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TEAMS AND INFORMATION TECHNOLOGY: CREATING VALUE THROUGH KNOWLEDGE

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Tora K. Bikson
The Rand Corporation

Susan G. Cohen
Center for Effective Organizations

Don Mankin
California School of Professional Psychology

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Center for Effective Organizations - Marshall School of Business
University of Southern California - Los Angeles, CA 90089–0806
TEL (213) 740-9814 FAX (213) 740-4354
http://www.marshall.usc.edu/ceo

Abstract

In this paper we examine how information and information technology can make teams more effective. We argue that as work has become more team-based, the technologies for supporting work have evolved in the same direction. Because knowledge is the basic of new and improved products, services, and work processes, organizations will need to find more effective ways to create, transform, and utilize knowledge to remain competitive. Teams supported by new information and communication technology are the primary means for accomplishing this goal. We present a case of a project team from a multimedia company designing a car dealership management system as part of its client's "showroom of the future" strategy, but argue that all types of teams—project, production, service, action, and parallel teams—engage in this "knowledge embedding" process.

If teamwork is the key to effective organizations, information is the key to effective teamwork. Information is not only necessary for effective teamwork, increasingly it **is** the work. Information is the raw material to be manipulated and transformed, and it is the basis for the process by which these actions occur. Information is what is exchanged by team members as they analyze and deliberate. Ultimately, it is the result of the process -- the solutions they devise, the decisions they make, and the new information and knowledge they generate.

This is not just the case for work that has always been knowledge-based, such as market research, engineering design, and systems development. All work is becoming more knowledge-based, even the work of production teams. Therefore, team members need "tools" to help them gain access to information, manage and analyze it, share it among themselves, and communicate it to others. These tools come in the form of new information and communications technology. It is this technology that will enable teams to function effectively within the rich matrix of information that, from the executive suite to the shop floor, now comprises the very essence of modern work.

In this chapter we examine how information and information technology can help make teams more effective. We begin by arguing that as work has become more team-based, the technologies for supporting work have evolved in the same directions. We then present the main point and organizing theme of this chapter:

> Knowledge is the most important strategic resource of the modern organization. It is basis for new and improved products, services, and work processes. To remain competitive, organizations will have to find more effective ways to create, transform, and utilize knowledge. Teams supported by new information and communications technology are the primary means for accomplishing this goal.

Throughout the remainder of the chapter we discuss and illustrate the kinds of information resources different kinds of teams need so that they can effectively engage in this "knowledge-embedding" process. Much of this discussion will focus on a project team from the dynamic, knowledge-intensive, emerging "new media" industry, but as we will see in the sections following our description of this "hi-tech" project team, the concepts and insights can be extended to action, production, service, management, and parallel teams as well. While this chapter primarily addresses the differences between these team types, the most interesting and important points of all may be what they have in common. We discuss these overarching themes and issues in the final section of this chapter.

The Convergence of Teams and Information Technology

Organizations are rapidly becoming team-based. In the modern organization, boundaries and interrelationships between teams are critical and need to be managed effectively. Many teams are temporary and work processes must take time into account. Members may be dispersed and collaboration must occur across organizational and geographic boundaries. Teams need to be able to share information quickly, make decisions locally, take actions, and communicate laterally inside and outside of the organization. The requirements for timely communication, cooperation and coordination, combined with the competitive necessity for knowledge-based products, services, and processes, have created the need to use information technology in new ways.

In the past two decades, information technology has evolved from stand-alone systems designed for individuals performing independent actions to networked systems used by teams of individuals for connection and collaboration. Distributed networking capabilities, advances in open systems, telecommunications, multimedia capacity, and shared digital environments have created opportunities for users from the same or different locations to work together. Computers and communication technologies continue to make dramatic improvements in performance while decreasing in price, and as a result, networked electronic tools are now in widespread use. Open systems architectures enable integration between different organizations as well as between different parts of large organizations using different technologies. Very fast telecommunication networks can now transmit interactive multimedia applications in real time: voice, video, and data. Mobile communications, cellular telephone technology, and wireless connectivity enable people to work together from almost any location. Shared digital environments allow groups of people to experience and respond to common events, even though they are miles apart -- e.g., finding oil reserves or rescuing people from an earthquake (1). Technological advances have helped to transform computer-based interactions into social ones, enabling collaborative and team-based work.

These advances have helped to generate interest in the development of a class of computer-based applications, commonly referred to as "groupware," to support teamwork. The term groupware was originally coined to represent specialized computer aids designed for groups doing collaborative work. Because of the popularity of groupware products such as Lotus Notes, this term has become common in the academic and practitioner literatures in recent years. The growing interest in media that enable communication, cooperation and coordination reflects how technology evolves to support changes in the workplace, in general. But it especially reflects the continuing effort to develop tools for helping teams create value-added products and services. (See Chapter 9 in this book for more discussion of groupware.)

Knowledge-Embedding Processes in Teams

That knowledge is important for high level, professional, and "high-tech" teams is obvious. It is perhaps less obvious that it is also important for teams with purposes that are more mundane, modest, and commonplace. Increasingly, teams of all kinds and levels are responsible for embedding their knowledge into their work processes, the products they produce, and the services they provide. The formal technical and scientific knowledge of industrial scientists and engineers is not the only source of new ideas, innovations and improvements. Managers are beginning to recognize the business value of the day-to-day innovations that come from experienced workers sharing their tacit knowledge about task processes. Production workers, for example, implement modest shop floor modifications of production machinery that can have major impacts on costs and quality. Computer users "tinkering" with new technologies reinvent their work and their tools to better match their needs, occasionally creating new products and services in the process (2).

The widespread use of teams and technical advances that support social computing enhance the knowledge-embedding process. Teams bring together the specialized expertise of their members to create new knowledge or new applications of existing knowledge. Networked technology provides tools to gain access to information, to analyze it, to shape and manage it, and to share it with others (3). Together, teams and information technology enable knowledge to be collaboratively created and deployed to achieve competitive advantage.

The knowledge that is created can be embedded in product designs, provided as customer services, used as a basis for process improvements, or leveraged into new business opportunities. For example, IBM advertises that it sells "business solutions," not computers. They focus on comprehensive solutions which include not only hardware and software, but also redesigned business processes, training, and consulting on how to get the most out of their new technologies and processes. Their sales teams -- which are made up of members with technical skills to provide expert consulting and the sales skills to close deals -- work with their customers in a mutual exploration of their business missions, critical processes and needs. They increase both their own and their customers knowledge as they work. The solution emerges from the collaborative effort between consultants and customers. Another example can be found in the shop floor improvement teams that regularly examine production data, using analytical tools such as statistical process control, and brainstorm new ways to improve their performance.

