organization. Fortunately, this period of radical organizational change has been accompanied by an equally radical change in telecommunications and computer technology. Thanks to these new technologies, teams can now be effectively reconstituted from formerly dispersed members. Thus, a key component of successful, twenty-first century organization will be the effective use of virtual teams.

Virtual teams are groups of geographically and/or organizationally dispersed coworkers that are assembled using a combination of telecommunications and information technologies to accomplish an organizational task. Virtual teams rarely, if ever, meet in a face-to-face setting. They may be set up as temporary structures, existing only to accomplish a specific task, or may be more permanent structures, used to address ongoing issues, such as strategic planning. Further, membership is often fluid, evolving according to changing task requirements.[4]

Virtual teams provide additional benefits in that they also can be used to address evolving interorganizational challenges that occur when organizations outsource some of their key processes to more specialized firms. By creating virtual teams, both within virtual organizations and within organizations undergoing other forms of transformation, firms can ultimately realize the competitive synergy of teamwork and exploit the revolution in telecommunications and information technology.

Why Virtual Teams?

Although the modern organization faces a number of challenges in its competitive environment,[5] the imperative for moving from traditional face-to-face teams to virtual teams derives primarily from five specific factors:

1. The increasing prevalence of flat or horizontal organizational structures.
2. The emergence of environments that require interorganizational cooperation as well as competition.
3. Changes in workers' expectations of organizational participation.
4. A continued shift from production to service/knowledge work environments.
5. The increasing globalization of trade and corporate activity.

The emergence of the flat or horizontal organization is largely a response to intensifying competitive operating environments brought about by increased global competition and recent advancements in both information and transportation technologies.[6] Organizational flattening pushes decision authority to lower levels in the organization, reducing the need for several layers of management. With fewer layers of centralized, hierarchical management structure, organizations become increasingly characterized by structurally and geographically distributed human resources. While the organization may retain the collective talent it requires, there is a reduction in the opportunity for linkages between remaining employees (e.g., personnel and offices close enough to facilitate traditional interaction). This kind of environment occasions the need to reconstitute the benefits of the large, resource rich organization within the context of the new flattened organization.

A second trend is a shift from traditional competitive business environments toward strategic cooperation among a synergistic group of firms that may not only coexist, but also actually nurture each other.[7] In the past, firms vertically integrated to maintain more control of processes from the

acquisition of raw materials to the manufacture of the final product. However, diversification and specialization have made direct management of far-flung processes unwieldy. Thus, firms have responded to this problem by eliminating their superfluous processes to concentrate on their core, value-added processes. Strategic partnering and/or outsourcing allows efficient span of control while maintaining larger economies of scale for the cooperative organizational group.

Although this segmentation enables more efficient management of each individual process, it often fails to provide an overarching structure by which these specialized organizations can compete within a large global market. These cooperative groups of organizations become increasingly interdependent, with the success of each individual organization enhancing the success of the cooperative organizational system.

A prominent example of this synergistic cooperation is the collaboration among a number of computer hardware and software developers. Unlike IBM in previous decades, firms such as Intel and Microsoft have avoided vertical integration and achieved unprecedented growth and dominance in the distributed computing environment. This success is largely due to their concentration on their respective core disciplines, thus avoiding the lack of focus inherent in vertically integrated organizations. While they have created and nurtured an environment in which both organizations flourish, the ultimate value of each is dramatically dependent upon the other. Without significant advances in chip technology, demand for personal computing software tools and distributed computing systems is limited. Conversely, advancements in computing software have led to an insatiable demand for faster, more powerful microprocessors.

Group success is dependent on effective communications and knowledge sharing among members. Microsoft's success in a variety of industries, including personal computers, corporate computing, telecommunications, and consumer electronics, is directly attributable to the firm's networking with software developers within these supplier organizations. By providing developmental versions of new software, Microsoft facilitates communication with its customers and acquires invaluable feedback prior to releasing final versions of its products. Product development is no longer an isolated task within the organization, but a collaborative effort in which product identity and loyalty is created via close customer involvement in the development process. Virtual teams provide an effective platform for these groups by using advanced technologies to facilitate their complex communication processes.