Some companies are beginning to recognize the strategic importance of this team-based, knowledge-embedding process. They are developing mechanisms to facilitate and capture the knowledge created by teams, and using the outcomes to develop new products and services or even new lines of business that fill a market niche. This is the business model for Digital Evolution, the company that provides the case we discuss next in this chapter.

Knowledge-Based Project Teams: A Case

> "In a small fast-paced company you have to have dynamic collegial management. Old project management specs and time lines don't really work. You have to have people who are aggressive about completing a project and who really want to be on the team and make it happen.
>
> I was looking for people I could work with under very trying circumstances: high stress, crummy locations, long hours -- people you can argue with at 2 in the morning over cold pizza, ... still realizing that you both have the same goal." (Project team leader, Digital Evolution)

These are the words of a project leader at Digital Evolution, a Los Angeles software firm, in response to our question about the keys to successful team staffing and management. The firm's business mission is to develop innovative digital communications products and resources in several vertical markets, including entertainment, health, education and training, and varied retail sectors. The project team that serves as a focal case for this chapter is engaged in producing a multimedia dealership management system for a major automobile manufacturer as part of the client's larger "showroom of the future" strategy. Other projects have involved the development of an interactive system to help customers choose health plans and an on-line multimedia history of contemporary rock music.

Because we believe this case yields valuable insights about today's teams and the information and communication technologies that facilitate their collaboration, we give it special attention here. Although it is a project team, it illustrates a number of significant team-technology relationships that characterize contemporary knowledge-based work groups of all kinds.

Organizational Context

We first encountered the project team at Digital Evolution's high-tech, high-touch headquarters. The team had just completed a successful prototype for the car dealership management system (CDMS) and was developing a real working version for use in future pilot trials. With about 22 members, this is currently the largest project team in the 80-person firm. The firm itself has grown in size at a rate of about 8 percent per month and more than doubled its revenues annually since its inception.

Just over 4 years old, the company was founded by its current president and CEO to fill what he perceives as a new business niche. He describes Digital Evolution this way.

> “We are network-centric, platform independent, and ... oriented toward knowledge-based value creation. At the core, we have to be innovators, not [just] appliers.
>
> New digital communications media are advancing technologically at breakneck speed. In this business, if you analyze an issue and say ‘here are the problems and here are the available tools’ you're destined to failure. To be effective you have to be able to say 'here are the problems–let's create what we need to solve them.'
>
> Value creation comes from the ability to gain knowledge from our clients and to apply that knowledge, ... along with our core competencies, to create products that fulfill a special industry or sector need." (President, Digital Evolution)

According to Digital Evolution's president, few companies today are positioned to compete in this niche. While many firms can generate Web sites, CD/ROMs or other multimedia products for their customers, they typically lack the expertise in back-end programming and big system architectures necessary to integrate such products with a client's existing applications and databases. In addition, many companies that sell proprietary technologies and customization services to meet clients' digital communication needs are not platform independent and may not be able to choose the best solution path for the customer. Finally, many system integrators building solutions that are largely pre-specified by clients are not usually skilled in front-end interface design, especially with multimedia technologies.

And rarely do any of the provider firms consciously set out to create new knowledge-based value in the resulting deliverable.

In contrast, Digital Evolution thinks of itself as a "practical digital think tank." Says the president, "we don't learn first, then implement what we know. We have to learn while implementing. "This is so because, given the rapid rate of change in network technologies, both clients' task demands and potential ways of addressing them are continuously evolving. As a result, Digital Evolution project staff live in "Web Weeks" -- for instance, noted the president, "what Microsoft posts on the Web today we have to take into account in our development work tomorrow."

In fact, it is partly for this reason that Digital Evolution feels it literally cannot afford to accept a project from which it cannot learn. Delivering innovative services to clients is regarded as an excellent vehicle for "developing intellectual assets. "Therefore, Digital Evolution takes on just two types of activities: (i) work-for-hire that involves creative problem solving or otherwise has intrinsic interest value for future work; and (ii) joint ventures with clients (and/or others) that can produce new knowledge-based products or tools which can be modified to serve similar needs among other client firms and thus have significant market potential. Either sort of activity might lead to the other.

In any event, activities are organized around projects and staffed by teams whose members reflect the competencies needed for a business that depends on continuous learning and creation of new value-added multimedia digital communications resources. From the president's perspective, the first requirement is that they be smart and enthusiastic ("this is 99 percent of it," he says). Among Digital Evolution's professional employees, about two-thirds are technical specialists (e.g., in systems architecture, database design, varied programming languages) while the other third are artists (e.g., in fine arts, graphic arts, music, animation). They report to a technology director and an art director, respectively. The relatively flat management structure also includes, beside the president, individuals responsible for internal R&D, business development, marketing, internal administration (e.g., human resources), and business and financial affairs.

Any given project will, at minimum, have a project manager and its own technical and art directors. The number of technical and artistic team members and the nature of their subspecialties varies according to project-specific task demands. Projects may also rely on clients' own experts and/or external consultants with expertise in the specific subject area of the system under development to complement the team's skills (see Figure 8-1).

Insert Figure 8-1 About Here

Generally (but not always) employees work on only one project at a time, although their involvement may be limited to a particular phase(s) of the effort, after which they move on to another project. Because their generic skill sets are useful across projects regardless of the specific subject area, they are "highly fluid."

The Project Team at Work

When we next encountered the CDMS project team, the pilot version of the system had just been accepted by the client and the specifications frozen. The subsequent effort would involve production of a working version of the pilot system -- a CDMS functionally integrated with the client's existing applications and ready for real-time use in field trials with a subset of 12 dealerships.

For this stage of work, CDMS team members had relocated to the customer's headquarters in a city about an hour's drive from Digital Evolution, exchanging their jeans and T-shirts for slacks with dress shirts and ties. The uniformly furnished building with its corporate decor presented a sharp contrast to the casual art-filled surroundings of our earlier meetings. In the words of the project leader:

> "We've definitely come to school here.... One lesson we've learned is that, when dealing with a client, perception is reality. We have to meet the client's dress code expectations as well as behavioral expectations. The project manager for [the customer] is a good source of clues.
>
> We've also learned about how to formalize some of the customer-team interaction processes, especially the process of status reporting. We're willing to learn. We are immersing ourselves in their processes intimately, then adapting to them." (CDMS project leader, Digital Evolution)

The center of team activity at the project site is a lab-like room jammed with linked workstations and housed within the customer's Information Systems (IS) department. Front-end programmers are exercising all the system functions that a dealership end user might conceivably invoke, while back-end programmers are determining that those actions or action sequences in fact operate with internal consistency and interoperate reliably with appropriate data generated from the client's mainframe-based applications. After each function is fully tested and revised by the CDMS team, it is transferred over the network from the lab to the client's IS department for further testing by their staff. Unlike other projects where there is a distinct geographical and/or organizational separation between customer and supplier, this transfer is effected in a relatively informal manner. The discrete and formalized steps usually involved in such projects -- e.g., handing off defined "deliverables at prespecified points in time, or "milestones" -- are replaced by ongoing, day-to-day interactions between the project team and the customer.