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The third major trend in the business environment centers on changes in employee expectations of how they will participate in the workplace. Future employees, who have grown up in an environment of personal computers, cellular phones, and electronic classrooms, will be more likely to expect organizational flexibility. The new generation of workers will be technologically sophisticated, and will expect technological sophistication from their employing organization.[8] An example of how changing employee expectations are already affecting the workplace can be seen in the increasing number of employees who are opting for telework alternatives. Teleworkers operate from their homes or some other remote location, connected to a home office primarily through telephones, fax machines, computer modems, and electronic mail. Telework provides cost savings to employees by eliminating time-consuming commutes to central offices and offers employees more flexibility to coordinate their work and family responsibilities. Teleworkers currently make up the fastest growing segment of the workforce.[9]

Virtual teams provide a platform for organizations to actually exceed these new employee expectations. For example, telework is usually limited to relatively independent job categories that involve low levels of collaboration. A virtual team format can expand telework's potential range by allowing employees involved in highly collaborative teamwork to participate from remote locations.

A fourth factor encouraging the development of virtual teams is the continued shift from manufacturing and production jobs to service and knowledge work. Production processes, by their very nature, are often more structured and defined. Service activities often require cooperation of team members in dynamic work situations that evolve according to customer requirements. The hallmark of successful service firms has been their ability to flexibly respond to the customer's needs as quickly as possible. This requisite flexibility fuels the movement from highly structured organizational forms to more ad hoc forms. Virtual teams enable this organizational flexibility because they integrate the effectiveness of traditional teamwork with the power of advanced communication and

information technologies, allowing them to accommodate increased dynamism in both team membership and task structure.

Finally, the increasing importance of global trade and corporate activity has radically altered the working environment of many organizations. Recent trade agreements, such as GATT and NAFTA, coupled with economic reforms in China and eastern Europe, have created increased opportunities for international trade. Whereas in the past, multinational operations were solely the domain of the world's largest corporations, technological advances in both communications and logistics have enabled smaller firms to compete in the global marketplace. Regardless of firm size, multinational operations require high levels of cooperation and collaboration across broad geographical boundaries.[10] Turning these networks of collaborators into fully connected virtual teams has the potential to increase both the efficiency and quality of communications in this challenging environment.

The Technology of Virtual Teams

Virtual teams are possible only because of recent advances in computer and telecommunications technology. Because these technologies define the operational environment of the virtual team, it is critical to examine how these technologies come together to form the infrastructure of virtual teamwork. Although all of the systems are somewhat interdependent, it is helpful to consider them as belonging to one of three broad categories of technology: desktop videoconferencing systems (DVCS); collaborative software systems; and Internet/Intranet systems. These three technologies provide an infrastructure across which the virtual team will interact and provide technological empowerment to the virtual teams' operation.[11]

Desktop Videoconferencing Systems (DVCS)

DVCS are the core system around which the rest of virtual team technologies are built. Although virtual teams would be possible with simple e-mail systems and telephones, DVCS recreates the face-to-face interactions of conventional teams, making possible more complex levels of communication among team members. While the technology of videoconferencing is not new, traditional videoconferencing systems typically involved dedicated meeting rooms that were very costly to set up and maintain. These videoconference rooms were also cumbersome and inconvenient to use, requiring specially trained technicians to facilitate even the simplest of meetings. The most sophisticated DVCS currently cost less than $1,000 per station, can be added to most any new generation of personal computer, and can be used with no outside facilitation. This combination of affordability and operational simplicity make DVCS an affordable organizational communications solution.[12]

Although technologically sophisticated, the DVCS is a relatively simple system for users to operate. A small camera mounted atop a computer monitor provides the video feed to the system; voice transmissions operate through an earpiece/microphone combination or speakerphone. Connection to other team members is managed through software on the user's computer; to ensure user familiarity, the software uses an on-screen version of a traditional telephone to control the system. The final component of the system is a high-speed data connection, which may be accomplished through local area network connections, or specialized digital phone lines. DVCS create the potential for two primary types of group communication:

1. All team members are actively connected in a session. With current technology, groups of up to sixteen team members can simultaneously videoconference, meaning that each user can see and hear up to fifteen other team members on his or her computer monitor. Functioning in this mode, the entire team or subunits of the team can conference as needed.
2. A face-to-face group can interact with a nonpresent team member or outside resource. The same DVCS used for individual interaction also permits a conference table of team members to have a traditional teleconference with one or more outside parties. Because the DVCS allows for multiple conference connections, a local group can connect with up to fifteen different individuals or groups.[13]

In addition to providing video and audio connections, most DVCS provide users with the ability to share information and even applications while they are interconnected. For example, users can simultaneously work on documents, analyze data, or sketch out ideas on shared whiteboards. In many respects, the DVCS creates a work environment where users have more options available to help them collaborate and share data than would be possible working around a conference table or huddled around an office computer.

Collaborative Software Systems

Collaborative software systems are the second component of the virtual team technical infrastructure. Effective collaboration requires team members to work both interactively and independently; collaborative software is designed to augment both types of group work activity and to empower teamwork processes.[14]

The simplest collaborative software application involves sharing traditional software products through the DVCS. As noted above, most DVCS allow users to share any application running on any one of their individual computers. Used in this manner, a variety of existing software applications become powerful collaborative tools, allowing multiple team members to create, revise, and/or review important information.

A second category of collaborative software systems is designed to empower real time group decision making and other creative activities. These systems, called group support systems (GSS), are specifically designed to create an enhanced environment for brainstorming, focus group work, and group decision making. These systems provide their users with a variety of support tools to poll participants and assemble statistical information relevant to the decision activity. Finally, these systems also allow users to "turn off" their individual identities during a brainstorming session and interact with relative anonymity, which can be very helpful in certain contexts.[15]

As with traditional teams, a substantial portion of the work of virtual team members may be conducted independently, and then passed along to the rest of the team at appropriate stages of the team's project. For this noninteractive aspect of the virtual team's work, there is also a developing body of software. This family of software provides specific support for collaborative accomplishment (e.g., project management, product design, document creation, and information analysis) when team members are working independently on team projects. The major focus of these collaborative software applications is to facilitate multiple authorship of documents and presentations, and joint development of databases, spreadsheets, and other information resources.

Collaborative software systems also may provide a comprehensive environment for group work. Lotus Notes, a dominant collaborative software product, is designed specifically for asynchronous teamwork (e.g., communication and data sharing where parties are working either at different times or independently) and combines scheduling, electronic messaging, and document and data sharing into one common product. By combining a number of collaborative applications and communications systems into an integrated framework, products like Lotus Notes facilitate both the production and communication necessary to effective teamwork. Although most of these types of software systems have been designed to facilitate teamwork in traditional work environments, they provide an equally powerful foundation for the collaborative empowerment of virtual teams.

The Internet and Intranets

The enormous popularity of the Internet is a significant indicator that a friendly medium can overcome the technophobia of a vast number of people, and this lesson has not been lost on business organizations. Recognizing that the explosion of the Internet is a microcosmic glimpse of the potential for employee interest and use of this new interconnective technology, a number of firms have adapted state of the art Internet technologies into internal internets, or Intranets. The Federal Express Corporation provides a good example of this adaptive process. After finding that its Internet website was a cost-saving solution for customer service, the company decided to try out the technology on an internal basis. In 1995, the firm operated over sixty Intranet websites among thirty thousand worldwide office employees.[16]

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Intranets provide organizations the advantage of using Internet technology to disseminate organizational information and enhance interemployee communication, while still maintaining system security. With the Internet and Intranets, organizational users realize the benefits of the familiarity of the same connective interface, whether working with internal or external information. For the virtual team, the Internet and Intranets provide an important communicative and informational resource. They allow virtual teams to archive text, visual, audio, and numerical data in a user-friendly format. The Internet and Intranets also allow virtual teams to keep other organizational members and important outside constituents such as suppliers and customers up-to-date on the

team's progress, and enable the team to monitor other ongoing organizational projects that might affect the task at hand.