The opportunity for close, in-person interactions with clients was regarded as an especially important feature of this project. It was one of the reasons behind Digital Evolution's decision to relocate the entire project team to the customer's headquarters. Their decision was in sharp contrast to the pervasive, and perhaps overly popularized image of virtual teams of high tech telecommuters keeping in touch with their customers and each other only via e-mail and video conferencing. Obviously, this project team felt that it was important to work face-to-face with the client staff members and "go to school" at their site to better learn the client's expectations, processes, context and culture. We will return to this point later in this chapter.

The Business Need

The automobile manufacturer's motivation for acquiring the CDMS has little to do with the technology and much to do with solving a pressing business problem. Cars manufactured by this corporation regularly rank very high on all assessments of quality and performance, but with equal regularity rank near the bottom when it comes to buyer satisfaction with sales and financial services.

Conceived as an application to support dealership practice, the CDMS employs a graphical user interface to "step through the entire process from the first sales stages to the end of the financing procedures. "Along the way it will give sales staff immediate access to up-to-date inventory information, help sellers and buyers engage in "what-if" trade-offs among the options offered, track and display resulting choices, and will eventually permit a seamless transition from sales to finance.

According to the project manager, initially the CDMS "works kind of like an interactive glossy multimedia brochure" in the showroom. For example, sellers can quickly show potential buyers still and moving images of cars in their range of interest. When the buyer has chosen a model for more detailed examination, the application brings up a set of options (a "package" plus other special alternatives). Clicks on the color palette allow the buyer then to view the selected model with the preferred exterior and interior colors. Likewise, alternative wheel options can be tried out on the model, or sun roofs, or sound systems, and so on until a desirable configuration has been reached.

At that point, the seller may bring up a summary of the selections and their cumulative cost. Or the buyer may wish to revisit some earlier choices in view of those made later. In any case, once the buyer has reached a decision, the CDMS can determine whether a car configured just as the buyer wants is available in stock there or at another dealership in the vicinity. If not, the CDMS can engage in a "fuzzy" search to find out whether the desired model -- configured with a close family resemblance to the chosen options -- can be found near by. Or the buyer may prefer to have the car special-ordered exactly as configured in the selection process.

Whatever the buyer decides, the relevant information is retained and transferred to the finance module of the CDMS for use by financial services staff. Financial staff can invoke their part of the application without having to repeat questions or re-enter data related to the prior selection process. Instead, the finance representative can begin where the sales staff left off, reviewing different approaches to paying for the car along with their associated costs and benefits and gathering the information required by the credit application. In the end, the CDMS will print a record of the sales and financing agreement that, when signed, officially documents the transaction.

The Knowledge Value Added

From Digital Evolution's perspective, this application is designed to be leveraged. Among the value-added capabilities Digital Evolution envisions for the CDMS are the following.

- CDMS-generated data can be used by the manufacturer to learn about buyer preferences. At present, like most automobile manufacturers, this corporation routinely receives sales data but has no way of knowing how well sales reflect buyers' first choices. CDMS data may also be integrated with ordering and shipping systems when buyers go for cars not in stock.

- The CDMS interoperates with an online independently-maintained consumer reports database that contains evaluations of cars from all major manufacturers. Potential buyers can use the system to examine dynamically generated data about the manufacturer's car and similar models of cars from different manufacturers. This enables comparison shopping without leaving the showroom -- a considerable advantage for a manufacturer whose products consistently rank high on quality/performance dimensions.

- The CDMS remembers buyers and prospective buyers. For the former, it can be used to produce follow-up inquiries, tune-up reminders, or current news of interest to owners of a particular type of vehicle. Or, when prospective buyers who do not reach a decision the first time around return to the showroom, the CDMS can be used to refresh their memory (and the seller's) about the models and configurations under consideration.

- Dealerships with a technologically sophisticated clientele can readily make the "brochure" module of the CDMS directly available on computers in their showrooms or on Web sites to those who prefer shopping electronically on their own. In fact, dealerships could easily put the entire credit application on line as well, so that all of a buyer's pre-purchase choices and other data entered from home would be in the system when the buyer arrives at the dealership.

In a number of ways, then, combining its expertise with the client's knowledge of dealership needs and existing databases enabled the CDMS project team to create substantial additional value in the product. At the same time, the team learned conceptual and technological lessons that could be applied to the development of systems for supporting sales and financial services for almost any class of durable consumer product.

Team Composition and Performance

The CDMS team is staffed and structured essentially as depicted in Figure 8-2 above, although its overall size has changed considerably over time. In the early months of the project, about 8 team members put together an initial "proof of concept" system for demonstration purposes. Moving closer to a functioning pilot system required expanding the team.

While some of the needed programmers could be recruited from existing Digital Evolution staff, Java programmers were new hires (previously Java programming "was not one of the core competencies here"). Graphic designers, fine artists and production artists were needed as well. The former take on layout and content design, while production artists work to optimize their use of multimedia resources (e.g., by making them as low-memory as possible). The CDMS today relies on about 100,000 lines of code and a huge store of multimedia digital objects, called "assets" by Digital Evolution professionals.

Having good art and making it work within the technology continues to be one of the hardest challenges for this interdisciplinary team. But as the project leader notes, creative resolution of these tensions remains a source of growth and strength.

> "Art will push the technology, and vice versa. A good example is our 'text refresh' tool....The artists wanted to be able to scroll the text on a screen, wrap it around the image, and so on, without any of the image objects moving -- whether they were outside the text or within a text box. The technical staff explained why this couldn't be done in the system, but the artists insisted on it. So eventually the techies figured out how to build it.
>
> This is how the art stretches the technology -- we take on approaches we wouldn't otherwise have contemplated. "(CDMS project leader, Digital Evolution)

Besides shared goal commitments and respect for each other's skills, team members identified two other dimensions of constructive disputes: not personalizing arguments ("we don't attribute negative motivation to the one who disagrees") and not forcing solutions ("we can leave things at an impasse for a while until we come to a compromise"). Thus, although there are "lots of inherent places for friction" in the project, "we're more productive because of it." For instance, the friction-engendered text refresh tool (see quote above) will be valuable to Digital Evolution in many future multimedia projects; its utility goes well beyond CDMS-like systems.

Technology to Support Project Team Performance

While CDMS team members are acutely aware of how the technology they are developing should support and enhance dealership performance, the information and communication technology they themselves use in their work has become so internalized as to be nearly transparent. Of the many questions we asked, those that targeted their own technological support seemed hardest for the team to answer.