The Internet and Intranets make a significant contribution to the collaborative environment because of the way that information is managed on both systems. They have proven to be a rich source of qualitative information, and new methods of information search and retrieval have been developed to effectively sort through their enormous volume of information. Systems such as Digital Equipment Corporation's AltaVista search engine provide a means to quickly and effectively locate information—first on the Internet, and now on Intranets and individual computers. Unlike traditional database software, which requires highly structured data, advanced search engines are able find text-based information from within a jumble of file types and formats. Most recently, these products have been enhanced to incorporate the very latest in user-friendly interfaces, further improving users' effectiveness by making an information search a more intuitive process. By enabling users to locate documents and text-based information from anywhere in their workgroup, these new data management tools provide a workable way to manage the distributed information resources of virtual teams.

Taken together, DVCS, collaborative software applications, and Internet/Intranet technologies form an informational infrastructure within which virtual teams can match or even surpass the effectiveness of face-to-face teams. Unfortunately, technology provides only a foundation for virtual teamwork; the real challenge to virtual team effectiveness is learning how to work with these new technologies. Although these new technical systems provide an incredibly rich communication context for virtual team members, they do not truly replicate the face-to-face environment. As such, virtual team members are challenged to recapture the effectiveness of face-to-face interactions using the virtual tools that are available to them.

Virtual Team Building

Developing effective virtual teams goes well beyond the technical problem of linking them together. As workers increasingly interact in a virtual mode, it is imperative that they rebuild the interpersonal interaction necessary for organizational effectiveness. While the virtual team presents a number of challenges in this area, it also presents the potential to recreate the way work is done. Within the virtual connection lies an opportunity for efficiencies and team synergy unrealized in traditional work interaction. John Verity writes:

> That is the essence of virtualization: rather than simply recreating in digital form the physical thing we know as a letter, e-mail reinvents and vastly enhances letter-writing. Unbound by barriers of time and space and endowed with new powers, the electronic letter does something new altogether. The same sort of thing happens when business, the arts, or government are reborn in digital form.[17]

Recreating teams in virtual mode requires resolution of the challenges and opportunities inherent in virtual team technology, as well as the development of a new team sociology.

New Challenges in Structure, Technology, and Function

As discussed earlier, changes in organizational structure and advances in informational technology define the environment in which the virtual team operates. While many of these challenges are present in traditional work settings, they become more pronounced in the virtual environment. Consider the following:

- More so than a traditional workgroup, the virtual team will probably have membership representing a number of different geographic locations within the organization, and may also include contingent workers from outside the organization.
- Virtual team members will be challenged to adapt to the telecommunication and informational technologies that link its members. Virtual team members will have to learn to use effectively new telecommunications systems in an environment where an important client or coworker is frequently never physically present.
- The virtual team's role transcends traditional fixed functional roles, requiring virtual team members to be prepared to adapt to a changing variety of assignments and tasks during the life of any particular team.

All of these factors affect the environment in which the individual members of virtual teams must learn to operate.

Virtual teams, because they have the potential to significantly decrease the amount of travel required of team members, can significantly increase the productive capacity of individual members. For this reason, virtual team members may be asked to participate in a higher number of sep-

arate team situations than was practical in traditional face-to-face teamwork. Thus, virtual team members may have multiple (and even competing) alliances outside their specific virtual team. This same challenge has been observed in traditional work settings, both in situations where contingent workers interact with permanent workers and when members of teams or workgroups are also members of other groups competing for their time and attention. Although problems associated with these factors are not new, outsourcing, organizational partnering, and the efficiencies afforded by advanced information technologies have increased the potential for conflict caused by multiple organizational roles.

Furthermore, the virtual team environment represents a pronounced structural difference from traditional workgroup participation because of their ability to transform quickly according to changing task requirements and responsibilities. Virtual team membership will be substantially more dynamic than traditional teams and virtual teams will be more likely to include members from locations that would not traditionally have worked together. This dynamism requires virtual team members to be particularly adaptable to working with a wide variety of potential coworkers.