For example, team members take it for granted that they always have access to one another and other Digital Evolution professionals as well as external consultants and customer liaisons by e-mail regardless of location. This is what makes it possible for project teams like this one to work full time at customer sites and yet feel fully connected to their home base. They also assume that they will be able to use the Web to stay updated on technical events in the broader environment that may affect their development plans or future prospects.

Besides generic communication facilities for close or distant interaction, the team makes use of standard development tools in its work. The Developer's Studio suite, for instance, includes "source safe," a programming management system that permits all project staff to read everything in the CDMS and to share components -- but it also has check-in/check-out services so that two programmers cannot simultaneously revise the same piece of code. Additionally the project relies on a spreadsheetbased bug-tracking tool as well as a standard flow-charting tool for graphic representation over time of interrelated subtasks and the team members responsible for this task.

However, the two most significant technologies supporting the team's work were developed by Digital Evolution professionals themselves. One is an online procedure for status self-monitoring and contact reporting. The very ease of informal horizontal interaction with members of the client company made it necessary to institute some formalized interaction processes, especially as the CDMS project grew in size and complexity.

In response to this need, Digital Evolution devised a daily reporting procedure. It documents tasks completed each day by the project team; meetings with client representatives; work orders (official descriptions of CDMS work or revisions approved by the client); and change requests (any new work or revisions to the CDMS proposed by the client that will require additional budget). These reports are circulated to client representatives and the project team. "We used to just talk to them," the president said; "now we write down everything they say to us and feed it back to them to verify it." The procedure has proved very useful for team self-management and especially for preventing communication-based project break-downs.

The other critical team support technology is the asset management system. As explained earlier, the CDMS project has developed a huge store of digital multimedia objects. Such objects are evoked by the CDMS as users interact with its varied "showroom" functions. As CDMS components are written or revised, programmers need to be able to find various assets, re-use them, create more of them, and the like.

The asset management system addresses this need. By virtue of naming conventions and other descriptors, it is possible to locate each image in the system and determine exactly where it is used in the CDMS. So, for instance, when the manufacturer introduces its new product line, all the 1998-model cars in the CDMS can be changed to 1999 models with relative ease. Since it was created by the team itself, both artistic and technical professionals understand how to use the system. Because it effectively facilitates the shared use of multimedia information resources, the system is expected to become a standard team-support technology at Digital Evolution. It is important to note that the need for this system was not foreseen early on at Digital Evolution, but soon became apparent with the CDMS project, their biggest and most complex project to date. Since the asset management system enables Digital Evolution to leverage the assets created by one project to serve other projects, the senior managers now view the system as essential to the future success of the company.

"Best Practices" For Different Types of Teams

The Digital Evolution CDMS case reveals several “best practices” of teams that perform knowledge work and use information and communication technologies to facilitate effective collaboration. As a project team, it illustrates several practices that particularly fit cross-functional groups which are assembled to complete a task within a defined period of time. In the section that follows, we will use the Digital Evolution case as the basis for identifying best “team-technology” practices for project teams. Then we will briefly discuss the five other types of teams -- action, production, service, management and parallel teams -- emphasizing information technology support for team performance. But first, a caveat is in order.

We are using the term "best practices" loosely. Because of the scarcity of organizational research on information technology support for different types of teams, no clear scientific evidence exists to support the identification of best practices. Due to the rapidly changing nature of computer and communications technologies, we cannot even describe practices as being "well-accepted" in organizations. Practices must continuously evolve and improve in a world in which significant change occurs in "web weeks."

Project Teams

Table 8-1 summarizes “best practices” for project teams based on Digital Evolution’s CDMS team. The effectiveness of all of the practices we have listed here depend on or are heavily influenced by new networked technology. Although some of the practices apply to all teams (e.g., respect other's skills, do not personalize arguments), the cross functional nature of project teams makes these practices especially important. The wide cultural chasms often found in technology-focused project teams, like the ones at Digital Evolution (e.g., between artists and computer scientists) pose even further challenges to their effectiveness. Therefore, translating such universal homilies as "respect each other's skills" into implementable practice can make the difference between projects that are successful and those that are not (3).

Insert Table 8-1 About Here

Because the competitive environment requires project teams to develop innovative products and services, learning and innovation processes are key. Digital Evolution models how an organization chooses projects based on learning potential; it assumes that learning occurs in the process of delivering products and services and views learning from projects as a means to develop intellectual assets. Finally, learning must occur at rapid rates to keep pace with changes in technology and the competitive environment.

The processes of coordination and cooperation occur across functional and disciplinary boundaries within project teams, as well as with groups external to the project team such as project sponsors, the constituencies represented by individual project team members, and other stakeholders. Project team members must be able to work with others of different backgrounds, work experiences, knowledge bases, and skills. We use the term “laterality” to describe this ability to relate to others quite different from oneself (3). The assistant CDMS project manager told us that he has both an artistic and technical background, and is able to act as a bridge and interpreter between the artists and technologists. Team members emphasized the respect and appreciation they have for each others’ knowledge and skills. They also talked about the creative resolution of conflicts between artists and technologists that result in new team capabilities. Decision-making is iterative and participative, and project management does not prematurely force solutions. Although these processes of cooperation and coordination are critical for all types of teams, they are particularly critical for project teams that need to harness expertise from different perspectives to develop innovative solutions.

A customer orientation helps a project team develop products and services that meet customer requirements. Although it may not make sense for all teams to co-locate with their customers during a project, as the team from Digital Evolution did, it kept the team focused on the customers needs and taught them "tacit" lessons about the work context. A strong commitment to achieving the customer’s priorities, communicating progress, and linking technical personnel across organizations helps ensure that the products and services being developed are those that customers will use. But commitment requires more than just good intentions and slogans. Whether through co-location or other means, project teams need to explicitly implement activities and linkages that maintain an ongoing focus on their customers.

Digital Evolution's use of technology to support project team performance is quite sophisticated. The project team takes for granted technological supports that many companies and project teams still lack. All project team members use e-mail. They are connected to one another, to other Digital Evolution employees located at the companies headquarters and elsewhere, to customer liaisons, and to anyone else outside the company that might be a useful source of expertise. They have access and the capability to derive whatever information they need from the Web. They are aware of the importance of early prototyping, and developed an initial prototype of their product for the customer prior to beginning the pilot system development work. They use standard project management and software development tools such as flow charting or bug tracking software. Perhaps most importantly, they have created customized tools that will have ramifications well beyond this one project. For example, the asset management system for digital multimedia objects will be used for other projects and other clients. It ensures that the intellectual assets created for one project can be applied to other projects.

Finally, the product being developed for their automotive client embeds value-added capabilities that not only address this automotive company's business need, but could be used to develop systems for supporting the sales and financial services of almost any consumer durable.

Action Teams

The information resource needs of action teams reflect the intense, dynamic, high-stakes, time-critical, and externally-driven nature of their work. The team must respond, often with little advance notice, to challenging and rapidly changing events and conditions generated, for example, by formidable adversaries, adverse environments, and watchful stakeholders. They must be able to work together effectively from the moment the engagement begins.