Differences in the functional role of the virtual team within the broader organization also create a different environment for the virtual team and its members. Virtual teams provide the capability for more flexible organizational responses, which means that the role of the virtual team, as well as the roles attributed to its members, will be substantially more dynamic than in traditional settings. The Danish hearing aid manufacturer, Oticon, exemplifies this concept. After several years of attempting to turn the company around using traditional cost-cutting and strategic marketing techniques, the president decided to restructure the organization into what is essentially a giant virtual team. Conceptualizing the entire staff as one large 150-member team, the firm now draws the necessary skills for specific projects from a pool of workers whose diverse skills most appropriately fit the project and task requirements.[18]

Each employee's physical location is no longer a barrier to effective team structure. What remains critical is how individual skill sets meet project requirements driven by an ever-evolving business environment. Virtual teams like these are more capable of addressing an evolutionary mission because their technological infrastructure is designed to facilitate transformations in response to changing organizational requirements.

By far the greatest difference in the working environment of virtual team members is the process of virtual interaction. Although electronic mail and various document-sharing capabilities have been in use in traditional work settings for some time, these systems have generally been supported by face-to-face meetings and geographic proximity to other workgroup members. In the virtual work environment, traditional social mechanisms that facilitate communication and decision making are effectively lost and participants must find new ways to communicate and interact, enabling effective teamwork within the new technical context.

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Changes in Work and Interaction

The challenges detailed above have the potential to create a radically different work environment for the virtual team participant, both because of the change from face-to-face to some degree of virtual interaction, and because the virtual team is expected to operate in a different form of organization and assume new organizational roles. These changes in the work setting affect the way that team members conduct their work and how they communicate and express themselves:

- Virtual team members must learn new ways to express themselves and to understand others in an environment with a diminished sense of presence.
- Virtual team members will be required to have superior team participation skills. Because team membership will be somewhat fluid, effective teams will require members who can quickly assimilate into the team.
- Virtual team members will have to become proficient with a variety of computer-based technologies.
- In many organizations, virtual team membership will cross national boundaries, and a variety of cultural backgrounds will be represented on the team. This will complicate communications and work interactions, and will require additional team member development in the areas of communication and cultural diversity.

Research has indicated that when the trappings of traditional communicative patterns are absent, communication dynamics are substantially altered. For example, in workgroup systems where members' primary interactions are through some form of electronic mail, the absence of traditional communicative cues (i.e., facial expression, gesture, and vocal inflection) make subtleties in communication more difficult to convey.[19] Additionally, when participants are able to use a communication system anonymously, the group also begins to lose distinctions among members' social and expert status.[20] Thus, the loss of traditional cues creates an environment that is substantially different from face-to-face interaction, requiring participants to reconstruct a viable workgroup dynamic. Within this reconstructed environment, there is an opportunity for enhanced organizational democracy and participation in work and decision making. Although technology certainly presents an opportunity for such development, the team's sociology will ultimately be a function of technology, the larger organizational culture, and the team's task requirements.[21]

Within the larger organizational culture and the technical environment, the group dynamic of a virtual team depends on the socialization process of the individual team. Unlike many traditional teams, virtual teams will be expected to be able to repeatedly change membership without losing productivity; little time will be available for team members to learn how to work together. Thus, effective virtual team members will have to be particularly adept at fitting into a variety of team situations.

The traditional factors identified with high team performance come into play in the virtual environment as well. Effective communication skills, clarity of goals, and a performance orientation will continue to be critical attributes for virtual team members.[22] To fully exploit the advantages of the new environment, virtual team members will require basic teamwork training and development, and will also need training to enhance team workers' facility with the new information and communication technologies. Effective training in such virtual function skills as how to best use telecommunicative capability and collaborative systems, may ultimately result in teams that function as naturally in a technologically empowered, virtual environment as teams currently do around a conference table. Additionally, when team members represent a variety of national or cultural groups, there will also be the need to teach team members how each of their respective cultures may differ and how they can overcome these differences and use them to the team's advantage.

Advanced technologies may also be used to improve or streamline the socialization of new team members. For example, Intranets allow teams to archive a wide range of information. New team members potentially could access a complete electronic history of the team's work, including not only text-based and graphical information, but also video and audio recordings of important team meetings. The availability of this rich history may allow new members to be brought up to speed on team task, culture, and members' personalities much more quickly than in traditional face-to-face teams.

Recall too that technology presents the opportunity to enhance a team's effectiveness by empowering the teams' collaborative activity. Both research and industry experience indicate that collaborative systems can augment a group's decision quality and performance potential,[23] and will likely do so in the virtual environment as well.[24] Given a proper set of communicative protocols (e.g., telephones, DVCS, electronic mail, and Internet/Intranets), collaborative software systems will add enormous performance potential to the virtual teams' environment. While learning to use collaborative tools is no more difficult than learning many other software systems, the effective use of collaborative tools likely will reorient the attitude of users toward the process of work. Michael Schrage writes:

> Collaborative tools and environments will spark the same kinds of questions and concerns as other fundamental technologies, which will in turn determine the effectiveness of both individuals and enterprises. "Why won't he get out the good collaborative tools with me?" is a question not unlike "Why won't he talk with me on the phone?" . . . The technology becomes a frame of reference and a new infrastructure for the way people relate to one another.[25]

Thus, among virtual team members, collaborative tools not only enhance the productive capacity of the team; they also become a central medium of the team's work process.

Capitalizing on Virtual Teams

It is important to stress that virtual teams are not an organizational panacea and that the degree to which organizations will benefit may differ. Developing the technology and employee skills neces-

sary for effective virtual team implementation carries a cost in time and financial investment that must be offset by the competitive advantage virtual teams afford. Digital Equipment Corporation provides an excellent example of the productive potential of virtual teams, having used them to develop computer systems for years. These teams share databases, simulation and modeling systems, and advanced communication systems to support the collaborative design of new products. This organizational structure has enabled Digital to increase the productive capacity of its technical experts, and maintain its position as a leader in its field.[26]

Therefore, although virtual teams provide many exciting opportunities, organizations require clear understanding of the purpose and goals they have for virtual team implementation. The organizational challenge is first to effectively create the virtual team and, second, to overcome the inherent resistance that inevitably accompanies large scale innovation.

Creating Virtual Teams

Once an organization determines that it has a need for virtual teams, the next challenge is to actually put them in place. At this juncture, the organization must define the teams' function and organizational role, develop the technical systems to support the teams, and assemble individual teams, as well as a cadre of potential team workers.

Managerial Direction and Control

Just as in any team environment, managers will need to clearly establish expectations about the virtual team's performance and criteria for assessing the team's success. Because of the dispersion of team members, effective supervision and control of the virtual team may appear problematic. However, the virtual team's rich communicative environment, along with the system's capacity for archiving data and communications, actually empowers considerably more managerial monitoring than is possible in traditional environments. Managers could, for example, actually view archived recordings of team meetings to assess member contribution and team progress. Finally, the reporting and administrative relationship between the team and its external manager or managers must be clearly established. Again, because none of the team members will necessarily be located in the same place as external management, clear schedules must be established of when the team will provide reports, interim deliverables, and final product.

It is also critically important that managers clearly define the virtual team's role within the context of the organization's greater mission, including the limits of the team's scope and responsibility. This will help the team to focus its efforts on activities that support the strategic direction of the firm.

Defining the Team's Organizational Role and Function

Virtual teams may be implemented as a response to one or a number of conditions detailed in the preceding sections. In turn, these underlying reasons for the introduction of virtual teams should determine the configuration of individual teams, dictate their mission, and ultimately determine the type of technical system required and the requisite skills and orientation of the team and its members. The following description of two types of team roles, while certainly not exhaustive, illustrates some of the range of the role and function of the virtual team.