New electronic media are increasingly able to support the challenging work of action teams. Firefighting teams in the US Forest Service, for example, rely on a range of advanced technologies to support their communication, cooperation and coordination needs during periods of action as well as between such engagements (4). The mission for these firefighting teams is expressed in terms of fire protection program objectives by the Forest Service's headquarters in Washington DC and made available online to all National Forests and Ranger Districts. The Washington headquarters also oversees the National Fire Management Analysis system, which provides an array of tools for understanding and decision making related to fire protection. For example, it is the basis for an annual modeling exercise conducted by each national forest, with input from its ranger district, to plan for the coming fire season using its own fire history as background. Results are aggregated from all forests by the Washington office, where the system is used to examine alternative fire suppression strategies from a cost-benefit standpoint and make fire protection policy recommendations.

Other information technologies are used to track equipment, supplies and personnel so that teams and materials can be rapidly deployed when a fire breaks out. The same technologies are used to track and deploy resources during a fire. In the past, radios and telephones were used by dispatching offices to pass along requests for equipment, materials or personnel until they arrived at units that could help meet those needs. Now, the Automated Resource Order System (AROS) -- a networked, agency-wide system -- uses intelligent forms that "know" where to go to get the needed resources and to automatically activate the request-filling process.

The actual work of fighting a fire is assisted by a simulation program called BEHAVE, which models fire behavior. First an infrared aerial photo of a fire is superimposed on a digitized map of the forest and its surroundings; this allows the fire management team leader to know where the hottest spots are and to locate roads, fire breaks, camping areas, near-by residences, and so on. The resulting electronic fire map can also be linked to other forest data collected or maintained on line -- about timber, ground fuels, moisture content, current wind direction and velocity, and the like. The fire officer can then simulate different fire suppression strategies and observe their results to guide the firefighting team.

In some regions, "kits" of portable computers loaded with the appropriate software and data are taken to a fire site -- sometimes by parachuting -- to provide constant access to a communications network and continuously updated data. In this way the firefighting team stays in contact with broader organizational resources; when necessary, the network can also be used to request and coordinate support from other federal, state or local agencies in the vicinity.

The National Fire Management Analysis System also provides a vehicle for organizational learning between engagements, up and down the hierarchy as well as over time. Information collected by lower-level units is transmitted upward to inform policy; the top-level unit aggregates the information across sources to develop planning models, analyze fire suppression strategies, and make the results available throughout the agency for local units to use. These models and findings are subsequently combined with local knowledge and data to support unit-by-unit fire protection plans and fire behavior models.

The Forest Service example demonstrates how computer-based tools can be used to support action teams of all kinds whether their mission is to fight fires, contain oil spills, or deal with police emergencies. What all action teams have in common is intense, time-critical activity during engagements, and less intense activity between engagements to prepare for the next time that events and circumstances require them to take action.

During engagements, action teams need systems that can rapidly deliver task-critical information about fast-changing, situation-driven events in real time. They also need locally customized decision making support to help explore options and strategies and to coordinate the deployment and redeployment of human and material resources. Finally, they need timely communications with others -- their own organizational unit, other relevant units of the organization, and external experts or organizations, depending on the nature of the team's engagements. These links, activated as needed, mean that additional resources and other support are always within reach. They also help assure that action teams stay attuned to the policies that should inform and guide their performance.

Between engagements, time is less critical and actions are not driven by immediate events. Therefore, the action team's needs shift from information support for real time action to planning and preparation for the next event. Interestingly, the general resources are similar but the purpose and particular features differ -- i.e., information to help plan and develop strategies for future events, management systems to ensure that resources are available when the immediate need arrives, and communication systems to promote enterprise-wide goal sharing and continuous organizational learning from prior engagements.

Different kinds of action teams have different domains and specific purposes, but they all are concerned with addressing immediate challenges posed by difficult events and conditions. Their effectiveness is probably as much a function of how well they plan and prepare for actions, as how well they execute them. What is true for the Forest Service firefighting teams is true for all action teams, regardless of their specific nature, domain and purpose: as much attention needs to be paid to information resources to support the planning for and learning from action as for the action itself.

Production Teams

The distinguishing feature of production teams is that they are responsible for generating tangible outputs on a continuous basis (5). Therefore, they need information and information tools that help them coordinate activities, track work in progress, communicate with those immediately “upstream” and “downstream” from them in the production process, monitor performance, and collaborate to solve problems (3).

For example, production teams at Encore Computers assemble midsize computers for simulations such as those used in pilot training. Because they are a low volume manufacturer and build systems to order, throughput is not an important issue, but quality is. In the early 1990s, Encore Computers undertook a major effort to make each production team concentrate on continuous quality improvement. They also developed an extensive database on all aspects of the plant's operations including daily quality reports. All of this information is available on computers located throughout the facility and production team members are trained to access the information.

Production team members use the defect data reporting system (DDRS) to audit defects. All team members audit the work on their direct “supplier” and are responsible for the work they pass on to their "customer." Whenever team members detect a defect, including procedural errors and ones of their own doing, they write it up on a form and enter it in the system themselves. On Monday every team gets a report (their choice of either hard copy or e-mail) of the defects supposedly attributed to them. By midnight Wednesday morning, they either “own it” or pass it on to the person or unit they think is responsible. The teams figure out what to do about the problem (with support from managers, technical staff, and plant-wide quality committees). In the first year of the system's operation, the teams identified $200,000 worth of defects they had resolved via this system. Everyone in the plant now uses the system and production team members and staff groups are less likely to blame each other for production problems.

This example illustrates several “best practices.” The information system is used to provide critical performance data which in turn are used by teams to solve problems and make improvements. These data are provided on a regular basis, enabling the team to continually monitor its quality. The focus on quality fits its product; if the teams worked instead on mass assembly of computers, then productivity data would probably be the focus. The information system also connects production teams to technical staff groups in the plant, which expedites problem-solution. Everyone in the plant has been trained to use the DDRS system and has access to it. The defect data reporting system enables team members to make better-informed decisions about their work, and helps to empower them. Production team members are also connected to others in the company (both inside and outside the plant) through e-mail, and the Encore culture supports open communication. The information and communication technology used by the production teams helps them develop knowledge about how to continuously improve their product and processes. Finally, although it is not explicit in the example presented here, Encore's production teams also have access to information about production schedules, task requirements, and work in progress.