Teams that are created to provide strategic responses to rapidly changing market conditions will operate in the most fluid of all virtual team environments. In addition to all of the challenges associated with virtual teamwork, these teams will be required to continuously evolve to meet changing tactical conditions. The configuration of these teams will be highly dynamic and dependent on current task and planning requirements. The role of these teams (and of the range of their potential participants) will be as highly adaptive response units, whose mission is to respond to market challenges and exploit market potentials. For example, Lithonia Lighting developed virtual marketing response teams from among independent sales agents, outside distributors, and their own electrical engineers. These virtual teams, which represent both product developers and end-user suppliers, provide the company with a unique capability to respond quickly to changes in the market and customer needs. Using these virtual teams, the company has dramatically increased both sales volume and customer satisfaction, while supply

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chain administrative costs have remained constant or decreased.[27]

Although flexibility is one of the potential virtues of the virtual team, virtual teams may also be created to operate in environments characterized by long-term membership and long task cycles. Virtual teams involved in complex development projects, for example, will capitalize on their ability to access a broader range of expertise and to more easily link to diverse functional resources. The role of these teams will be to manage and execute traditional organizational processes, but with the advantage of resources and expertise unavailable save for their virtual construction.

Developing the Teams' Technical Systems

Once the role and mission of the teams have been clarified, the technical systems that will enable the teams' work will have to be designed and brought on line.

Teams whose task environment requires a high degree of informational integration and/or creative group participation are candidates for greater use of collaborative software applications, in addition to DVCS. This collaborative software will benefit teams whose members must produce group documents and presentations, interactively develop and analyze data, or engage in complex team-level planning and decision making. System design must also reflect an understanding that not all teams need all systems; system design must be task-oriented in order to avoid unnecessary technical overload of team members. The Xerox Corporation met this challenge when it connected two groups of scientists (one in Palo Alto, the other in Portland, Oregon) by arranging for constantly active phone, computer linking, and video conferencing between central areas in the two offices. The two sets of scientists, although 500 miles apart, could communicate with each other just as easily as if they were walking into the next room. No communication systems had to be operated; no complex protocols followed. Scientists simply walked up to the camera and started talking, or shared information back and forth through their computer links. Scientists working on the project report that the richness of the communication system significantly assists them in their work; because the system provides such high-quality communication, users regard their communications with long distance colleagues casually and indicate that their geographical separation no longer inhibits their collaboration.[28]

Teams whose task environment requires a high degree of personal interaction may simply require basic DVCS systems. However, depending on the frequency of use and the number of participants, these teams may need more advanced DVCS systems that use dedicated high-speed phone lines that allow information to flow more quickly between participants and allow for near broadcast quality video transmission. Although the more advanced systems add considerable cost to the DVCS, the increased costs may be justified where video interaction must be as absolutely seamless as is possible, such as in client presentations or sensitive negotiation sessions.

Developing Teams and Team Members

In addition to developing the hardware and software infrastructure for virtual teams, it is equally critical to develop the teams themselves and to develop employees who can effectively participate in this new environment. This means that current potential team members must be trained and acclimated to the virtual team environment. Additionally, to fully exploit the virtual team's potential for optimized membership, organizations must extend their definition of human resources to include the broad range of consultants and contingent workers who may potentially participate on a team in only a virtual mode.

Training and developing virtual team members is in many ways no different from training and developing good team members in general; developing skills in communication, goal setting, planning, and task proficiency are all as important for the virtual team as for the traditional team. What is different about the virtual team is the amount of technical training that is required to empower the team member to function in the virtual environment. Learning to use all of the traditional team skills in an environment where most interactions take place through a telecommunications medium is a critical challenge. This is particularly true since technology continues to evolve and reinvent itself at an ever-increasing rate. Training to maintain technical proficiency will be an important component of any virtual team member's continuing education program.

Since virtual team members' interactions may take place across a relatively alien set of telecommunications systems, the first priority in virtual team preparation is to effectively teach team members how to fluently communicate with each other within the new media. Although team members can easily be taught to operate new technologies, they must be given an opportunity, through training and team development, to establish their own slang terminology and communications protocols.

Over time, the team will develop a variety of methods to ensure that their communication is both efficient and accurate.

When team flexibility is highly stressed, team members will also require a very different attitude toward the team than would traditional team workers. Traditional teams provide members with feelings of cohort and social presence; in an extremely flexible virtual team environment, employees will have to learn to join teams and accept new members into teams without the benefit of time-related socialization. Thus, teams will benefit from learning to express explicit norms and role expectations to new members, who will in turn, be required to quickly acculturate according to the team's guidelines. It will be critical to the functionality of the virtual team that members are instilled with the same commitment to the virtual group activities as they would to any traditional team function.

In addition to training and developing team resources, human resources planners will have to identify potential team members from outside traditional organizational boundaries. As noted earlier in the paper, the virtual team provides the opportunity to build teams out of personnel who could not possibly work together under traditional circumstances. If the potential of virtual teams is fully realized, firms will have the opportunity to greatly expand access to expertise, overcoming constraints that might have been prohibitive in the past. Additionally, organizations will have to rethink how to compensate these individuals, whose contribution to a particular team may be less than full-time.

Given the diversity of potential personnel available to the virtual team and the potential fluidity of team membership, organizations may want to consider the development of team development specialists. Team development specialists would function as resources to teams, assisting them with technical problems and facilitating their interaction when necessary. Providing this level of support would allow the virtual team to focus more on its objectives, rather than on the processes associated with teamwork in the virtual environment.

Challenges and Obstacles

Like any organizational innovation, the introduction of virtual teams will encounter a number of challenges and obstacles. Virtual teams require organizational restructuring and the introduction of new work technologies. The potential for startup problems and deliberate resistance is substantially greater than for changes in structure or technology alone. In discussing virtual teams with professional managers, the following four areas of potential resistance were consistently identified.[29]

Technophobia

Although an increasing percentage of the workforce is computer-literate (and even computer-oriented), a significant number of valuable employees are uncomfortable with computers and other telecommunications technologies. One of the greatest challenges in the introduction of virtual teams is the successful incorporation of valuable, technophobic personnel into the virtual team environment. Part of this problem will be obviated as both computer and telecommunications technologies become more user-friendly. The introduction of graphical operating systems (such as Microsoft Windows 95) opened up computing to a number of new users, and similar introductions of simplified operating systems, intuitive programs, and speech recognition capabilities should encourage even the most technologically recalcitrant to use sophisticated computer systems. In the meantime, organizations can more easily facilitate migration to the virtual team environment by providing training and technical support specifically geared to system novices.

Trust and Cohesion Issues

In an environment where one's primary interaction with others takes place through an electronic medium, it is only natural to expect that participants will wonder whether the system is being used to monitor and evaluate them. The free flow of team members' communication, which once might have taken place away from the office, may now be inhibited by concerns about privacy and system security. To counter this problem, organizations must establish clear policy regarding communications privacy, and must then strictly adhere to that policy. Over time, participants will realize that the virtual team system is a safe medium across which to share ideas and concerns.

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Burnout and Stress

One of the benefits of the virtual team environment is its ability to efficiently connect people and en-

able greater levels of productivity. This may result in employees' being assigned to more teams, creating a more complex and potentially stressful work environment. Organizations must be careful not to overextend virtual team members and saddle them with levels of responsibility that they cannot reasonably satisfy. One important supervisory role will be to ensure that virtual team members have enough private time to complete their individual assignments and prepare for their team participation.

Structural Resistance

The introduction of virtual teams will require significant amounts of organizational restructuring. Aside from the reasons detailed above, some resistance will occur because organizational members do not see this particular kind of change as desirable or necessary. To overcome their concerns, management must carefully design an implementation program that highlights the contribution that virtual teams will make and ties these contributions to important organizational values.[30]

Looking to the Future

The world of the virtual team is far from static; continuing changes in technology and competitive environments will present new opportunities and imperatives for virtual teamwork. Nicholas Negroponte writes, "Computers are getting smaller and smaller. You can expect to have on your wrist tomorrow what you have on your desk today, what filled a room yesterday."[31] As telecommunication technologies continue to evolve, the virtual interface will provide more realistic presence, while simultaneously costing less and becoming easier to use.

Many of these same technological advances will create more virtual interaction in workers' private lives as well. This change will increase employee expectation of working in a virtual mode; as an increasing number of people socialize and shop in cyberspace, these same virtually-savvy people will be expecting a similar experience in their workplace. The economic imperative for virtual teams, combined with changing societal experience of the virtual, may well transform the virtual team from an innovative source of competitive advantage into a dominant organizational form.

Endnotes

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