Encore's production teams are by no means unique. The very nature of production requires information about customer requirements, the production tasks, the availability of materials and supplies, the overall process, and the outcomes. Whether they are producing computers, pet food, or wood products, all production teams require information about various aspects of the production process. In recent years, comprehensive, integrated ERP (enterprise resource planning) systems for coordinating and tracking production from order to delivery have become a multibillion dollar business. Traditionally, these systems focused primarily on make-to-stock and repetitive manufacturing. But some of the newer systems are designed to address manufacturers' desires for tailorable products and mass customization. They include features that support make-to-order, engineer-to-order and project-based manufacturing. In the hands of well-designed production teams these new, more flexible systems can be a powerful tool for generating and applying knowledge to the continuos improvement of manufacturing processes and their outputs.

Service Teams

Services differ from products in that they are intangible and are simultaneously produced and consumed. Therefore, service team members often do not need to be co-located and may need to perform their service at customers' sites (e.g., telephone repair crews). The potential value of the service is highly time-dependent and perishable, and the quality may be highly variable depending upon human action and behaviors (6). Some services are provided in brief encounters with customers, such as retail sales, yet others entail long-term relationships, such as management consulting (7). These characteristics have implications for the design of information technology and communication tools to support service team work.

Mobile communications systems can connect service team members who are geographically dispersed. For example, self-managing teams composed of field service technicians for a gas and electric utility we have worked with communicate with one another and customer service representatives via two way radio phones and a mobile data terminal system that indicates the location of reported gas leaks (3). Mobile communication systems provide more flexibility than wire-dependent e-mail systems; they enable people to communicate with one another from any location.

Service team members can use information tools to create shared understandings of the service they are providing to customers. An electronic white board or shared data base can be used to represent the information that is presented to customers. In essence, a shared artifact is created, thereby enabling more effective collaboration among them. By making information explicit, the intangibility and variability of the service provided by team members is reduced. For example, a commercial bank decided to use a Lotus Notes application as the mechanism for document management in the lending process. In the commercial bank, portfolio managers were responsible for generating new business leads, negotiating lending deals, and maintaining borrower relationships. Account executives analyzed potential deals for their credit worthiness and were supported by credit analysts. Service teams composed of portfolio managers, account executives, and credit analysts worked together to get loans approved.

Prior to the implementation of Lotus Notes, problems such as lengthy delays in paper exchange, lack of version control, and difficulty in accessing loan documents in preparation were common. After implementation, the collaborating parties (portfolio managers, account executives and credit analysts) shared credit documents stored in a common document database. Team members could open, print, or even edit (if given editing rights) any document, any time, and in any banking office. Close to real-time co-authoring and deal approving were possible, eliminating costly delays and increasing service responsiveness. The documents from one loan could be used as templates for other loans, and a client's loan history could easily be assessed.

The use of the shared database in Lotus Notes increased all service team members' understanding of the criteria used for approving loans. Judgments of the degree of business risk to be tolerated and of credit worthiness became less variable and more explicit. As a consequence, the service being provided for customers became more tangible. In addition, the document management system supported immediate transactions as well as the development of long term relationships with clients. Employees could learn about the loan approval process by electronically accessing loan documents.

One of the key functions of information and communication technology for service teams is to connect them directly with their customers. Service teams need feedback from customers on the quality of services they provide. An information system can be designed to listen to customers (both internal and external) and to provide data that can be used in making improvements (6). The commercial bank discussed above is now considering tracking client satisfaction with its new commercial loan approval process and using its information system to assess service quality.

In summary, both examples illustrate the information technology “best practices” for service teams and their general applicability to service teams with widely varying purposes and functions. These best practices include systems to support “anytime-anyplace” communication among members, “real-time” data acquisition and analysis, development of shared artifacts to support collaboration, direct connection with customers, and collection of service quality data that can be used for feedback, learning, and improvements.

Management Teams

Research that examines information technology support for management teams is almost nonexistent. In fact, management team members are often the least accepting of new information technology and may lack the capacity to take advantage of its potential (3). Thus, this section will necessarily be speculative, making inferences about the practices that have future promise based on the tasks that management teams must perform and our own limited observations of their tools in use.

Senior management teams are the strategic focal points for their organizations. They link internal operations with external factors, and direct and re-direct strategy to respond to changing competitive conditions. They need to develop “corporate coherence” -- an ability to ensure that diverse parts of the organization work together to meet competitive challenges across product lines and markets, and to create product families that share common features. Coherence is needed to leverage core competencies across business units and functions, and to respond quickly and effectively to environmental jolts (8).

An example of how information and communication tools can help achieve this coherence is found in an oil and gas company we studied that formed a high level management team to lead the implementation of a successful future growth strategy. Business success, in the view of the Division President, requires teamwork to manage core business fundamentals and strategies, and nimbleness to capitalize on new business opportunities. The company created cross-functional management teams to span key business processes, and the executives on the top team serve as contact points for these management teams. The contact role is separate from a supervisory role, and the contact executives support teams from functions different from those they lead. This design requires the management team members to closely work together. E-mail has helped them to a certain extent, but to achieve true coherence, they need information and communications tools that can integrate real-time information on the internal operations and performance of the organization with information on changing conditions in the external environment (3).

Another key role for senior management teams concerns the effective management, distribution and use of information. This role is illustrated by the senior management team for the International Atomic Energy Agency (IAEA), a United Nations organization charged with promoting peaceful uses of atomic energy and preventing its proliferation in weaponry. The team is constituted like the one described above and e-mail is in widespread use at all levels of the organization. A 1997 policy manual notes that "information management, like financial and personnel management, is a managerial responsibility. It is of critical importance to Agency efficiency and effectiveness, and consequently should also be well managed, based on best practices." This directive means that managers must plan for and guide the use of the technological resources required for creating and distributing the information needed by the programs they oversee.

Such a role also surfaces in a description of managerial competencies. The IAEA manual notes that managers must "ensure that the team is kept well informed on all relevant issues," using computers as a "management tool to obtain and distribute information" and to promote its free and open flow "inside and outside the Agency," as appropriate. As a corollary, managers are expected to understand the capabilities of computers and the applications in use. In some organizations, use of communication and information technologies is an option for senior management teams. In the IAEA it has become a necessity at the highest job levels, and its institutionalization in official policy manuals sends a strong signal to the rest of the organization that competent and productive use of these tools is closely linked to effective mission performance.

A final point to note is the capability of computers and networks to link senior management to professionals and peers in other organizations. The cultivation of "loose ties" has been shown to engender new insights and to bring high level managers in contact with perspectives and alternatives that they would not be likely to encounter in day-to-day communications within their organizations (9). But these kinds of extramural interactions in the past have been difficult for managers to arrange, since their days are typically filled up with scheduled and unscheduled meetings and other interactions.

Electronic mail connections with those in other organizations can enable managers to develop and sustain loose ties (10), operating in much the same way as casual in-person interactions. In contrast to the IAEA policy, many organizations have not encouraged or supported collegial interactions beyond their own boundaries. However, the emergence of online connections at operational levels of organizations with customers and suppliers has stimulated the development of broader interorganizational network use. In the future, more senior management teams can expect to experience the benefits of email-based connections with their counterparts in other organizations.

These examples by no means exhaust the ways in which management teams can make effective use of new networked media. For example, executive teams could use tools for gathering information from multiple external sources and for aggregating these data quickly to construct high level views of results and trends. Management teams could also use analytical tools to generate alternative scenarios so that they can test the implications of varied strategic options and assess whether their strategic initiatives are resulting in increased market share and profitability (3). Although we are not aware of any management teams that are presently using such applications, the potential impact on their effectiveness is significant. Management teams would be well advised to explore these and other applications and generally to promote the use of information and communication tools to enhance collaboration, learning, and knowledge creation for themselves and throughout the organization.

Parallel Teams

The information resource needs of parallel teams are perhaps less salient than for any other team type. Their work is typically less intense, involving regular but not necessarily frequent meetings, and is usually secondary to the members' primary job responsibilities. In addition, parallel teams usually do not have the formal authority to implement the results of their work or to request that regular work units do so.

Despite these limitations, when provided with the appropriate authority, resources and charter, parallel teams can be highly effective and value-adding. A new team in Digital Evolution, the firm described earlier in this chapter, demonstrates how a well-designed parallel team can contribute to an organization's functions. It also illustrates a potential, though modest role for technology in their performance.

As we explained earlier, Digital Evolution is formally organized around project teams whose job, in part, is to create added value for clients and for the firm by building on innovations developed in earlier projects. Some of these innovations -- those with significant and broad new applicability -- might become the core of joint ventures that create substantial returns for the company as well as the customer.

Given that returns on investment in intellectual assets is a key part of Digital Evolution's business strategy, we asked the CEO how the firm captures reusable insights and builds upon innovations that arise in independent projects of varied size, nature and duration. Because this is a high tech company, it might be assumed that technology would be the answer -- a data warehouse, a document repository, groupware for collaboration. To be sure, technology plays a part. But the solution turns more importantly on a parallel team -- a team whose task it is to recognize the knowledge-based innovations that projects engender in the course of their work and think about ways to capitalize on them.

This function until recently had been accomplished informally, the CEO explained. Project leaders typically meet about once a month to share problems, solutions, new technologies or techniques; this is a natural incubator for innovation. There was also a small group of people who tried to keep up with what was going on across the projects, make connections between project ideas, think of ways to leverage them, and so on. Now the firm has constituted an internal innovation team to perform these activities on a more formal basis.

According to the CEO, this parallel team has two main missions. One is to recognize and refine innovative ideas embedded in ongoing projects. Digital Evolution's staff continually build innovative technologies or techniques in response to project-specific needs. The innovation team is charged with stepping back and considering how these efforts could have much broader utility and value, either internally (e.g., the asset management system) or externally. The team's second mission, he continued, is to figure out "what we should be playing with," adding that "after all, innovation comes from play."

The internal innovation team at Digital Evolution is illustrative of positive parallel team practices in a number of ways. First, the firm explicitly recognizes the key parts that innovation and organizational learning play in its primary business processes; the functions performed by the innovation team are therefore central rather than peripheral. Equally important, perhaps, is the fact that for many employees this parallel team's tasks will be self-motivating and intrinsically rewarding -- they enjoy learning from one another and mastery of new software tools is seen more as a right than a responsibility. Third, the team will not have to wait and wonder about whether the results of its transformative knowledge-sharing deliberations will ever reach those who are empowered act on recommendations on since the decisionmakers themselves are also on the team.

Two practices represented by the establishment of this parallel team are especially noteworthy. One is the reliance on humans to handle the functions of organizational memory and learning. Many large and small organizations are making investments in groupware, document management software and database management systems to capture organizational memory and learning. Digital Evolution too realizes that such technologies are critical for retention and reuse of the information objects it develops (e.g., the asset management system) and for purposes of record keeping (e.g., the contracting reporting system). In the fast-paced world of today's networked organizations the capture, retention and documentation of what has been created and shared in electronic media is a daunting task, and one that merits considerable attention. But by itself it is not sufficient to accomplish what humans do in the name of memory and learning -- transfer knowledge to new situations, make inferential leaps or synergistic connections, or reinvent today's tools to serve tomorrow's needs. That's the job of the innovation team at Digital Evolution. Perhaps, as they grow larger and more formal, technology support will become increasingly necessary, but for now technology is an adjunct, not the core of this congenial, highly social, and apparently very effective practice.

The other practice to underscore is the explicit assigning of responsibility for recognizing, articulating and considering the future value of innovations that spring from day-to-day practice. Research literature on organizational innovation confirms the view that most innovations come from individuals who generate them in the course of trying to solve a problem in their daily work. Because their focus is on the work itself, such individuals are happy to have handled the challenge successfully and go on to their next task. Even when such innovations could be broadly useful to the organization, however, they are rarely recognized at an institutional level, publicized, or made available for redeployment. The parallel innovation team at Digital Evolution is intended to address that shortfall in ways that informal, collegial lateral relationships could not. In the process, it may also overcome another problem that project-based organizations may experience -- assuring that the value-added contributions of projects outlive the projects themselves.

While the two practices just described are based on an innovation team in a leading edge high tech firm, it is easy to see how their lessons can be applied to parallel teams with quite different charters. Perhaps, the most important lesson from this example, a lesson that is relevant to all team types and not just parallel teams, is that technology is most effective when augmenting human capabilities, not replacing them.

Best Information Practices For All Teams

As this chapter demonstrates, the nature of a team, the substantive domain of its tasks and the broader environment within which it works all influence the kinds of communication and information resources required to support its effective performance. Table 8-1 summarizes these resources for project teams; Table 8-2 summarizes them for the other types of teams discussed in this chapter.

Insert Table 8-2 About Here

Some parallels and commonalties which cut across all team types are evident in the two tables. While the details and domains may vary for different types of teams, as well as for different teams of the same type, there are general categories of needs for information and communication resources that apply in some degree to all teams. They are:

- *internal communications*. Almost all teams need systems, whether they are technology-based or not, for communication and coordination among team members.

- *external communications*. They also need systems for external communications and coordination -- e.g., with customers and suppliers, other teams, stakeholders, and technical experts.

- *task information, applications and analytical tools*. All teams require information that is directly relevant to their specific work tasks and domains as well as software applications and tools that enable them to extract new knowledge from this information. Data bases, simulations and analysis and decision-making tools are examples of technologies that provide these capabilities.

- *performance feedback*. Information on their performance is critical for all teams so that they can identify areas for improvement.

Conclusion

These broad categories of information resources are not the only "best practices" that all teams have in common. The context within which they function, and how the context can be designed to encourage, support and facilitate team performance, is a critical success factor for all teams, regardless of type or the domain of their work. Much of this book has been about organizational supports for team-based work; the same is true for the role of new technology in team effectiveness. Engendering an organizational context that nurtures knowledge-based teams, however, involves much more than assessing their needs for information and acquiring the technologies to deliver it. Rather, these new interactive tools must become part of the ways teams work, enabling them to integrate their diverse expertise and incorporate it into the tasks at hand. The organization must provide the context -- the climate, the policies, and the incentives -- for this transformative process to occur.

For example, frequent and open group communication, where individuals are not afraid to express their real views even when they disagree with others, is critical to value-added knowledge work. Confronting and resolving differences constructively is, in fact, one of the chief ways that interdisciplinary teams succeed in doing what can't be done by individuals working independently (11). Project teams at Digital Evolution express and reconcile divergent approaches by email, in-person meetings and late night arguments -- and feel free to leave disagreements unresolved until solutions emerge. The culture accepts and expects these kinds of interactions. In other organizational contexts, concerns about voicing honest disagreement (especially with the views of high-ranking others when important outcomes are at stake) have led to the adoption of decision support systems with the capability for anonymous commenting and evaluation (12). Either avenue is more productive for teams than the inability to allow dissenting ideas to surface.

Further, organizations must find a way to reward team as will as individual performance. A number of organizations have introduced groupware technologies with the aim of making information resources that have been developed or used by any given individual accessible to others. However, without a culture that values and rewards intellectual teamwork, organizations should expect to get only the most superficial benefits--if any--from their investments in groupware (13).

Much the same holds true for organizational support for innovation and learning. Innovation, for instance, inherently involves risk-taking--not all new ideas will prove to be workable, and even the solutions ultimately found to be viable will likely have undergone significant change between inception and actualization. Only in organizational cultures that tolerate ambiguity and permit risk-taking can team innovation thrive (14). In one organization we studied, for example, attempted innovations are not regarded as failures if they don't work but only if the organization fails to learn from such trial and error experimentation.

Many organizations also appear to believe that learning from their experiences, whether positive or negative, is simply a matter of capturing them, documenting them, and making them accessible in a shared electronic repository. To be sure, knowledge capture is a start, but it is only a start. Creative transformation and reapplication of knowledge in new situations over time is a dynamic process that most often springs from a community of practice as its members engage with one another and with the tasks and tools at hand in the effort to reach shared goals (15). These "improvisations" do not arise as planned functions of automated systems; rather, they reflect the malleability of interactive media as teams adapt or reinvent them to meet new challenges. As they explore and test the capabilities and limits of their new technologies, try new things, and share their knowledge with others, the technology becomes second nature. User and tool merge, work tasks and interactions flow, and new levels of effectiveness and creativity are attained.

How, then, can organizations develop or acquire communication and information technologies that will be sufficiently transparent and modifiable to support creative value-adding knowledge work? One possibility is that these problems will disappear in the future as workplaces are increasingly inhabited by new cohorts of workers who have grown up with these technologies and for whom they feel "natural." This is surely part of the answer, reflected, for instance, in the ways that Digital Evolution professionals take their networked multimedia tools for granted. On the other hand, the pace of technological advance is so rapid that none of the tools in use today are ones that they grew up using. So, new technologies will continue to stretch the capabilities of ever more sophisticated generations of users.

Another possibility is that interfaces to communication and information technologies will soon be so vastly improved that even those who are not computer professionals will experience these media as natural and transparent, interposing no obstacles between them and knowledge work. This, too, is part of the answer. But while it is clear that contemporary interfaces and high level languages have put the full power of networked computer system within the grasp of nontechnical professionals, we are still far from systems whose functions are intuitively obvious. When asked about this prospect for the future, one information scientist in an organization we studied said "I don't believe in miracles."

User experience and technical advance will no doubt help produce more natural and effective interactions between computer-based tools and the people who use them. However, we believe that the real answer lies in the nature of the development and change processes themselves. That is, the processes for developing and implementing new ways of working, such as teamwork, and the new technologies for supporting them must be dynamic, participatory, and designed for learning. Best practices for guiding successful change processes can be built on these guidelines:

- design and implementation processes should integrate user experience and technical expertise;
- these processes should involve all key stakeholders;
- designs and plans should be dynamic and open to change;
- new technologies and ways of working should be implemented as experiments and be designed for learning; and
- users should be allowed, even encouraged to explore the possibilities and limits of their new tools and workplace designs.

The outcomes of these dynamic, participatory change processes are systems that embed the joint knowledge of all of the stakeholders collaborating in the process. In effect, the best practices listed in Table 8-1 and 8-2 are the reflections of such processes. How an organization gets there may be more important than the specific practices noted. These processes are essentially the same regardless of team type. To support value-creating knowledge-based teams, the nature of the social and technological change processes themselves is ultimately more important than the types of technologies on which they are typically focused (for more information on these new change processes see 3 and 16).

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Table 8-1

Project Team "Best" Practices Based on Digital Evolution Case

Key Categories	"Best Practices"
Learning and Innovation	accept projects based on learning potential learn while implementing high velocity learning ("web weeks")
Coordination and Collaboration	laterality - can act as a bridge and interpreter between different functional areas - respect for each other's distinct skills - creative resolution of tensions among participants from different functional areas not personalizing arguments iterative processes - not forcing solutions prematurely
Customer orientation	relocation of project team to customer's site commitment to achieving customer priorities willingness to adapt to customer expectations, e.g. dress code and behaviors formalizing customer-team interactions through regular status reporting

clear linkage of technical personnel across organizations

Information Technology to Support Team Performance	e-mail access to each other, external consultants and customer liaisons
	access and capability to use the web
	early prototyping
	use of standard development tools, for example, Developer’s Studio Suite, Bug Tracking Tool, Flow Charting Tool
	creation of customized IT tools for project
	on-line procedure for status self-monitoring and contact reporting
	asset management system for digital multimedia objects
Output	knowledge value added capabilities to product and services being created
	value creation model to expand business

Table 8-2

Information and Communications Technology "Best Practices"

Supporting Performance of Each Type of Team

Type of Team	"Best Practices"
Action Teams	between engagements simulations for modeling and planning for engagements resource management systems for tracking equipment, etc. communications for organizational learning during engagements simulations of engagements resource management systems for rapid deployment of resources communications among teams members, other teams, etc.
Production Teams	critical performance data on quantity and quality of production connections with customers, suppliers, technical staff information on orders, production schedules, work in progress, etc.

Service Teams	communication among geographically dispersed members shared data bases and other artifacts (e.g., info on work orders, progress) communication with customers (e.g. feedback on quality of service and responsiveness)
Management Teams	information on internal operations and performance information on changing external conditions, markets, competitors, etc communications with professionals and peers in other organizations systems for aggregating data from multiple sources into high level views analytical tools for generating alternative scenarios
Parallel Teams	systems for capturing, retaining, and documenting what the team creates and shares social mechanisms (e.g., meetings, shared assumptions to avoid overreliance on technology